RBFEx
ISSN Online: 2675-1372

Revista Brasileira de Fisiologia do Exercício

Original article

Correlation between stroke severity and functional dependence of hospitalized patients

Correlação entre a gravidade do acidente vascular cerebral e a dependência funcional de pacientes internados

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ABSTRACT

Introduction: Some patients suffering from a stroke have functional capacity limitations since the hospital stay. The severity of the condition may be a factor that correlates with the degree of functional dependence of these individuals. **Objective:** To analyze the correlation between stroke severity and the functional status of patients admitted to a reference hospital in the central-western region of Brazil. **Methods:** This is an analytical cross-sectional study, in which the sample was carried out by convenience. Functional status assessment was performed using the Functional Independence Measure (FIM) and Barthel scales, while stroke classification was obtained using the National Institute of Health Stroke Scale (NIHSS). **Results:** 68 participants were evaluated, with an average age of over 60 years. In the analyzes between the stroke severity index and the functionality measures assessed by the FIM and Barthel Index, an inverse correlation was identified ($p < 0.001$). 48.5% of patients were classified as less severe, 42.6% as moderate, 4.4% as moderate to severe and 4.4% as severe. Regarding the assessment of functionality, evaluated by the FIM, 5.9% were classified as complete dependence, 32.4% modified dependence with assistance in up to 50% of activities, 20.6% modified dependence with assistance in up to 25% of activities. activities and 41.2% with complete/modified independence. **Conclusion:** The findings of the present study point to an unfavorable correlation between the degree of stroke and functionality, indicating a negative effect of increased severity on the participants functionality.

Keywords: stroke; functional status; patient acuity.

RESUMO

Introdução: Pacientes acometidos por acidente vascular cerebral podem possuir limitações da capacidade funcional. A gravidade do acometimento pode ser um fator que se correlaciona com o grau de dependência funcional desses indivíduos. **Objetivo:** Analisar a correlação entre a gravidade do AVC e o estado funcional de pacientes internados em um hospital de referência da região centro-oeste do Brasil. **Métodos:** Trata-se de um estudo transversal analítico, em que a amostra foi realizada por conveniência. A avaliação do estado funcional foi realizada através das escalas Medida de Independência Funcional e Índice de Barthel, enquanto a classificação do acidente vascular cerebral foi obtida através da National Institute of Health Stroke Scale (NIHSS). **Resultados:** Foram avaliados 68 participantes, com idade média superior a 60 anos. Nas análises entre a gravidade do AVC e as medidas de funcionalidade, foi identificada correlação inversa ($p < 0,001$). Dentre os participantes, 48,5% foram classificados como menor gravidade, 42,6% gravidade moderada, 4,4% moderada a grave e 4,4% como grave. No que se refere a avaliação da funcionalidade, avaliada pela MIF foram classificados 5,9% como dependência completa, 32,4% dependência modificada com assistência em até 50% das atividades, 20,6% dependência modificada com assistência em até 25% das atividades e 41,2% com independência completa/modificada. **Conclusão:** Os achados do presente estudo apontam uma correlação inversa entre o grau de AVC e funcionalidade, indicando efeito negativo do aumento da gravidade sobre a funcionalidade dos participantes.

Palavras-chave: acidente vascular cerebral; gravidade do paciente; estado funcional.

Received March 15, 2024; Accepted on: April 3, 2024.

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Introduction

Among cerebrovascular diseases, stroke has had a major impact on health, with an increase in the incidence rate in Brazil in recent years [1]. It is estimated that, each year, approximately 795,000 people suffer a new or recurrent stroke and that 1 in 4 people over the age of 25 will have a stroke in their lifetime, making it the second leading cause of death and morbidity worldwide [2, 3].

Stroke is characterized by neurological impairment that begins suddenly, lasting more than 24 hours, with presumed vascular origin [4]. Functional disability affects a large proportion of these patients and can include sensory and motor deficits, such as hemiparesis, dysphagia, neglect and other local neurological deficits, which directly affect the quality of life of these individuals [2].

Functional improvement after stroke is driven by neural recovery, neuroplasticity and the individual's physiological and psychosocial adaptation to functional impairments, which may include aspects of functional rehabilitation [5].

In the hospital environment, these patients can be classified according to the severity of the stroke, as well as the level of functional impairment. To assess the severity of a stroke, the National Institute of Health Stroke Scale (NIHSS) can be used, which makes it possible to classify its severity according to the scores obtained [6]. To assess functional dependence, scales such as the Functional Independence Measure (FIM), widely used in the hospital environment, and the Barthel Index, known for evaluating basic activities of daily living in stroke patients, can be used [7,8].

In view of this, the objective of the present study is to evaluate the correlation between stroke severity and the functional dependence of these patients in the hospital phase. Understanding this correlation can be significant in helping to decide on the best hospital therapeutic plan for these patients, given the severity of each case.

Methods

This is a cross-sectional, analytical study, carried out in the wards of a reference emergency and trauma hospital in the Central-West region of Brazil.

The research was approved by the Research Ethics Committee (REC), CAAE: 62102322.6.0000.0033. After approval by the REC, a search was carried out in electronic medical records and patients who matched the study profile were selected. Data collection was carried out in the hospital wards by previously trained evaluators, initially applying the evaluation form with clinical and demographic data and then the evaluation scales. The assessments were carried out over four months, covering the period from November 2022 to February 2023.

Individuals over the age of 18, diagnosed with stroke, who were hospitalized in the hospital wards and who agreed to participate in the research by signing the Free and Informed Consent Form (ICF) were included. Patients with previous functional dependence, chronic obstructive pulmonary disease and/or asthma, and those

with a hospital stay of more than 10 days were excluded. The length of stay was limited so that the NIHSS could be applied.

To determine the degree of stroke, the NIHSS was used, being a reliable instrument that allows this classification through the evaluation of 15 items. Severity can be classified according to the score, as minor (1 to 4), moderate (5 to 15), moderate to severe (16 to 20) and severe (21 to 42) [6].

The patient's functional status was assessed using the Barthel and FIM scales. The Barthel Index quantifies functionality through activities of daily living. The total score ranges from 0 to 100, where 100 indicates greater independence [7].

The FIM assesses functionality based on the performance of motor and cognitive tasks in activities of daily living. The final score is calculated by adding the points assigned to each item, which can vary between 18 and 126 points. The level of dependence will be classified according to the total FIM score, which is: 18: complete dependence; 19 to 60: modified dependence with assistance in up to 50% of activities; 61 to 103: modified dependence with assistance in up to 25% of activities; and 104 to 126: complete/modified independence [8].

The Johns Hopkins scale is used to assess the patient's mobility over a 12-hour period, or at the time of the professional's approach. Its score is defined according to the patient's ability to perform the proposed task, with a score that varies from 1 to 8, with the highest score determining greater functional mobility [9].

The assessment of muscular strength was carried out using handgrip strength (HGS), used as a general indicator of muscular strength and power. To be evaluated, the participant was seated with the spine erect, holding the dynamometer, where the shoulder was placed in a neutral position and the elbow was flexed at 90º. Maximum isometric grip strength is requested, 3 times on each limb, with a 30-second rest interval between repetitions. Only the best result of each member is considered [10]. The reference values considered were described in Table I, according to a study developed by Jorge *et al.* [11].

Table I - Handgrip strength values, according to Jorge *et al.* [11]

Age range	Right HGS	Left HGS
20-29 years	20.1±1.15 kgf	20.9±1.40 kgf
30-39 years	29.1±0.85 kgf	29.5±0.66 kgf
40-49 years	24.2±0.98 kgf	22.4±0.95 kgf
50-59 years	16.7±0.36 kgf	16.9±0.56 kgf
60-69 years	17.1±0.62 kgf	16.7±0.66 kgf
70-79 years	17.1±0.49 kgf	16.0±0.56 kgf
80-89 years	14.9±0.38 kgf	13.5±0.37 kgf

HGS = handgrip strength. Kgf: kilogram/force

Scores were calculated and patient classifications were determined regarding specific assessments in the statistical system Package for the Social Sciences - SPSS (version 23.0), in addition, all clinical data from other forms were also transformed

into codes and organized in the same program. The data were analyzed in descriptive terms to characterize the data, and normal continuous variables were calculated as mean, standard deviation and 95% confidence interval; continuous variables were not calculated into medians and interquartile range; categorical variables were analyzed in terms of frequency and percentage. Spearman correlation was also performed for non-parametric data. An r value was considered to be between 0.70 - 1 strong correlation, 0.31 - 0.69 moderate correlation and 0 - 0.30 weak correlation. P<0.05 was adopted as the level of clinical significance.

Results

70 individuals were included, 2 being excluded due to the impossibility of completing the evaluations, totaling 68 patients hospitalized for stroke, 58 (85.3%) ischemic and 10 (14.7%) hemorrhagic, predominantly male with a mean age greater than 60 years, as shown in Table II.

Stroke severity assessed using the NIHSS was classified for 33 (48.5%) as minor, 29 (42.6%) as moderate, 3 (4.4%) as moderate to severe and 3 (4.4%) as serious. The evaluation of the functional independence measure of the participants categorized 4 (5.9%) as complete dependence, 22 (32.4%) modified dependence with assistance in up to 50% of activities, 14 (20.6%) modified dependence with assistance in up to 25% of activities and 28 (41.2%) with complete/modified independence. The mean NIHSS and MIF scores as well as the results of the other measures collected are presented in Table III.

Regarding the assessment of mobility in bed, 4 (5.9%) were able to lie down, 7 (10.3%) performed transfers in bed, 16 (23.5%) sat at the bedside, 7 (10 .3%) performed transfers outside the bed, 2 (2.9%) remained in an upright position for 1 minute, 5 (7.4%) walked 10 steps or more, 5 (7.4%) walked 7.5 meters or more a further 22 (32.4%) walked 75 meters or more.

Regarding handgrip strength, when compared with the healthy population, our results indicate heterogeneous values, within the average among the population aged 20 to 50 years, and reduced values in the population over 60 years old, as seen in Table IV.

In the analyzes between the stroke severity index and the functionality measures assessed by the FIM and the Barthel Index, a large inverse correlation was identified, indicating a negative effect of increased severity on the participants' functionality. On the other hand, the increase in manual strength correlated positively with the assessment of the patient's mobility, assessed using the Johns Hopkins scale, as seen in Figure 1.

Table II – Characteristics of included participants

Sociodemographic	Total (n = 68)
Age (SD)	62.43 (14.5)
Sex, n (%)	
Feminine	29 (42.6)
Masculine	39 (57.4)
Involvement, n (%) (%)	
None	8 (10.5)
Left hemiplegia	9 (11.8)
Right hemiplegia	17 (22.4)
Left hemiparesis	9 (11.8)
Right hemiparesis	10 (13.2)
Right upper limb plegia	1 (1.3)
Left upper limb paresis	6 (7.9)
Right upper limb paresis	3 (3.9)
Right lower limb paresis	5 (6.6)
Dysarthria	5 (6.6)
Aphasia	3 (3.9)
Quantity of medications (SD)	3.53 (3.26)
Smoking, n (%)	34 (50)
Alcoholism, n (%)	38 (55.9)
Sedentary lifestyle, n (%)	41 (60.3)
Comorbidities, n (%)	
Type I Diabetes	0
Type II Diabetes	24 (35.3)
Hypertension	46 (67.7)
Cardiovascular disease	14 (20.6)
Hemodynamics (SD)	
Systolic blood pressure	132.21 (19.98)
Diastolic blood pressure	82.01 (12.11)
Heart rate	79.51 (14.01)
Peripheral oxygen saturation	94.79 (2.36)

SD = standard deviation; N = number

Table III – Scoring and classification of participant assessment measures

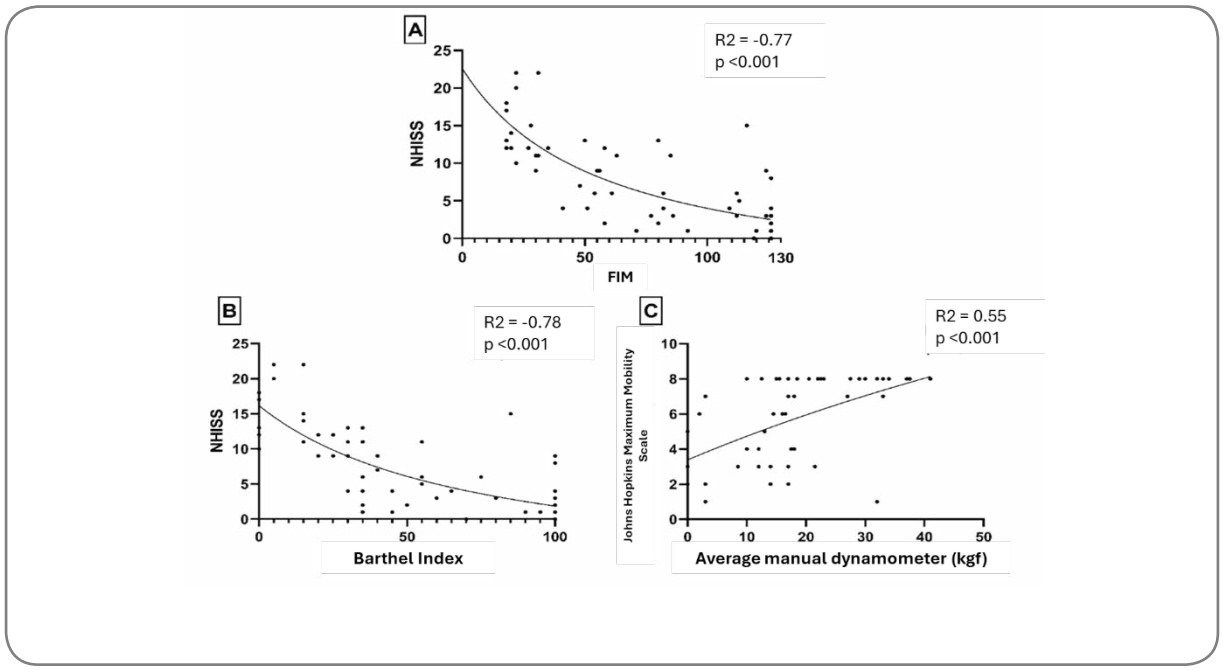
Instrument	Score/Classification Average (SD)
NIHSS	6.87 (5.96)
Barthel index	54.34 (36.04)
Functional independence measure	79.74 (40.68)
Complete dependency, n (%)	13 (19.1)
Severe dependence, n (%)	18 (26.5)
Moderate dependence, n (%)	8 (11.8)
Mild dependence, n (%)	10 (14.7)
Totally independent, n (%)	19 (27.9)
Johns Hopkins Maximum Mobility Scale	5.07 (2.5)
Average manual dynamometer [kgf]	18.62 (10.78)

SD = standard deviation; NIHSS = National Institute of Health Stroke Scale; Kgf = kilogram/force; N = number

Table IV - Handgrip strength

Age	N	HS Average [kgf]	SD
20-29	1		
Right hand		4.00	.
Left hand		2.00	.
30-39	3		
Right hand		30.00	11.53
Left hand		26.67	11.37
40-49	7		
Right hand		23.71	10.99
Left hand		14.57	10.87
50-59	20		
Right hand		17.20	16.79
Left hand		20.75	14.31
60 – 69	17		
Right hand		16.00	13.12
Left hand		13.24	12.61
70-79	13		
Right hand		8.23	10.99
Left hand		16.38	12.08
Acima de 80	7		
Right hand		6.57	8.84
Left hand		4.00	8.24

SD = standard deviation; HGS = handgrip strength; Kgf = kilogram/force; N =mnumber



NIHSS = National Institute of Health Stroke Scale; Kgf = kilogram/force
Figure 1 – Spearman correlation measurement between stroke severity index and functionality measures (A and B), and manual dynamometry with hospital mobility scale (C). Stroke: cerebrovascular accident

Discussion

Regarding the main objective of the study, the results show a negative correlation between the severity of the stroke, assessed by the NIHSS, and the degree of functionality, assessed by the FIM and Barthel scales. The data corroborate a study by Jang *et al.* [12], who point out a better recovery after hospital discharge in individuals who were classified as having a lower stroke severity on admission, that is, the lower the severity of the stroke, the better the functional prognosis after discharge. Brandão *et al.* [13] evaluated the correlation between the severity of the stroke and the degree of dysphagia, evaluated as functionality parameters, observing a negative correlation, which consolidates the results of the present study.

The NIHSS scale is widely used to classify stroke severity, being well disseminated in the literature and identified as a predictor of mortality, functionality and outcome [14-16]. Research conducted by Bhaskar *et al.* [14] evaluated the correlation between stroke severity and functionality, using, respectively, the NIHSS and the modified Rankin scale. Consolidating the data found in this study, they concluded that there was a moderate positive correlation between the NIHSS scores on admission and the Rankin scale score 90 days after admission.

Regarding the level of functionality of the sample studied, our research showed that 19.1% of patients were completely dependent; 26.5, severe dependence; 11.8, moderate dependence; 14.7, mild dependence; and 27.9, total independence. The study conducted by Baskhar *et al.* [14] showed that 61% of patients reported unfavorable functional results at discharge and 66% evaluated 3 months after the onset of the stroke. The data are compatible with the findings of our research, since only 27.9% of the patients evaluated showed total functional independence.

Regarding the assessment of handgrip strength, it was heterogeneous in the population aged 20 to 59 years and reduced in individuals over 60 years of age. Regarding the assessment of mobility in bed, 4 (5.9%) were able to lie down, 7 (10.3%) performed transfers in bed, 16 (23.5%) sat at the bedside, 7 (10.3%) performed transfers outside the bed, 2 (2.9%) remained in an upright position for 1 minute, 5 (7.4%) walked 10 steps or more, 5 (7.4%) walked 7.5 meters or more 22 (32.4%) walked 75 meters or more. When analyzing the data above, it was observed that 60.3% of patients were able to carry out their activities outside of bed, which can be explained by the intervention of physiotherapy while still in the hospital environment.

Li *et al*. [17] carried out a meta-analysis that aimed to research the effect of early mobilization in patients with stroke in the acute phase and concluded that early intervention did not change the Rankin scale score but was associated with better Barthel scale scores. Bernhardt *et al*. [18] pointed out that early intervention seems to improve the quality of life in patients in intensive care, which highlights that hospitalized patients have significant benefits if mobilized early. A systematic review with meta-analysis conducted by Miranda *et al*. [19] recently concluded that early mobilization should be started 24 hours after the stroke, with short-term exercises aimed at sitting, standing up and walking, which emphasizes the relevance of stimulating functionality in the early stages.

Our research showed that there is a moderate positive correlation between the degree of hospital mobility and handgrip strength, which can be explained by the correlation described between handgrip strength and global muscle strength [20]. The results highlight the relevance of implementing training in the hospital phase, to contribute to a better functional prognosis.

Studies indicate that early mobilization improves the prognosis of stroke patients after hospitalization, as it encourages transfers, position changes, sitting and early ambulation of patients [18,21,22]. Although it is known that the capacity for neuroplasticity is influenced by the initial nature of the injury, it is difficult to draw a functional prognosis for these patients [23].

Regarding the characterization of the sample in the present study, the majority were male (57.4%), with an average age of over 60 years, which is similar to the population of other studies referring to stroke [14,24]. Brandão *et al*. [13] showed that, although the prevalence of stroke is higher in males, female gender and age are associated with a worse functional prognosis and higher mortality.

Regarding the lifestyle habits evaluated in this research, 50% of patients reported smoking. A systematic review with meta-analysis, conducted by Pan *et al*. [25], showed that smoking patients have an overall increased risk of stroke compared to non-smokers, with a higher risk for current smokers compared to former smokers. Smoking is associated with both pulmonary and cardiovascular diseases, which poses more risks to these patients, as this association can lead to worse outcomes [26].

Regarding the consumption of alcoholic beverages, more than half of the participants (55%) reported drinking alcohol. Studies indicate that its excessive

consumption is directly associated with cardiovascular diseases, causing important changes in blood pressure [27,28]. A meta-analysis of prospective studies, conducted by Zhang *et al*. [29], investigated the dose-response relationship of alcohol consumption with stroke. It pointed out that low alcohol intake is related to a lower risk of morbidity and mortality, while excessive alcohol intake is associated with increased risks in these patients.

Considering our sample, 60% of individuals reported being sedentary. The study by Zhuang *et al*. [30] showed that a sedentary lifestyle is a risk factor associated with cardiovascular diseases, however research suggests that vigorous exercise reduces the risk of myocardial infarction and not stroke. On the other hand, Prior & Suskin [31] pointed out that physical exercise improves the occurrence of risk factors associated with stroke, demonstrating that high-intensity physical activity can be a protective factor for the disease.

Among the comorbidities found in the present study, the majority of individuals reported having high blood pressure (67.7%), followed by type II diabetes (35.3%) and cardiovascular diseases (20.6%). Arterial hypertension is the most important modifiable risk factor for stroke [32]. The study conducted by Sokol *et al*. [33] showed that reducing systolic blood pressure by 2 mmHg was associated with a 25% reduction in the risk of stroke, while reducing diastolic blood pressure was associated with a 50% lower risk, highlighting the need to maintain adequate blood pressure control. arterial.

In relation to heart diseases, the literature points to an important correlation with stroke, with atrial fibrillation (AF) being one of the main causes, since the displacement of the thrombus formed in the cardiac vessels impacts distally on brain regions, causing stroke. In addition to AF, other heart diseases are identified as factors associated with the disease, such as atrial septal aneurysm, patent foramen ovale, cardiomyopathy, left ventricular dysfunction, infective endocarditis and aortic atheromatosis [34]. Among the participants in our study, 20.6% reported having heart disease, but these were not specified due to the participants' lack of knowledge.

Another factor reported in our research was the presence of type 2 diabetes, which is associated with a higher risk of cardiovascular events [35]. The study by Barbaresko *et al*. [36] showed that patients with type 2 diabetes are associated with the risk of stroke and myocardial infarction. Hill [35] pointed out that diabetic patients are approximately twice as likely to have a stroke compared to non-diabetics in any age group.

The study carried out has important limitations regarding the number of participants who made up the sample. The research was restricted to a period of four months, having a limited number of participants. We suggest that new studies be carried out that can cover a larger sample

Conclusion

The findings of the present study point to an unfavorable correlation between the degree of stroke and functionality, indicating a negative effect of increased severity on the participants' functionality.

Based on the data highlighted above, it can be inferred that it is essential to measure the severity of the stroke to estimate a prognosis related to functional capacity and mortality risk. Furthermore, the importance of presenting the measured score in the medical record must be highlighted, so that rehabilitation professionals can categorize care and program a treatment plan based on each patient's prognosis. We also emphasize that early mobilization should be part of the treatment plan, as it is associated with greater functional benefits.

Conflicts of interest
The authors have no conflict of interest in publishing this article.

Sources of financing
None

Authors' contributions
Conception and design of the research: Nunes ELG, Gardenghi G; **Data collection:** Barbosa IOF, Ferreira BK, Campos MLS; **Data analysis and interpretation:** Barbosa IOF, Nunes ELG, Pereira LS, Gardenghi G; **Manuscript writing:** Barbosa IOF, Nunes ELG, Gardenghi G; **Critical review of the manuscript:** Barbosa IOF, Nunes ELG, Pereira LS, Ferreira BK, Campos MLS, Petto J, Gardenghi G.

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