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Functional independence, clinical aspects, and sociodemographic factors in patients in the acute phase of stroke: an association analysis

Independência funcional, aspectos clínicos e fatores sociodemográficos em pacientes na fase aguda do Acidente Vascular Cerebral: uma análise de associação

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ABSTRACT

Purpose: To analyze the association of functional independence with clinical aspects of neurological impairment, the location and extent of neuronal damage and sociodemographic factors in patients in the acute phase of stroke. **Methods:** Analytical cross-sectional study in 90 adult and older patients affected by ischemic stroke, admitted to the hospital within 24 hours of the vascular event. Sociodemographic factors and clinical aspects data were collected from electronic medical records and/or interviews in order to depict the patients'profile, Oxfordshire Community Stroke Project, Alberta Stroke Programme Early CT Score, National Institute of Health Stroke Scale, and Functional Independence Measure. **Results:** Neurological impairment, according to the National Institute of Health Stroke Scale, was associated with functioning in the first 24 hours after the stroke. Furthermore, the presence of arterial hypertension, age, inactive work, smoking and extent of neuronal damage were associated with functional dependence, but did not remain in the final model of this study. **Conclusion:** Functional dependence is associated with arterial hypertension, age, inactive work, smoking, extent of neuronal damage, and degree of neurological impairment in the first 24 hours after the vascular event. Furthermore, a higher level of neurological impairment was independently associated with increased levels of functional dependence.

Keywords: Functional status; Ischemic stroke; Neurology; Activities of daily living; Neurologic manifestations.

RESUMO

Objetivo: Analisar a associação da independência funcional com aspectos clínicos de comprometimento neurológico, a localização e extensão do dano neuronal e os fatores sociodemográficos em pacientes na fase aguda do AVC. **Método:** Estudo analítico de recorte transversal, realizado com 90 pacientes adultos e idosos acometidos por AVC isquêmico, que tiveram admissão no ambiente hospitalar nas primeiras 24 horas após o evento vascular. A coleta dos dados referentes aos aspectos clínicos e fatores sociodemográficos foi realizada pelo prontuário eletrônico e/ou entrevista para descrever o perfil dos pacientes, Oxfordshire Community Stroke Project, Alberta Stroke Programme Early CT Score, National Institute of Health Stroke Scale e a Medida de Independência Funcional. **Resultados:** O comprometimento neurológico, de acordo com a National Institute of Health Stroke Scale, foi associado à funcionalidade nas primeiras 24 horas após o AVC. Além disso, a presença de hipertensão arterial, idade, trabalho inativo, tabagismo e extensão do dano neuronal estiveram associados à dependência funcional, mas não permaneceram no modelo final deste estudo. **Conclusão:** A dependência funcional está associada à hipertensão arterial, idade, trabalho inativo, tabagismo, extensão do dano neuronal e grau de comprometimento neurológico nas primeiras 24 horas após o evento vascular. Além disso, um nível mais elevado de comprometimento neurológico foi independentemente associado a níveis aumentados de dependência funcional.

Palavras-chave: Estado funcional; AVC isquêmico; Neurologia; Atividades cotidianas; Manifestações neurológicas.

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INTRODUCTION

Functional independence requires satisfactory motor and cognitive conditions and the functioning of body organs, systems, and structures and is directly related to the environment where the person lives[1]. Health conditions are related to functioning and disability, involving what the person can or cannot do in terms of motor, cognitive, and social skills[2]. Stroke is the main cause of disability in Brazil and the world, affecting about 90% of survivors[2,3].

The etiology of stroke is diverse and involves non-modifiable (such as age and sex) and modifiable predisposing factors (such as hypertension, diabetes mellitus, high cholesterol, cardiovascular diseases, sedentarism, atrial fibrillation, smoking, and alcohol consumption)[4]. Since life expectancy has increased in Brazil and chronic diseases are highly prevalent among older adults, the number of people with sequelae of brain diseases and lesions has grown considerably[5].

Depending on the artery involved, the localization of the lesion, and the extent of the brain damage, countless complications can affect various aspects of the patient's life[6]. Guidelines for the early management of hospitalized patients with acute ischemic stroke include the use of scales to classify the severity of the stroke, preferably the NIHSS, head and neck imaging tests, blood glucose assessment, blood pressure measurement and temperature, antiplatelet and anticoagulant treatment, dysphagia assessment, respiratory support, performing mechanical thrombectomy, among others. Furthermore, it is recommended that all individuals be evaluated for functionality, aiming for early rehabilitation[7].

Postural disorders, sensory and motor deficits, hemiplegia, hemiparesis, cognitive changes, oral or written language changes (comprehension and/or expression), speech difficulties, dysphagia, memory impairment, and thought disorganization are some of the typical changes caused by stroke[6]. Loss of independence and autonomy in the activities of daily living (ADL) is the most significant impact, causing the worst consequences to the patient[3]. Functional dependence may lead to emotional disorders, mood changes, activity limitations, and participation restrictions, directly affecting their quality of life[6].

Functioning and neurological impairments must be identified as early as the acute phase of stroke to determine the patient's limitations and degree of dependence in tasks such as eating, communicating, bathing, getting dressed, walking, lying down, getting up, and so forth[2,3,8]. Careful and comprehensive measurements of functioning in this phase are crucial to clinical management and rehabilitation and enable better treatment and more favorable results[2,3,5,6].

Functional capacity assessments verify performance in ADL, while neurological assessments indicate sensory, motor, and cognitive functions that may have been affected or preserved. Hence, they ground short- and long-term rehabilitation strategies[8]. The acute phase is when patients recover the fastest from deficits[9]; therefore, classifying this early their degree of independence increases their chances in intervention and rehabilitation towards better functional and quality-of-life prognosis.

Studies in the literature have estimated functioning in the chronic phase of the disease and analyzed the benefits of rehabilitation[1,6,8,10]. Others have approached functional conditions in the acute phase[2,11], though not at hospital admission – i.e., the first 24 hr after stroke. Patients presumably have some degree of functional dependence in the first hours after the vascular event, considering individual and clinical aspects. Therefore, the objective of this study is to analyze the association of functional independence with clinical aspects of neurological impairment, the location and extent of neuronal damage and sociodemographic factors in patients in the acute phase of stroke.

METHODS

This analytical cross-sectional study comprised patients hospitalized in the Stroke Unit (SU) at the Hospital Risoleta Tolentino Neves (HRTN), in Belo Horizonte, Minas Gerais, Brazil. The SU at HRTN is accredited by the Ministry of Health as a type-III reference center for stroke. Type-III is the highest complexity level in acute stroke treatment, according to the emergency stroke care guidelines of the Ministry of Health[12]. The stroke treatment includes the management of all acute stroke cases admitted to the institution (with the exception of those requiring intensive care and those for whom palliative care is defined), with a focus on acute phase treatment, early rehabilitation (including speech therapy, physiotherapy, and occupational therapy), and comprehensive etiological investigation.

The research was approved by the Research Ethics Committee of the Federal University of Minas Gerais (CAAE – 32809514.4.4.0000.5149; 787.231).

Participants

The sample comprised 90 adult and older patients affected by ischemic stroke. The inclusion criteria were as follows: aged 18 years or older; diagnosed with stroke and confirmed with neurological assessment and head CT scan; admitted to the hospital within 24 hr of the vascular event; adequate level of awareness, according to the Glasgow Coma Scale[13]; absence of delirium, according to the Confusion Assessment Method[14]; and an informed consent form (ICF) signed by the patient or someone responsible for them. Patients with other neurological diseases, prior cognitive, neuropsychiatric, or motor impairments (as determined by medical evaluations and documented in the patient's medical records), or those who did not complete all data collection instruments, were excluded.

Data collection

All data collection instruments were administered on the same day by the same trained and experienced professional. Sociodemographic factors and clinical data were obtained from medical records and/or interviews to describe the patients' profiles. Their age, sex, educational attainment, comorbidities, occupation, head CT scan, and clinical examination were analyzed.

Stroke was classified based on clinical characteristics and anatomical localization of the lesion indicated in the head CT scan, following the Oxfordshire Community Stroke Project (OCSP). This instrument divides the physiological mechanisms into four subtypes: lacunar infarct (LACI), total anterior circulation infarct (TACI), partial anterior circulation infarct (PACI), and posterior circulation infarct (POCI)[15].

The Alberta Stroke Programme Early CT Score (ASPECTS) was used to measure the topography of brain tissue changes caused by acute ischemic stroke in the anterior circulation.

The middle cerebral artery (MCA) territory is subdivided into 10 standardized regions, evaluated in two head CT scans – one of the thalami and basal ganglia and the other right above the basal ganglia. Its score ranges from 0 to 10, in which 10 means no tomographic evidence of acute ischemic lesion in MCA territory, while 0 indicates diffuse ischemia in the whole MCA territory[16].

The degree of neurological impairment was assessed with the National Institute of Health Stroke Scale (NIHSS), which was developed to this very end. Its 11 items encompass the level of awareness, eye movements, visual field, facial movements, motor function, upper and lower limb ataxia, sensitivity, language, dysarthria, and spatial neglect. The scores vary according to the items; the maximum score on the scale is 42 points – the higher the score, the more severe the neurological impairment[17].

Lastly, the functional independence measure (FIM) was used to quantitatively assess the assistance the patient needed to perform a series of motor and cognitive everyday tasks. These are grouped into the following dimensions: self-care, transfers, locomotion, sphincter control, communication, and social cognition – which includes memory, social interaction, and problem-solving. Each task is scored from 1 to 7, corresponding respectively to total assist and complete independence. The total FIM score, ranging from 18 to 126 points, is the sum of all dimension scores[18,19]. The level of dependence is classified as follows: 18 points, complete dependence; 19 to 60, modified dependence (assistance in up to 50% of the tasks); 61 to 103, modified dependence (assistance in up to 25% of the tasks); and 104 to 126, complete independence, corresponding to normal task performance[20].

Data analysis

The Statistical Package for the Social Sciences (SPSS), version 21.0, was used for statistical data analysis. Descriptive analyses of all variables were made with the absolute and relative frequency distribution of the categorical variables and numerical synthesis of the continuous variables. Association between functional independence and sociodemographic and clinical variables was assessed with the chi-square and Fisher exact tests and their respective p-values and then analyzed. FIM was defined as a two-variable category for the comparative analysis of the level of functional dependence between the participants, according to the reference scores – from 18 to 103 points defined functionally dependent patients, and ≥ 104 points defined functionally independent ones. Before comparing the dependent variable with independent continuous variables (age, educational attainment, and NIHSS and ASPECTS score), their distribution was analyzed with the Kolmogorov-Smirnov test. For all analyses, the significance level was set at 5%. Variables with a statistically significant association at 20% ($p < 0.20$) in the univariate analysis were included in the multiple logistic regression model. The variable with the highest p-value in each step of the analysis was removed from the model with the manual backward method. In the final model, the variables with a significant association at 5% were maintained. The magnitude of the associations was assessed with the odds ratio (OR) and 95% confidence intervals. The goodness of the model was assessed with the Hosmer-Lemeshow test.

RESULTS

From the total number of participants, 52.2% were females, with a mean age of 65.0 years (± 11.6). As for educational attainment, they had attended school for a mean of 4.2 years (± 3.4).

The mean FIM score was 77.39, while the mean NIHSS score was 7.88, indicating some degree of neurological impairment in most participants (93.3%). Half of the participants were classified as LACI in OCSP. The mean ASPECTS score regarding the extent of the acute ischemic lesion in MCA territory was 9.13 (Table 1).

Table 1. Descriptive analysis of the functioning and neurological variables (N=90)

FIM – Total score		
Mean ± SD	77.39 ± 34.00	
Median (min-max)	86.00 (18-126)	
FIM – Divided into 4 categories		
	N	**%**
Up to 18: complete dependence	3	3.3
19 to 60: modified dependence with assistance in up to 50% of the tasks	25	27.8
61 to 103: modified dependence with assistance in up to 25% of the tasks	38	42.2
104 to 126: complete independence	24	26.7
Total	90	100.0
NIHSS – Total score		
Mean ± SD	7.88 ± 6.75	
Median (min-max)	6.00 (0-30)	
OCSP – Classification		
	N	**%**
LACI	45	50.0
TACI	7	7.8
PACI	35	38.9
POCI	3	3.3
Total	90	100.0
ASPECTS – Total score		
Mean ± SD	9.13 ± 1.19	
Median (min-max)	9.50 (5-10)	

Subtitle: N = number of participants; FIM = Functional Independence Measure; SD = standard deviation; min = minimum; max = maximum; NIHSS = National Institute of Health Stroke Scale; OCSP = Oxfordshire Community Stroke Project; LACI = lacunar infarct; TACI = total anterior circulation infarct; PACI = partial anterior circulation infarct; POCI = posterior circulation infarct; ASPECTS = Alberta Stroke Programme Early CT Score

In relation to clinical aspects and sociodemographic factors, there was a greater proportion of participants with a history of active work (p = 0.031) and smoking (p = 0.038) among functionally independent patients, and a greater proportion of participants with arterial hypertension (p = 0.030) among functionally dependent ones (Table 2). Age was associated (p = 0.007) with functioning; the highest mean age (67.0 years) was found among functionally dependent participants. The highest median NIHSS score (9.0 points) was likewise associated (p < 0.001) with functionally dependent individuals, whereas the highest median ASPECTS score (10.0 points) was associated (p < 0.001) with functionally independent participants (Table 3).

In the logistic regression model, only the degree of neurological impairment was associated with functioning. A 1-point increase on NIHSS made patients 1.45 times (45%) as likely of being functionally dependent, according to FIM (OR = 1.45; CI = 1.15-1.84). Age was maintained in the final model as an adjustment variable because of its relevance to the study outcome (Table 4).

Table 2. Association analysis between the degree of functional independence and sociodemographic and clinical variables (N=90)

Variables	Functional Independence		p-value
	Yes	No	
	N(%)	N(%)	
Sex			
Females	8 (33.3)	35 (53.0)	0.098*
Males	16 (66.7)	31 (47.0)	
Total	24 (100.0)	66 (100.0)	
Active work			
No	8 (33.3)	39 (59.1)	0.031*
Yes	16 (66.7)	27 (40.9)	
Total	24 (100.0)	66 (100.0)	
Previous stroke			
No	12 (50.0)	30 (45.5)	0.702*
Yes	12 (50.0)	36 (54.5)	
Total	24 (100.0)	66 (100.0)	
Sedentarism			
No	22 (91.7)	54 (81.8)	0.213**
Yes	2 (8.3)	12 (18.2)	
Total	24 (100.0)	66 (100.0)	
Diabetes Mellitus			
No	18 (75.0)	48 (72.8)	0.829*
Yes	6 (25.0)	18 (27.3)	
Total	24 (100.0)	66 (100.0)	
Obesity			
No	23 (95.8)	60 (90.9)	0.396**
Yes	1 (4.2)	6 (9.1)	
Total	24 (100.0)	66 (100.0)	
Arterial Hypertension			
No	12 (50.0)	17 (25.8)	0.030*
Yes	12 (50.0)	49 (74.2)	
Total	24 (100.0)	66 (100.0)	
Smoking			
No	11 (45.8)	46 (69.7)	0.038*
Yes	13 (54.2)	20 (30.3)	
Total	24 (100.0)	66 (100.0)	
Alcoholism			
No	21 (87.5)	54 (81.8)	0.387*
Yes	3 (12.5)	12 (30.3)	
Total	24 (100.0)	66 (100.0)	
OCSP Classification			
LACI	10 (41.7)	35 (53.0)	–
TACI	2 (8.3)	5 (7.6)	
PACI	11 (45.8)	24 (36.4)	
POCI	1 (4.2)	2 (3.0)	
Total	24 (100.0)	66 (100.0)	

Subtitle: N = number of participants; OCSP = Oxfordshire Community Stroke Project; LACI = lacunar infarct; TACI = total anterior circulation infarct; PACI = partial anterior circulation infarct; POCI = posterior circulation infarct *Chi-square test; **Fisher exact test

Table 3. Association analysis between the degree of functional independence and continuous variables (N=90)

Variables	Functional Independence		p-value
	Yes	No	
Age (in years)			
Mean ± SD	58.8 ± 13.3	67.2 ± 12.4	0.007*
Median	60.0	67.0	
Educational attainment (in years)			
Mean ± SD	4.2 ± 3.2	4.2 ± 3.5	0.867**
Median	4.0	4.0	
NIHSS (Total Score)			
Mean ± SD	2.9 ± 2.2	9.7 ± 6.9	<0.001**
Median	3.0	9.0	
ASPECTS (Total Score)			
Mean ± SD	9.6 ± 0.7	9.0 ± 1.3	0.021**
Median	10.0	9.0	

Subtitle: SD = standard deviation; NIHSS = National Institute of Health Stroke Scale; ASPECTS = Alberta Stroke Programme Early CT Score *Student's t-test; **Man-Whitney test

Table 4. Multiple logistic regression analysis between Functional Independence Measure results and selected sociodemographic and clinical variables

Characteristics*	Initial Model		Final Model	
	OR (95% CI)	p-value*	OR (95% CI)	p-value*
Active work	0.76 (0.18-3.32)	0.720	–	–
Age	1.03 (0.98-1.10)	0.263	1.04 (0.99-1.09)	0.118
Smoking	2.12 (0.61-7.35)	0.696	–	–
Arterial hypertension	1.03 (0.98-1.10)	0.263	–	–
NIHSS	1.45 (1.15-1.84)	0.002	1.45 (1.15-1.84)	0.002
ASPECTS	1.09 (0.58-2.07)	0.788	–	–

Subtitle: OR = odds ratio; CI = confidence interval; NIHSS = National Institute of Health Stroke Scale; ASPECTS = Alberta Stroke Programme Early CT Score *Wald test Reference categories: Active work: yes; Arterial hypertension: no; Smoking: no Initial/final model fitting (Hosmer-Lemeshow): p=0.616/p=0.821

DISCUSSION

This study showed that functional dependence is associated with arterial hypertension, age, inactive work, extent of neuronal damage, and degree of neurological impairment in the first 24 hr after the vascular event. Moreover, the NIHSS score for the degree of neurological impairment was independently associated with higher levels of functional dependence, measured with FIM.

The association between functional dependence and the participants' older mean age indicates that older adults can have worse post-stroke functional prognoses. Also, just over half of the subjects in this study were females. Research has verified that age and sex influence functioning in post-ischemic stroke patients. According to the authors, in childhood and early adulthood, men have a greater incidence of ischemic stroke and worse functional results than women. However, with advancing age, the rates of ischemia increase in women, and ischemic stroke becomes more common and more debilitating among them[21].

Concerning the participants' history, having actively worked before the stroke was associated with functional independence, indicating that social participation and labor activity may indicate better post-stroke functional prognoses. No article was found in the literature associating previous active work with post-stroke functioning. Although getting back to work is one of the main objectives of individuals who were active before the vascular event, less than half of them manage to resume such activities because of limitations imposed by acquired disabilities, difficult access to rehabilitation, or sociocultural context[22,23].

The statistically significant association found in this research between smoking participants and functional independence – which, however, did not remain in the multivariate analysis – may seem at first an incongruence. On the other hand, this study did not approach aspects such as time and amount of tobacco consumption, which prevents an association between these factors. Also, the literature demonstrates that smoking is a risk factor for ischemic stroke, a risk that increases with greater tobacco consumption[24].

The association between functional dependence and arterial hypertension – which is one of the main modifiable risk factors for stroke[25] – suggests it as an indicator of worse functional prognoses. A study reported that individuals with pre-existing hypertension have a smaller area of recoverable neuronal tissue (penumbra) and larger infarcts than normotensive subjects[25]. Another study verified that both arterial hypertension and low arterial pressure were associated with unfavorable outcomes of the ischemic event, resulting in death or functional dependence over 6 months[26].

The present study also found an association between a smaller area of MCA affection (according to ASPECTS) and functional independence, indicating an association between less extensive neuronal damage and better post-stroke functioning. Research has verified that less extensive hypodense area in head CT scan is one of the most important variables to determine good prognoses and better responses to post-stroke treatment[27]. Other authors have identified that ASPECTS scores higher than 7 are related to better results 6 months after ischemic stroke[28].

In the multivariate analysis, only neurological impairment (according to NIHSS) was associated with functioning in the first 24 hr after stroke. Hence, the greater the neurological impairment, the worse the participant's functional prognosis. Scholars found a relationship between clinical severity of stroke and degree of functional independence in hemiplegic patients assessed with motor FIM; they pointed out that the more severe the patient's clinical condition, the worse their functional independence and, therefore, the greater their dependence to perform ADL[11]. Other studies also found that high NIHSS scores tend to worsen post-stroke prognoses[27,28].

NIHSS measures motor and non-motor deficits, furnishes precise information on the patients' impairments, and helps define therapy goals and plan hospital discharge. On the other hand, as it measures only disabilities, it does not inform about limitations to perform ADL, such as difficulties with locomotion, sitting, standing, walking, and upper limb functions[29]. Thus, the association between neurological impairment and functional independence indicated in the present study helps outline goals and strategies to optimize these individuals' performance while still in the acute phase, as patients with greater neurological impairments have higher levels of functional dependence and consequently need greater assistance in ADL.

A prospective study observed that patients who score 5 or less in NIHSS are discharged faster from the hospital; those who score from 6 to 13 need a rehabilitation program; and those who score more than 13 frequently need intense and extensive rehabilitation[30]. Hence, according to the mean NIHSS score (7.88), these patients were already in need of rehabilitation when they were admitted to the hospital, which could favor their recovery from deficits towards functional independence.

The literature demonstrates a positive correlation between the degree of neurological impairment and the level of functional disability in patients in the chronic phase of stroke, indicating that greater neurological impairment corresponds to greater functional disability in this stage as well[8]. Thus, reliable prognoses must be made as early as the acute phase of stroke, as patients recover faster from deficits in this period, whereas 3 to 6 months after the event they reach a functional recovery plateau[8,9]. Therefore, it is important to take advantage of cerebral plasticity principles in the acute phase to obtain maximum functioning recovery[2].

This study characterized functioning in the first 24 hr after stroke, demonstrating that the level of neurological impairment was associated with functional independence. These results demonstrate the importance of early detection of functional dependency in the first hours of the stroke, as this variable is related to the severity of the patient's clinical condition. Loss of independence and autonomy to perform ADL has countless negative impacts on the person's life[3,6]. Thus, assessment and intervention in the acute phase are essential to prevent greater limitations and avoid decreased functional capacity. Measuring the person's physical and clinical conditions is essential to clinical management and rehabilitation, also helping public policies respond more precisely to the needs of people with limited functioning[5,6].

Although the objective of this study was to analyze functional independence to perform ADL, one of its limitations was that no analyses based on the motor and cognitive domains of the FIM scale were made. Future studies should longitudinally follow-up these patients to assess the association between functional independence and neurological impairment in the acute, subacute, and chronic phases of ischemic stroke.

CONCLUSION

Functional dependence is associated with arterial hypertension, age, inactive work, smoking, extent of neuronal damage, and degree of neurological impairment in the first 24 hours after the vascular event. Furthermore, a higher level of neurological impairment was independently associated with increased levels of functional dependence. Assessment and intervention in the acute phase are essential to prevent greater limitations, avoid decreased functional capacity and is essential to clinical management and rehabilitation, also helping public policies.

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