

Determinants of Patient-Reported Physical and Mental Health 90 Days After Stroke: A Prospective Brazilian Cohort Study

Determinantes da Saúde Física e Mental Relatada pelos Pacientes 90 Dias Após o AVC: Uma Coorte Prospectiva Brasileira

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ABSTRACT

Background: Stroke is a leading cause of long-term disability worldwide, yet patient-reported quality of life (QoL) data after stroke remain scarce in low- and middle-income countries (LMICs), where the burden is disproportionately high.

Objective: To identify independent predictors of poor patient-reported physical and mental health 90 days after stroke in a Brazilian cohort.

Methods: Prospective observational cohort of 907 adult stroke patients admitted to Santa Casa de Porto Alegre (2022-2025). PROMIS-10 was administered at 90 days. Multivariate logistic regression identified independent predictors.

Results: Poor physical health was independently predicted by female sex (OR 1.71; 95% CI 1.13–2.59), severe neurological deficit at admission (NIHSS; OR 4.30; 95% CI 1.30–14.20), and greater functional disability at discharge (mRS; OR 1.37; 95% CI 1.21–1.55). Poor mental health was independently predicted by hypertension (OR 1.63; 95% CI 1.03–2.57), severe NIHSS (OR 5.88; 95% CI 1.75–19.76), and higher mRS at discharge (OR 1.15; 95% CI 1.03–1.29). Public health system (SUS) coverage was associated with worse scores in univariate analyses but lost significance after adjustment, suggesting clinical severity mediates the socioeconomic effect on QoL.

Conclusions: Stroke severity and functional status at discharge were the strongest independent determinants of patient-reported QoL at 90 days. Female sex and hypertension identify subgroups at disproportionate risk of poor physical and mental health respectively. These findings support integrating patient-reported outcomes into stroke care quality assessments in resource-constrained settings.

Keywords: Stroke Rehabilitation; Stroke; Quality of Life

RESUMO

Introdução: O AVC é uma das principais causas de incapacidade de longo prazo em todo o mundo; entretanto, os dados sobre qualidade de vida relatada pelos pacientes após o AVC ainda são escassos em países de baixa e média renda, onde a carga da doença é desproporcionalmente elevada.

Objetivo: Identificar preditores independentes de pior saúde física e mental autorrelatada 90 dias após o AVC.

Métodos: Coorte observacional de 907 pacientes adultos com AVC admitidos na Santa Casa de Porto Alegre entre 2022 e 2025. O instrumento PROMIS-10 foi aplicado aos 90 dias. Regressão logística multivariada foi utilizada para identificar preditores independentes.

Resultados: Pior saúde física foi predita de forma independente pelo sexo feminino, déficit neurológico grave na admissão e maior incapacidade funcional na alta hospitalar. Pior saúde mental foi predita de forma independente por hipertensão arterial, NIHSS grave e maior mRS na alta. A cobertura pelo Sistema Único de Saúde (SUS) esteve associada a piores escores nas análises univariadas, mas perdeu significância após ajuste, sugerindo que a gravidade clínica medeia o efeito socioeconômico sobre a qualidade de vida.

Conclusões: A gravidade do AVC e o estado funcional na alta hospitalar foram os mais importantes determinantes independentes da qualidade de vida aos 90 dias. Esses achados reforçam a importância da incorporação de desfechos relatados pelos pacientes nas avaliações da qualidade do cuidado ao AVC, especialmente em cenários com recursos limitados.

Palavras-chave: Reabilitação do Acidente Vascular Cerebral; Acidente Vascular Cerebral; Qualidade de Vida

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Conflict of interest

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INTRODUCTION

Stroke affects more than 11.9 million people annually and remains one of the leading causes of long-term disability globally. Approximately 94 million individuals worldwide live with its consequences, spanning physical, cognitive, emotional, and social domains^{1,2}. According to the Global Burden of Disease Study, stroke accounts for approximately 143 million disability-adjusted life years (DALYs) lost each year³, a burden that falls disproportionately on low- and middle-income countries (LMICs), which account for 86% of stroke-related deaths and 89% of DALYs worldwide.⁴

In Brazil, stroke is the leading single cause of death and the primary driver of adult disability, with outcomes that are compounded by socioeconomic inequality, insufficient control of vascular risk factors, and heterogeneous access to acute care⁴. Despite this substantial burden, data on post-stroke quality of life (QoL) in LMICs remain scarce, and even scarcer when measured from the patient's own perspective. Understanding what patients themselves perceive as poor health after stroke is not a secondary concern: it is central to designing care pathways that deliver value.

The Patient-Reported Outcomes Measurement Information System (PROMIS) Global Health-10 is a validated, brief instrument developed by the National Institutes of Health that captures both physical and mental dimensions of self-reported health^{5,6,7}. Its inclusion in the International Consortium for Health Outcomes Measurement (ICHOM) Stroke Standard Set positions it as a key metric for longitudinal follow-up after stroke⁸, and its use in this cohort aligns directly with the principles of Value-Based Health Care (VBHC), a framework that defines value as the improvement in outcomes that matter to patients relative to the cost of achieving them^{9,10}. In the context of stroke, applying VBHC requires moving beyond mortality and dependency rates to systematically capture patient-centered outcomes¹¹.

Prospective stroke cohorts that have used PROMIS-10 for 90-day follow-up are largely confined to high-income countries. Whether the predictors of poor patient-reported outcomes identified in those settings translate to a Brazilian population, characterized by a higher prevalence of uncontrolled vascular risk factors, greater socioeconomic heterogeneity, and distinct healthcare structures, has not been established. This is a critical evidence gap, given that interventions to improve post-stroke QoL must be tailored to the context in which they are implemented.

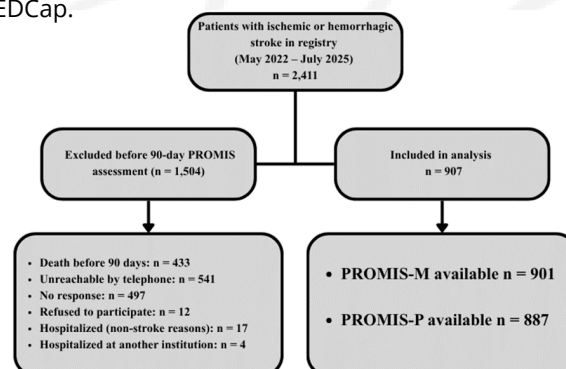
The primary objective of this study was to identify the independent determinants of poor patient-reported physical and mental health 90 days after stroke, as measured by the PROMIS-10, in a large prospective Brazilian cohort. Secondly, we examined whether the association between healthcare coverage type and patient-

reported outcomes persisted after adjustment for neurological severity and functional status at discharge, as an exploratory assessment of potential pathways linking socioeconomic context to quality of life after stroke. The results contribute to a growing evidence base supporting the integration of patient-reported outcomes into routine stroke care quality assessment in LMICs.

METHODS

Data collection was conducted at the Santa Casa de Porto Alegre, a large tertiary healthcare network located in southern Brazil. The main complex comprises eight hospitals with a total of 1,132 beds, complemented by an additional satellite hospital. As a result, Santa Casa de Porto Alegre serves as one of the primary reference centers for acute stroke care in the state of Rio Grande do Sul. The institution provides comprehensive management for patients from the Sistema Único de Saúde (SUS), as well as those with private or supplementary insurance. Its reach extends across the Porto Alegre metropolitan area and adjacent municipalities, serving a population of approximately 4.4 million inhabitants.¹²

This analysis is nested within a prospective institutional stroke registry (n=2,411), consecutively followed by the Santa Casa's Value Management Office for up to 24 months after the index event. The study was approved by the Comitê de Ética em Pesquisa em Seres Humanos da Santa Casa de Misericórdia de Porto Alegre, CAEE (58363122.5.0000.5335), and informed consent was obtained from all participants or their legal representatives. Inclusion criteria comprised adults aged 18 years or older with ischemic or hemorrhagic stroke who completed the PROMIS-10 at 90 days. Of 2,411 registry patients, 907 (37.7%) met all criteria and were included; the remainder were excluded due to death before 90 days (n=433), being unreachable (n=541), or other reasons (n=530). A flow diagram is presented in Figure 1 in accordance with STROBE recommendations. Patient-reported outcomes were administered by telephone (5–15 minutes) at follow-up points defined by ICHOM⁸, using instruments validated for the Brazilian population; proxy responses were accepted when patients were unable to respond. Clinical data were extracted from electronic medical records and managed in REDCap.



A T-score of 40, one standard deviation below the population mean, corresponds to raw scores of 12 and 10 for PROMIS-P and PROMIS-M respectively; since raw scores are integers, scores of 13 and 11 are the lowest values above this threshold. Poor outcomes were therefore defined as PROMIS-P <13 and PROMIS-M <11.⁸ Variables were dichotomized into good and poor outcomes according to the cutoff points described above and tested directly in univariate and multivariate logistic regression models.

The normality of distributions was assessed using the Shapiro-Wilk test and visual inspection of histograms and Q-Q plots. Given the large sample size and the approximate symmetry of the PROMIS score distributions, results were presented as mean $\pm$ standard deviation, even in the presence of minor violations of normality. All statistical analyses were conducted using R software. Categorical variables were presented as absolute frequencies and percentages and compared using the chi-square test. Binary logistic regression analyses were performed to identify predictors of worse scores on the PROMIS-10, considering the physical and mental domains separately. Variables with $p < 0.20$ in the univariate analysis were included in the multivariate models¹³. Statistical significance was set at $p < 0.05$, with a 95% confidence interval. Of 907 respondents, complete data for all model covariates — including NIHSS, available in 639 patients (70.5%) — were available for 504 (PROMIS-P model) and 513 (PROMIS-M model) patients respectively. Patients excluded from regression models due to missing covariates did not differ significantly from included patients in age, sex, SUS coverage, stroke type, or discharge mRS (all $p > 0.10$), supporting a missing-at-random assumption.

Of note, NIHSS score at admission was recorded in 639 of 907 respondents (70.5%), primarily owing to absence of documented neurological assessment outside scheduled admission windows. Regression models including NIHSS as a predictor were therefore fitted on this complete-case subset; the denominators reported in Tables 3 and 4 reflect the number of patients with complete data for all variables included in each model. To evaluate whether missingness in NIHSS introduced differential bias, a sensitivity analysis was performed replacing NIHSS with a binary 'NIHSS available' indicator as a covariate in the full-sample model; results were consistent with the complete-case primary analysis. Patients with and without NIHSS documentation did not differ significantly in age, sex, SUS coverage, stroke type, or discharge mRS (all $p > 0.10$), supporting a missing-at-random assumption for this variable. Missing data rates for all other variables are provided in Supplementary Table 2.

The primary outcomes of this study were poor physical and mental health at 90 days after stroke, defined as PROMIS-10 Physical Health (PROMIS-P) scores <13 and Mental Health (PROMIS-M) scores <11. Secondary outcomes were the mean PROMIS-P and PROMIS-M analyzed as

continuous variables. Independent variables included sociodemographic characteristics (age, sex, healthcare coverage used as a contextual proxy for socioeconomic position, given the absence of individual-level income or education data in this registry), clinical factors (stroke type, NIHSS at admission, comorbidities such as hypertension and diabetes), and functional status at discharge (modified Rankin Scale).

RESULTS

907 patients (37.7%) who completed the PROMIS-10 questionnaire were included in the present analysis. The mental health score (PROMIS-M) could be calculated for 901 patients (99.3%), and the physical health score (PROMIS-P) for 887 patients (97.8%).

Table 1. Baseline characteristics and stroke presentation (n=907)

Clinical Values	Overall
Age median [IQR]	69 [59; 77]
Sex, No (%)	
Male	447 (49.3)
Female	460 (50.7)
Public Health (SUS)	690 (76.1)
Diabetes mellitus	300 (33.1)
Hypertension	652 (71.9)
Current/recent smoking	152 (17.2)
Hemorrhagic stroke	97 (10.7)
Stroke severity — NIHSS score, median [IQR]	5 [2; 10]
Stroke severity — NIH Stroke Scale (NIHSS)^a	
No stroke symptoms (NIHSS = 0)	25 (3.9)
Minor (1-4)	273 (42.7)
Moderate (5-15)	275 (43)
Moderate to severe (16-20)	47 (7.4)
Severe (21-42)	19 (3)
^a Data available for 639 patients only	

Tables 2 and 3 present the univariate and multivariate logistic regression analyses. Model denominators (n=504 for PROMIS-P; n=513 for PROMIS-M) reflect the number of patients with complete data for all covariates included in the respective multivariate models, principally driven by the 70.5% availability of NIHSS. Patients excluded from the regression models owing to missing covariates did not differ significantly from included patients in age, sex, SUS coverage, stroke type, or discharge mRS (all $p > 0.10$), supporting the validity of the complete-case approach.

Table 2. Predictors of poor PROMIS-P (<13) at 90 days post-stroke. (n=504)

	Univariate		Multivariate	
	OR	p-value	OR	p-value
Age	1.01 (1.001-1.02)	0.035	1.00 (0.98-1.01)	0.863
Female (ref: male)	1.40 (1.05-1.87)	0.021	1.71 (1.13-2.59)	0.010
SUS (ref: No)	1.50 (1.05-2.13)	0.023	1.29 (0.73-2.26)	0.377
Hemorrhagic Stroke (ref: Ischemic)	1.17 (0.75-1.84)	0.483		
NIHSS Severity (ref: Minor)				
Moderate	1.31 (0.90-1.90)	0.151	0.83 (0.53-1.30)	0.408
Mod. to Severe	1.37 (0.68-2.75)	0.372		
Severe	7.14 (2.46-20.74)	<0.001	4.30 (1.30-14.20)	0.017
Diabetes (ref: No)	1.44 (1.07-1.94)	0.017	1.12 (0.72-1.75)	0.603
Hypertension (ref: No)	1.49 (1.07-2.08)	0.018	1.40 (0.86-2.30)	0.175
Smoking (ref: No)	1.07 (0.739-1.56)	0.708		
Discharge mRS	1.36 (1.23-1.49)	<0.001	1.37 (1.21-1.55)	<0.001

* Not included in the multivariate model (p≥0.20 in univariate analysis)

Table 3. Predictors of poor PROMIS-M (<11) at 90 days post-stroke. (n=513)

	Univariate		Multivariate	
	OR	p-value	OR	p-value
Age	1.00 (0.99-1.01)	0.702		
Female (ref: male)	1.05 (0.79-1.38)	0.721		
SUS (ref: No)	1.73 (1.23-2.43)	0.002	1.33 (0.79-2.26)	0.283
Hemorrhagic Stroke (ref: Ischemic)	1.14 (0.74-1.78)	0.548		
NIHSS Severity (ref: Minor)				
Moderate	1.34 (0.94-1.91)	0.104	1.18 (0.78-1.78)	0.433
Mod. to Severe	1.66 (0.88-3.14)	0.113	1.44 (0.67-3.12)	0.352
Severe	3.86 (1.46-10.16)	0.006	5.88 (1.75-19.76)	0.004
Diabetes (ref: No)	1.39 (1.04-1.85)	0.025	1.33 (0.87-2.00)	0.177
Hypertension (ref: No)	1.64 (1.19-2.26)	0.002	1.63 (1.03-2.57)	0.035
Smoking (ref: No)	1.12 (0.78-1.61)	0.515		
Discharge mRS	1.23 (1.12-1.34)	<0.001	1.15 (1.03-1.29)	0.013

* Not included in the multivariate model (p≥0.20 in univariate analysis)

After multivariate adjustment, only female sex, severe NIHSS, and higher mRS at discharge remained independently associated with worse physical PROMIS scores at 90 days ($p < 0.05$). For the mental PROMIS domain, only the presence of hypertension, severe NIHSS, and higher mRS at discharge remained independently associated with worse scores ($p < 0.05$).

DISCUSSION

The dominant independent predictors of poor patient-reported quality of life at 90 days were stroke severity at admission (NIHSS) and residual functional disability at discharge (mRS), outweighing sociodemographic characteristics, comorbidities, and healthcare coverage after multivariate adjustment, a finding with important implications for how stroke outcomes are measured and how care systems should be evaluated in middle-income settings.

The primacy of NIHSS and mRS as determinants of PROMIS-10 scores is consistent with evidence from high-income settings. Rimmele et al.¹⁴, in a prospective European cohort using the ICHOM Standard Set, found that initial

neurological severity and pre-existing functional disability were the primary independent predictors of poor physical and mental PROMIS-10 scores at 90 days. Sanchez-Gavilan et al.¹⁵ similarly reported that functional disability at discharge and greater initial severity were the most robust determinants of worse patient-reported outcomes at three months, even after adjustment for comorbidities and sociodemographic factors. Our results replicate and extend these findings to a Brazilian population with a substantially higher burden of uncontrolled vascular risk factors and marked socioeconomic heterogeneity, suggesting that the centrality of neurological injury and residual disability as drivers of patient-reported health is a generalizable phenomenon, not context-specific.

The association between female sex and worse physical PROMIS-10 scores warrants specific attention. Women in this cohort were independently more likely to report poor physical health at 90 days, consistent with prior evidence showing that women tend to present with stroke at older ages, carry a greater burden of comorbidities, and experience worse functional outcomes than men^{16, 17}. Psychosocial mechanisms, including differences in caregiver availability, domestic role demands, and social support networks, may further amplify the subjective impact of physical disability among women. These sex-specific disparities underscore the need for targeted rehabilitation strategies and post-discharge support tailored to female stroke survivors.

Hypertension was independently associated with worse mental health scores at 90 days, an association that persisted after adjustment for stroke severity and functional status. This finding goes beyond the well-established role of hypertension in increasing stroke risk and severity. Chronic hypertension causes structural and functional changes in the cerebral microvasculature, including endothelial dysfunction, arterial stiffness, and impaired autoregulation, that may contribute to post-stroke depressive symptoms and cognitive dysfunction independently of the acute infarct volume^{18, 19, 20}. The persistence of this association in the mental domain, but not the physical domain, after multivariate adjustment suggests that hypertension may exert a direct neurobiological effect on emotional well-being beyond its role in mediating stroke severity.

Patients with public healthcare coverage (SUS) had significantly worse PROMIS-10 scores in univariate analyses, but these associations lost statistical significance after adjustment for NIHSS and mRS (Tables 3 and 4). This attenuation is consistent with prior Brazilian stroke data and is compatible with, though not evidence of, an upstream pathway whereby socioeconomic vulnerability leads to greater neurological severity at presentation, which in turn drives worse patient-reported outcomes. This pattern would be plausibly linked to well-documented inequities in vascular risk factor control and access to timely acute stroke care in Brazil. However, attenuation of a regression coefficient after covariate adjustment cannot be

interpreted as formal evidence of mediation: it may equally reflect residual confounding, colinearity between SUS coverage and the clinical covariates, or both. Formal causal mediation analysis, including decomposition of total, direct, and indirect effects with appropriate counterfactual assumptions, is required to test this pathway and remains a priority for future research.^{22, 23, 24}

If the observed attenuation does reflect a genuine mediating role of stroke severity, it would carry practical implications: equitable access to high-quality acute stroke care and secondary prevention could narrow a substantial portion of the QoL gap between SUS and private patients, independently of post-discharge interventions. This hypothesis is consistent with the data but was not formally tested in this study.

This study has limitations. Only 37.7% of prospective institutional stroke registry completed the PROMIS-10 at 90 days, raising the possibility of selection bias. The sensitivity analysis showed no significant differences between respondents and non-respondents in age, sex, NIHSS, or comorbidities; however, respondents had significantly worse functional status at discharge. This counterintuitive finding likely reflects lower engagement in post-discharge follow-up programs among patients with favorable recoveries, and implies that the prevalence of poor PROMIS-10 scores in this sample may slightly overestimate population-level rates. Telephone administration is subject to information bias, particularly in patients with post-stroke aphasia or cognitive impairment, though proxy responses were allowed in such cases. The absence of formal mediation analysis precludes causal inference regarding the pathway between healthcare coverage, clinical severity, and patient-reported outcomes. The observed attenuation of the SUS effect after adjustment may reflect mediation, residual confounding, or both, and should not be interpreted as evidence of mediation without a formal decomposition of direct and indirect effects. Finally, this is a single-center cohort in southern Brazil, and generalizability to other Brazilian regions and LMICs with different healthcare contexts should be assessed prospectively.

These findings have direct implications for stroke care policy in LMICs. If stroke severity is the primary driver of poor self-reported outcomes, and socioeconomic vulnerability operates through its effect on severity rather than independently, then equity in post-stroke QoL begins upstream, with prevention, timely reperfusion, and equitable access to acute care, not only with post-discharge rehabilitation. Female sex and hypertension identify subgroups at disproportionate risk of poor physical and mental health respectively, pointing to differential care needs that standardized outcome registries can help address. Systematic integration of PROMIS-10 into routine stroke follow-up in Brazil and similar settings is both feasible and necessary to monitor whether care improvements translate into outcomes that matter to

patients. Formally testing the mediation pathway between socioeconomic determinants, clinical severity, and patient-reported outcomes remains a priority for future research.

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SUPPLEMENTARY 1.0

Sensitivity analysis, N (%)			
Variable	Respondents (n = 907)	Non-respondents (n = 1504)	p-value
Age, y (mean ± DP)	69 [59, 77]	68 [59, 77]	0.333
Female	460 (50.7)	541 (51.2)	0.814
Public Health (SUS)	690 (76.0)	834 (77.3)	0.522
NIHSS (median [IQR])	5 [2, 10]	5 [3, 10]	0.492
Discharge mRS (median [IQR])	2 [0–3]	1 [0–3]	<0.001
Hypertension	652 (71.9)	763 (70.7)	0.566
Diabetes	300 (33.1)	358 (33.2)	0.961
Stroke Type			
Ischemic	810 (89.3)	971 (89.9)	0.617
Hemorrhagic	97 (10.7)	101 (10.1)	

Values are expressed as mean ± standard deviation, median [interquartile range], or n (%). Student's t-test or Mann-Whitney U test were used for continuous variables, and the chi-square test for categorical variables.

SUPPLEMENTARY 2.0

Incomplete variables, response rate (%)	
NIHSS	70.45%
mRs	80.48%

Denominator = 907 respondents at 90 days