Original Article

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Functional behavior of individuals after chronic stroke: a longitudinal study

Comportamento funcional de indivíduos após acidente vascular cerebral crônico: um estudo longitudinal

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ABSTRACT

Objective: Identify the functional behavior of individuals after chronic stroke eighteen months of evolution. **Method:** Prospective longitudinal study with data collections carried out between February 2019 and December 2019. Data was collected from individuals who had ischemic or hemorrhagic stroke more than 6 months previously and individuals were over the age of 18 years. An assessment was carried out to collect sociodemographic data, and information was collected on the use of orthoses, physical activity, physiotherapy treatment, smoking history, frequency and occurrence of falls, among others. In addition, the 10-meter Walk Test (10MWT), the Human Activity Profile (HAP) questionnaire, cognition assessment with the Mini Mental State Examination (Mini-Mental), the international falls self-efficacy scale (FESi) and functional capacity assessment with the Duke Activity Status Index (DASI) were carried out. An 18-month follow-up was carried out. **Results:** The study obtained 44 individuals, among which 35 had ischemic stroke, with an average age of 65 years and 60 months after the stroke. The individuals did not show changes in their functional level, they maintained independent walking with an average habitual walking speed of 0.75m/s, the use of orthosis, the reach of objects, independent feeding, and the use of an independent bathroom. **Conclusion:** After 18 months of follow-up, the individuals had maintained their functional behavior in most cases, and it can be said that they had reached a plateau in their state of health.

Keywords: Stroke, Motor Disorders, Exercise, Continuity of Patient Care

RESUMO

Objetivo: Identificar o comportamento funcional de indivíduos após AVC crônico dezoito meses de evolução. **Método:** Estudo longitudinal prospectivo com coletas de dados realizadas entre fevereiro de 2019 e agosto de 2020. Foram coletados dados de indivíduos que tiveram AVC isquêmico ou hemorrágico há mais de 6 meses em indivíduos maiores de 18 anos. Foi realizada uma avaliação para coleta de dados sociodemográficos, coletadas informações sobre uso de órtese, prática de atividade física, realização de tratamento fisioterapêutico, histórico de tabagismo, frequência, ocorrências de quedas, entre outros. Além disso, foram realizados Teste de Caminhada de 10 metros (TC10m), questionário de Perfil de Atividade Humana (PAH), avaliação da cognição com Mini Exame do Estado Mental (Mini-Mental), escala internacional de auto eficácia de quedas (FESi) e avaliação da capacidade funcional pelo Duke Activity Status Index (DASI). Foi realizado um acompanhamento no período de 18 meses. **Resultados:** O estudo obteve 44 indivíduos, entre os quais 35 tiveram AVC isquêmico, com uma média de idade de 65 anos e 60 meses após o AVC. Os indivíduos não apresentaram alterações no seu nível funcional, mantiveram a marcha independente com média de velocidade de marcha habitual de 0,75m/s, o uso de órtese, o alcance de objetos, a alimentação independente e o uso de banheiro independente. **Conclusão:** Após 18 meses de acompanhamento, os indivíduos mantiveram o seu comportamento funcional na maioria dos casos, podendo dizer-se que atingiram um patamar no seu estado de saúde.

Palavras-chaves: Acidente Vascular Cerebral, Transtornos Motores, Exercício Físico, Continuidade da Assistência ao Paciente

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Conflict of Interests
Nothing to declare

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INTRODUCTION

Stroke is the second leading cause of death in the world and a major cause of disability in the world.[1,2] Stroke is currently a major public health problem in Brazil.[3]

Individuals who had stroke live with several motor sequelae for many years, which leads to a significant impact on their level of functional dependence, especially in activities of daily living.[4] Individuals after stroke need constant care with a rehabilitation team, with physical therapy treatment, in order to promote maximum functionality and independence for these individuals within the context in which they are inserted.[5]

Although there are some longitudinal studies that followed different outcomes in stroke population[6-10] there are no studies that describe the prospective follow-up of individuals after stroke regarding their functional behavior over a period of 18 months. The study that longitudinally followed 367 individuals after stroke in Brazil was conducted in Joinville for a period of three years, and identified the risk factors for functional dependence of individuals with ischemic stroke.[7] The longitudinal study by Cabral[9] with 399 individuals after stroke also in the city of Joinville for a period of five years evaluated the recurrence of stroke events, the probability of survival over the five-year period, the causes of death, and the functional outcomes individuals after stroke.[9]

The retrospective cohort study investigated 124 post-stroke individuals living in the city of Salvador on the potential predictors of community integration of individuals in a residential environment.[8] Recently, a study investigated whether there was a relationship between the functional activities performed before the stroke and in the first 6 months after the stroke in Brazil, and found that comorbidities and extended hospital stay were associated with worse outcomes.[10] In addition, it was observed that improvement in functionality over time was seen to be related with an increase in quality of life of individuals after stroke.[10]

Studies involving individuals after stroke present difficulties in recruiting them, with the main barriers including people's lack of interest in participating, complex protocols, strict eligibility criteria, exhaustive testing, and the transportation of participants.[11]

The lack of interest of individuals in participating in scientific research can derive from both the deficit of financial resources, the scarcity of family encouragement, insufficient instructions about the importance of treatment and research, as well as the demotivation caused by the depression that the disease itself causes.[12] Thus, the characterization of motor, sensory, and functional components of this population is an important factor to identify and measure the levels of limitation and dependence of these individuals.[13] Thus, providing more information about this dysfunction so that treatments, interventions and even prevention aimed at functionality are performed more effectively and efficiently, promoting the faster reinsertion of this individual after the stroke on the community.

OBJECTIVE

The aim of the present study was to verify changes over time in the functional behavior of individuals with chronic stroke during an 18-month period of prospective follow-up.

METHOD

A longitudinal prospective study was developed at the Faculdade de Ciências Médicas de Minas Gerais and approved by the Ethics in Research Committee (CAAE: 04500918.7.0000.5134), between February 2019 to August 2020.

Individuals with chronic strokes were recruited from previous research databases, where telephone contacts were made available to invite them to take part in the research, and those who agreed were scheduled for a face-to-face meeting. The individuals had their first assessment done personally. After agreeing to participate in the research, they signed the informed consent. Then, the following instruments were used: evaluation form and standardized tests for sample characterization. This evaluation occurred on a day predetermined by the researchers and according to the availability of the participants in the in a university laboratory. The variables evaluated at follow-up were collected through phone calls and this moment is considered the baseline of the study for the variables evaluated at the 18 months follow-up. Two trained researches performed the assessments through phone calls.

The inclusion criteria were individuals over 18 years old who had had a stroke for more than six months.[14] Exclusion criteria were individuals who could not speak and/or could not be understood. Considering a longitudinal evaluation with baseline and three follow-ups, with 80% power, moderate effect size (r= 0.50), α= 0.05, the estimated sample size necessary for the present study was 66 individuals.[15]

For characterization purposes, gender (female or male), age, date of birth, telephone number, who they live with, occupation, associated pathologies, number of stroke episodes, date of the last episode, time since stroke onset (in months) were collected. In addition, type of stroke (ischemic or hemorrhagic), use of orthosis (yes or no), physical activity practice (yes or no), with how often and for how long practice physical activity, perform physiotherapeutic treatment (yes or no) - how often and for how long, smoke (yes, no, or ex-smoker), and if the individual fell in the last six months and last year (yes or no and how many times) were collected. These questions were asked at baseline and reassessed by telephone every 6 months, totaling 18 months of follow-up.

To assess functional behavior, data were collected longitudinally, over a period of 18 months, every six months, (baseline, 6, 12 and 18 months). The assessment was performed with questions regarding the perceived functional behavior. The questions were: do you walk independently?, can you leave the house independently?, do you use orthosis?, do you sit independently?, do you speak and can be understood?, do you manage to reach objects?, do you eat independently?, do you use the bathroom independently?, do you perform physical therapy? - if yes, how often and how often, do you perform o physical activity? - if so how and how often, do you smoke or do you ever smoked? The questions had the possibility of a “yes” or “no” answer.

After completing the assessment, questionnaires were filled out and tests validated for the study population were carried out.[16-21] The 10-meters walk test (10mMWT) was performed to measure the walking speed (m/s).[16,17] The individual must walk a distance of 10m at their usual speed, with 2 meters at the beginning and end for acceleration and deceleration, and the time it takes for the individual to complete this route will be timed. Physical activity levels were assessed using the Human Activity Profile (HAP) questionnaire.

This consists of 94 questions about routine activities that

require high or low energy expenditure.[18] The participant must answer whether they still do, have stopped doing or have never done the proposed tasks and, according to the energy expenditure of each activity, the metabolic equivalent (MET) will be calculated. Activities with lower energy expenditure also have a lower value. The maximum and adjusted scores for the activity will be calculated and the adjusted score will be used.[18]

The Mini Mental State Examination (MMSE) was used to screen the cognitive decline.[19] The International Falls Effectiveness Scale (FES-I) was used to assess the risk of falling.[20] The FES-I is a questionnaire that contains 16 domains with different activities of daily living with four possible answers and respective scores from one to four ("Not at all worried" to "Extremely worried"). The total score can vary from 16 to 64 (no concern to extreme concern) in relation to falls while carrying out the specific activities in the questionnaire.

The Duke Activity Status Index (DASI)[21] was used to assess functional capacity. It is a 12-item questionnaire that assesses daily activities such as personal hygiene, locomotion, household chores, sexual function and leisure, with their respective metabolic costs. Each item has a specific weight based on the metabolic cost (MET).[22] Participants were asked to identify each of the activities they were able to perform. The final score ranges from zero to 58.2 points. The higher the score, the better the functional capacity. These measurements were only taken at baseline.

Statistical Analysis

The sample was described by mean and standard deviation values for continuous variables and absolute and relative frequency for categorical variables. The description of the ability to perform each functional activity was done by the percentages of individuals who reported doing and not doing each activity. The assessment of changes in the individuals' functional profile over 18 months was performed by the Generalized Estimation Equation (GEE) model that checks for patterns of change in the sample's reported ability to perform each of the assessed activities.

The Null Model was considered for assessing change in the ability of individuals able to perform each activity. In cases where the null model indicated change, the influence of ability at baseline on changes over time were evaluated. Then, by the same model, whether changes occurred at 6, 12 and 18 months were assessed. For all these analyses, $p<0.05$ was considered significant. At the end, the individual's chance of changing their ability to perform each activity was assessed by Odds Ratio (OR) and 95% IC values. For all analyses the answer "no" was considered the reference category. All analyses were performed in the R statistical program, considering a significance level of 0.05.

RESULTS

One hundred sixty-nine chronic individuals after stroke were initially contacted by telephone, and of these, 77 agreed to participate in the study (Figure 1). At the end of the study, a retention rate of 81% was found (62 individuals), which is defined as the number of individuals who remained in the study as a proportion of the total number of participants recruited at the initial assessment.

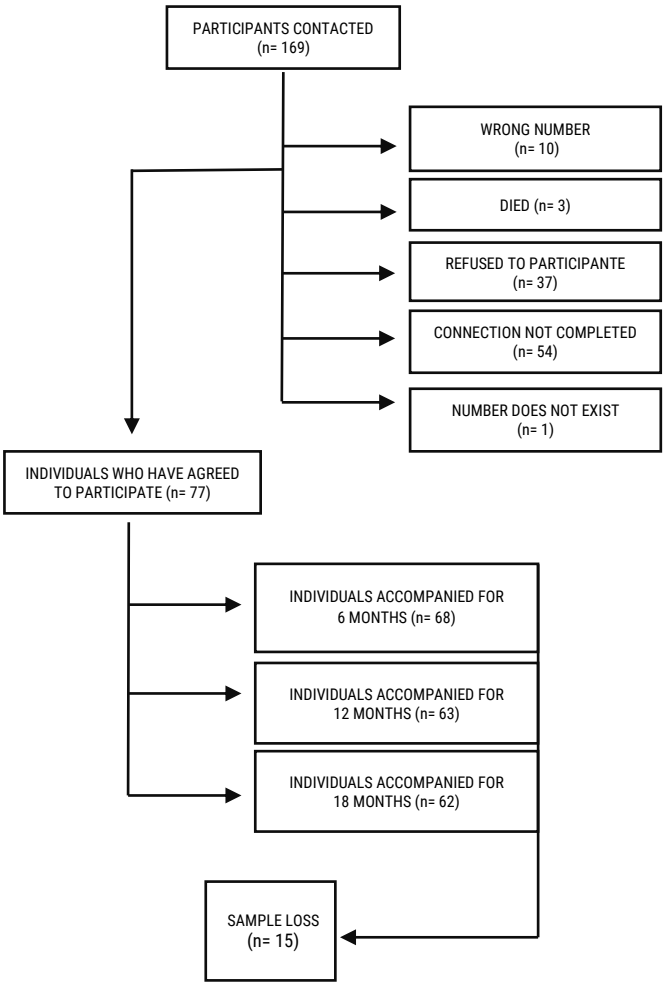

Figure 1. Recruitment Flowchart

The included individuals presented a mean age of 63.94 years; 55% ischemic stroke, with a mean evolution time of 90.61 months. They had a mean habitual walking speed of 0.75 (± standard deviation) m/s. Other characteristics of the sample are shown in Table 1.

After 18 months of study, all individuals were already performing most of the activities independently. The activities of reaching and eating were performed by 100% of the individuals during all follow-up, showing that these individuals had no loss of skills regarding these activities. Regarding independent walking, 96.1% were able to do it, and at the end of 18 months, 96.8% had this ability. Regarding going out independently, 71% did it at baseline and 76% after 18 months. At baseline, 99% of the individuals were physically able to sit up by themselves, and this figure was 98% at 18 months follow-up. At baseline 99% of the participants were able to speak and be understood, and after 18 months 97% had this ability. Regarding going to the toilet independently, 92% of the sample were able to do so at baseline and at the 18 months follow-up (Table 2).

The results of the Generalized Equation Estimation, for the variables that showed variation between individuals who could or could not perform the activities throughout the four evaluations carried out in 18 months (Table 3). There was no change in these variables, thus remaining with this ability. The null model $p<0.05$ for all activities evidenced that there was change over time in the ability to perform all activities except sitting independently, where the change in ability was not significant at 18 months.

Table 1. Baseline sample characteristics

Variables	
Time since stroke onset (months), mean ± SD	90.6 ±59.1
Age (years), mean ± SD	63.9 ±16.8
Type of stroke	
Ischemic, n (%)	55 (74)
Hemorrhagic, n (%)	10 (14)
Couldn't answer, n (%)	9 (12)
Perform physiotherapy	
No, n (%)	44 (57)
Make use of orthosis	
No, n (%)	46 (60)
Comorbidities	
Yes, n (%)	57 (76)
Smoking	
Smoker, n (%)	7 (9)
Smoked and stopped, n (%)	14 (19)
Habitual Walking Speed - 10 meters walk test (m/s), mean ± SD	0.8 ±0.3
Human Activity Profile (HAP) - adjusted activity score, mean ± SD	40.9 ±25.8
Duke Activity Status Index, mean ± SD	26.8 ±14.7
International Scale of Self - Efficacy for Falls, mean ± SD	28.8 ±10.7
The Mini Mental State Examination, mean ± SD	24.7 ±3.1

SD- standard deviation

Although there was a transition in speech and comprehension skills in 18 months, the ability the individual had at baseline did not influence this transition. As for walking, going out independently, and going to the bathroom, having the ability at baseline contributed to maintaining it over time. In these same activities, there was a transition during the follow-up of

Table 2. Description of the percentage of individuals who were able to perform activities related to functional behavior throughout the follow-up

Variable	Baseline (n= 77)	6 months (n= 68)	12 months (n= 63)	18 months (n= 62)
Walk independently n (%)				
Yes	74 (96%)	64 (94%)	61 (97%)	60 (97%)
Goes out independently n (%)				
Yes	55 (72%)	47 (70%)	48 (76%)	47 (76%)
Sit independently n (%)				
Yes	76 (99%)	66 (99%)	62 (98%)	61 (98%)
Speak n (%)				
Yes	76 (99%)	66 (99%)	61 (97%)	60 (97%)
Reach n (%)				
Yes	77 (100%)	67 (100%)	63 (100%)	62 (100%)
Feed independently n (%)				
Yes	77 (100%)	67 (100%)	63 (100%)	62 (100%)
Use bathroom independently n (%)				
Yes	71 (92%)	62 (93%)	57 (92%)	57 (92%)

of individuals in the variables walks independently, goes out independently, and uses the bathroom independently. Individuals who performed the activity at baseline remained able to perform them, and the individuals who did not perform them and remained in the study acquired the ability to perform them over the course of 6, 12 and 18 months.

The overall Odds Ratio of the significant model indicates that, even with the sample losses, individuals without the motor skills at the beginning have a chance of acquiring them over 18 months, with the highest chances observed in speech and comprehension and toilet skills.

Table 3. Generalized Estimation Equation to verify the transition of functional skills at 18 months

Activities	Null Model p -value	Baseline p-value	6 months p-value	12 months p-value	18 months p-value	Odds Ratio (IC95%)
Walk independently	<0.0001	<0.000	0.001	<0.000	<0.000	2.34 (1.94 – 5.67)
Goes out independently	<0.0001	<0.000	0.038	0.018	0.014	6.41 (3.56 – 9.43)
Sit independently	0.0953	0.659	0.324	0.549	0.976	1.45 (0.65 – 8.97)
Speak	<0.009	0.481	0.06	0.025	0.019	7.48 (4.56 – 10.67)
Use bathroom	<0.001	<0.000	0.025	0	0	6.51 (4.76 – 9.65)

DISCUSSION

This is the first study that followed the functional behavior of individuals with chronic stroke over 18 months as far as we know. After this period of longitudinal follow-up, the present study found that most functional abilities were maintained throughout the follow-up. After 18 months of follow-up, the most pronounced restriction by the individuals was the difficulty in going out independently; at the baseline with 28.6% and at the end of the study with 24.1%. The result obtained in this study is in agreement with Palstam,[22] who observed for 5 years post stroke individuals and noticed that the main restrictions were in mobility, outdoor activities, and help from others.

According to Cabral,[23] complications of immobility and other causes such as intracranial hypertension and acute myocardial infarction accounted for 90% of deaths within 30 days, 100% of those who died within one year and 50% of those who died within 3 years. These findings demonstrated that mobility restrictions are present in individuals after stroke, as was observed in the present study.

In the study by Campos,[7] it was observed that the individuals who were already independent in the first month after stroke maintained their independence in 3 years. This demonstrates that the functional abilities could be maintained over time. The longitudinal study by Cabral[9] observed that after the first year of the stroke event that only 20% of survivors became disabled.

The individuals after stroke tend to maintain their level of functionality after one year of the event. These studies corroborate

the findings of the present study in which the individuals after stroke maintained their levels of functionality during the eighteen months of follow-up.

Recently, Yumei[24] found a disability rate of 63.8% at baseline the individuals after acute stroke and one of the factors that the study associates with the high rate is the age of these individuals, since older age is associated with worsening functional outcome and greater difficulty in changing the functional status of individuals. The study showed 32.5% of the individuals after stroke aged between 60 and 69 years. In the present study the individuals after stroke presented an average age of 63.9. In the present study, individuals after stroke had an average age of 63.9 years, despite not having a disability rate, the individuals in the present study had no changes in their functional status. One hypothesis for this is the chronicity of the disease, in which the functional status stabilizes.

In the variable speaking and being understood, a decrease in the percentage was found with a lower number of speaking individuals at the end of the study. With that, due to the social isolation arising from the pandemic, measures of social distancing made it difficult to access rehabilitation and increased stressors and impacting the rehabilitation process of individuals as also observed by Sylaja.[25] In that the interruption of rehabilitation in individuals after a sudden stroke leads to changes in walking, difficulties in maintaining care with health professionals such as speech therapists and occupational therapists, due to the prioritization for the care of individuals contaminated by SARS-CoV-2/COVID-19.

It was found that the individuals who participated in the present study were already able to perform most of the variables independently in the baseline. What can justify the fact that the individuals in this study did not have a significant change in the performance of the activities mentioned above is due to the chronic phase of the stroke, as mentioned by Campos.[7] In which after one year after the event of the health condition there are no significant improvements in their functional picture, causing this stabilization to occur.

This study showed an increase in individuals walking independently and leaving the house independently after 18 months. It is believed that this is due to the pandemic and rehabilitation activities being suspended, with less social interaction between individuals. It is understood that those who were independent enough to walk remained active indoors so as not to lose their independence. According to Palstam[22] who conducted a five-year follow-up with individuals after stroke, the individuals which were able to move independently without assistance, both indoors and outdoors, also felt socially supported, and have returned to their work.

At the end of the study, a retention rate of 81% was found, which is defined as the number of individuals who remained in the study as a proportion of the total number of participants recruited at the initial assessment. The study ended with 62 subjects at 18 months. According to Polese et al.[26] the recruitment and retention rate in individuals after chronic stroke is low. Low recruitment and retention rates are a concern because they can affect the validity of the results.[27,28]

This study has great clinical relevance. It contributes new knowledge about the functionality over time of this health condition, so that there are new possibilities for interventions and treatments for these individuals who have already been affected and even as a way of preventing a decline in functionality. As a way of encouraging the practice of physical activity for those with a lower level of functionality, the use of cellular devices to monitor step counts is already recommended in the literature.[29] The use of a questionnaire that assesses functional capacity by telephone for post-stroke individuals has also been validated. In order to reverse the functional status of these individuals.[30]

In our study there was an information bias (memory) of the individuals, due to the research variables being based on the individual's recollection. This was expected from the beginning of the study due to the longitudinal design, that is, this bias is inherent in this type of study, as can be seen in Bedaque.[31]

CONCLUSION

Thus, after carrying out the follow-up over 18 months and evaluating the functional behavior of individuals who were in their chronic post-stroke phase, we can conclude that they have maintained their functional behavior in most cases, and we can say that they have reached a plateau in their health condition.

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