Walking capacity, performance, and confidence as predictors of falls in post-stroke individuals

Capacidade, desempenho e confiança da marcha como preditores de quedas em indivíduos pós–acidente vascular encefálico

Capacidad de la marcha, rendimiento y confianza como los predictores de caídas en personas pos accidente cerebrovascular

Patrick Roberto Avelino[1,2], **Kênia Kiefer Parreiras de Menezes**[2,3], **Maria Tereza Mota Alvarenga**[2], **Aline Alvim Scianni**[2].

ABSTRACT | This study aims to assess the correlation between walking capacity, performance, and confidence and the number of falls in post-stroke individuals, in addition to investigate which of these walking-related variables could predict falls in this population. In total, 95 post-stroke individuals were evaluated according to the number of falls in the last year and walking capacity (10-meter walk test), walking performance (ABILOCO-Brazil) and walking confidence (modified Gait Efficacy Scale). Pearson''s correlation coefficient was used to assess the correlations between variables. Multiple linear regression was used to assess whether walking-related variables can predict falls in post-stroke individuals. No significant correlations were found between capacity (*p*=0.87) and walking performance (*p*=0.06) and number of falls. A significant, negative correlation, with moderate magnitude, was found only between walking confidence and falls (*r*=−0.43; *p*<0.01). In the regression analysis, only walking confidence remained in the model (*p*<0.01) as a predictor of the number of falls in post-stroke individuals, explaining 18% (R²=0.18) of this variable. Thus, this study results demonstrated that only walking confidence is directly related to the number of falls in post-stroke individuals, which is also the only variable that can be considered a predictor of this event in this population.

Keywords | Gait; Accidental Falls; Stroke.

RESUMO | O objetivo deste estudo foi avaliar a correlação entre capacidade, desempenho e confiança da marcha e número de quedas em indivíduos após sofrerem acidente vascular encefálico (AVE), além de investigar quais dessas variáveis relacionadas à marcha poderiam predizer as quedas nessa população. Foram avaliados 95 indivíduos pós-AVE, de acordo com número de quedas no último ano e capacidade de marcha (por meio de teste de caminhada de 10 metros), desempenho na marcha (pela aplicação do questionário ABILOCO-Brasil) e confiança na marcha (pela análise de *modified gait efficacy scale*). O coeficiente de correlação de Pearson foi utilizado para avaliar as correlações entre as variáveis. A regressão linear múltipla foi aplicada para avaliar se as variáveis relacionadas à marcha são capazes de predizer as quedas em indivíduos pós-AVE. Não foram encontradas correlações significativas entre capacidade (p=0,87) e performance na marcha (p=0,06) e número de quedas. Correlação significativa, negativa, de magnitude moderada, foi encontrada somente entre confiança na marcha e quedas (*r*=−0,43; p<0,01). Na análise de regressão, apenas a confiança na marcha permaneceu no modelo (p<0,01) como preditora do número de quedas em indivíduos pós-AVE, sendo capaz, sozinha, de explicar 18% (R²=0,18) dessa variável. Assim, os achados do estudo demonstraram que apenas a confiança na marcha está diretamente relacionada com o número de quedas em indivíduos pós-AVE, sendo essa também a única variável que pode ser considerada preditora desse evento nessa população.

Descritores | Marcha; Acidente por Quedas; Acidente Vascular Cerebral.

[1]Faculdade de Santa Luzia (FACSAL) – Santa Luzia (MG), Brazil. E-mail: patrickpk4@yahoo.com.br. ORCID-0000-0002-7248-4767
[2]Universidade Federal de Minas Gerais (UFMG) – Belo Horizonte (MG), Brazil. E-mail: mtmalvarenga@outlook.com. ORCID-0000-0002-5536-8035
[3]Fundação Comunitária de Ensino Superior de Itabira (Funcesi) – Itabira (MG), Brazil. E-mail: keniakiefer@yahoo.com.br. ORCID-0000-0002-9906-9555

RESUMEN | El objetivo de este estudio fue evaluar la correlación entre la capacidad de la marcha, rendimiento y confianza con el número de caídas en personas después del accidente cerebrovascular (ACV), además de identificar las variables relacionadas con la marcha que podrían predecir caídas en esta población. Se evaluó a un total de 95 personas pos-ACV de acuerdo al número de caídas en el último año y la capacidad de la marcha (por medio de la prueba de caminata de 10 metros), el rendimiento de la marcha (aplicando el cuestionario ABILOCO-Brasil) y la confianza en la marcha (por el análisis de *modified gait efficacy scale*). Para evaluar las correlaciones entre variables, se utilizó el coeficiente de correlación de Pearson. Para determinar si las variables relacionadas con la marcha pueden predecir caídas en personas pos-ACV, se aplicó regresión lineal múltiple. No se encontraron correlaciones significativas entre la capacidad (p=0,87) y rendimiento de la marcha (p=0,06) con el número de caídas. Se encontró únicamente una correlación negativa significativa de magnitud moderada entre la confianza en la marcha y las caídas (r=−0,43; p<0,01). En el análisis de regresión, solamente la confianza en la marcha permaneció en el modelo (p<0,01) como la predictora del número de caídas en personas pos-ACV pudiendo explicar, por sí sola, el 18% (R²=0,18) de esta variable. Los hallazgos del estudio demostraron que la confianza en la marcha fue la única variable que estuvo directamente relacionada con el número de caídas en personas pos-ACV, además de ser la única predictora de caídas en esta población.

Palabras clave | Marcha; Accidentes por Caídas; Accidente Cerebrovascular.

INTRODUCTION

A cerebrovascular accident (CVA) is defined as an acute neurological dysfunction with rapid onset of symptoms—which has a vascular origin and may vary according to the affected region of the brain[1]. With high mortality, the CVA is responsible for producing significant physical, psychological, cognitive, and social deficits in affected individuals, resulting in high morbidity and disability rates, especially for older adults[2]. CVA impairs the body's structures and functions and, as a result, the individual may have difficulties to perform basic activities of daily living[3], generating different public health problems, such as falls[4]. Consequences of falls are serious for the health of these individuals, including fractures, major injuries, pain, fear of falling or post-fall syndrome, institutionalization and even death[5].

Gait is a factor directly associated to falls, since if an individual with a CVA has a reduction in gait speed, this can be considered a causal factor for falls[6]. According to the International Classification of Functioning, Disability and Health (ICF), the concept of locomotion or gait is the ability to move while standing on a surface, so that one foot is always on the ground, as when walking, walking slowly, walking forwards, backwards or sideways[7]. There are two significant qualifiers for gait assessment, which are capacity and performance[7]. Capacity describes the ability of an individual to perform a task or an action and, to assess it, it is necessary to have a "standardized" environment to neutralize the variable influence of different environments[7]. On the other hand, performance describes what the individuals do in their usual living environment, that is, the "involvement in a life situation" or "the lived experience" of people in the context in which they live[7]. Both should be considered during gait assessment, as they provide additional information about the patient's condition.

Another significant factor that must be evaluated in the gait of individuals with CVA, and which may be directly related to falls, is trust, since individuals who limit their activities because of fear of falling, particularly increase the risk of becoming fallers[8]. Confidence in gait can decrease after a stroke, due to a set of limitations that restrict mobility and the ability to perform daily life tasks. Thus, individuals with low self-confidence tend to focus more on their limitations and deficiencies[9], changing their perception of the risk of falling and increasing its incidence.

There are previous studies investigating the relationship between gait and falls in post-stroke individuals. Faria et al.[10] aimed to compare hemiparetic patients with and without a history of falls in the last six months, according to the components of the ICF and, specifically for gait speed, no significant difference was found between fallers and non-fallers. Another study, with 23 post-stroke individuals, aimed to verify the relationship between gait speed and self-efficacy for falls, finding no significant correlation between both measures[11]. The study by Harris et al.[12] investigated the relationship between mobility and falls in 99 post-stroke individuals, also without finding mobility as an explanation for the risk of falls in this population. Although studies suggest that gait is not related to falls, all studies evaluated such activity

through its ability, and no previous studies were found that investigated gait as a predictor of falls, including measures of performance and confidence.

Such results could help professionals to determine if there is a correlation and, if so, which factor contributes most to the reduction in the number of falls in this population, prioritizing their treatment during the rehabilitation process. Thus, the aim of this study was to evaluate the correlation between gait capacity, performance and confidence and the number of falls in post-stroke individuals, in addition to investigating which of these variables related to gait could predict falls in this population.

METHODOLOGY

Study design

This is an observational, cross-sectional study.

Participants

The recruitment period for participants was from August 2018 to March 2020, selected from members of the community in general. Inclusion criteria were: (1) individuals of both sexes, with no age restriction; (2) patients diagnosed with stroke and more than six months post-injury; and (3) being able to walk and answer questionnaires. Participants who had any other neurological or musculoskeletal conditions that could interfere with the tests were excluded.

Procedures

After the initial collection of the participants' demographic and clinical data, the inclusion criteria and signature of the informed consent form were analyzed. Subsequently, participants were asked the number of falls in the last year, and measures of gait ability, performance and confidence were collected. All collections were performed at the Laboratory of Neurology at the Universidade Federal de Minas Gerais.

Gait ability
The ability to walk was assessed using the 10-meter walk test[13]. The test was performed on a flat surface, and the time needed to travel the central 10 meters was recorded in seconds using a digital stopwatch and used

to calculate the individual's usual speed, reported in m/s. Standardized instructions for performing the test were always provided by the same examiner[14].

Gait performance
To measure gait performance, the ABILOCO-Brasil[15] questionnaire was used. The questionnaire contains 13 items about walking in different everyday situations, and is conducted in the form of an interview, at which time participants were asked to rate their perceptions, according to the answers "Impossible" or "Possible" (impossible=0, possible=1)[15,16]. After the end of the interview, the answers were submitted to online analysis on the website www.rehab-scales.org, which converted the raw scores into a linear measure (*logits*)[15,16].

Gait confidence
Gait confidence was assessed using the modified gait efficacy scale (mGES), a 10-item scale that assesses the individual's perception of their level of gait confidence in challenging circumstances[17,18]. Items are rated individually on a 10-point Likert scale, in which a score of 1 represents "no confidence at all" and a score of 10 represents "complete confidence", thus making scores from 10 to 100. The higher the score achieved by the individual, the greater the confidence in their mobility ability[18].

Sample calculation

The sample size calculation was performed based on regression analysis, which considered the inclusion of three independent variables (ability, performance and confidence in walking). According to the formula n=30+10k, where k is the number of possible predictor variables to be included[19], the minimum sample to be considered in the study is 60 individuals.

Statistical analysis

Descriptive statistics and normality tests (Kolmogorov-Smirnov) were performed for all variables. Pearson's correlation coefficient was used to assess correlations between gait measures (ability, performance and confidence) and the number of falls. The strength of the correlations was classified as low ($r<0.30$), moderate ($0.30 \leq r \leq 0.50$) and high ($r>0.50$)[20]. Multiple linear regression was used to assess which gait variable (ability, performance and confidence) best predicts falls. All analyses were performed using SPSS 23.0 statistical software with a significance level of 5%.

RESULTS

Out of 714 individuals, 619 could not be contacted, refused to participate, or did not meet the inclusion criteria. Thus, 95 individuals participated in the study, 38 men (40%). The mean age of participants was 67 years (SD=13), with a predominance of ischemic stroke (76%), and a mean onset time of 30 months (SD=27). Table 1 shows the detailed characteristics of the participants.

Table 1. Characteristics of the participants (n=95)

Age, years, mean (SD)	67 (13)
Sex, man, number (%)	38 (40)
CVA type, number (%)	
Ischemic	72 (76)
Haemorrhagic	16 (17)
Unknown	7 (7)
Affected side, number (%)	
Right	52 (55)
Left	43 (45)
Number of episodes, number (%)	
1	63 (66)
>1	32 (34)
Onset time, months, average (SD)	30 (27)
Walking speed, m/s, average (SD)	0.79 (0.27)
Gait performance, ABILOCO (*logits*), average (SD)	2.95 (2.31)
Gait confidence, mGES (0-100), average (SD)	69 (22)
Number of falls, mean (SD)	1.15 (3.62)

SD: standard deviation; CVA: stroke; mGES: modified gait efficacy scale.

Significant correlations between capacity (p=0.87) and gait performance (p=0.06) and number of falls were not found. Significative, negative, of moderate magnitude correlation was only found in gait confidence and falls (r=−0.43; p<0.01). In the regression analysis, only gait confidence remained in the model (p<0.01) as a predictor of the number of falls in post-stroke individuals, explaining 18% (R^2=0.18) of this variable (Table 2).

Table 2. Regression analysis of possible gait-related variables as predictors of the number of falls (n=95)

Model	B (SD)	B	R2 adjusted	SEE
Model 1				
Constant	5.47 (1.02)	-	-	-
Gait confidence	−0.07 (0.01)	−0.43	0.18	3.29

SD: standard deviation; SEE: standard error of estimate.

DISCUSSION

This study aimed to evaluate the relationship between gait ability, performance, and confidence and the number of falls in post-stroke individuals, in addition to investigating which of these three gait-related variables could predict falls in this population. The results showed that there was a significant correlation only with gait confidence, which is also the only variable that can be considered a predictor of the number of falls in post-stroke individuals.

Similar to previous findings in the literature, this study also did not find a significant correlation between gait ability, assessed by gait speed, as well as previous studies and falls[10-12]. Gait speed measurements are often used to measure the capacity of post-stroke individuals[14]. However, walking, especially in the community, requires gait adaptation in adverse conditions, with attentional demands and performing additional tasks, for example, carrying a bag[21], components not included in the gait speed test or in ABILOCO-Brasil, performance measure which also did not show a significant correlation with falls. The recovery of walking after a stroke, directly related to performing such activity without the presence or with the fewest possible number of falls, is complex, and requires not only gait speed, but mainly the ability to perform more complex walking tasks in diverse environments[21], since capacity is not measured in an individual's real-life environment, but in a standardized environment. In addition, although ABILOCO assesses performance in different activities in the patient's real-life environment, this instrument assesses the perception regarding the possibility of performing or not certain tasks[16], but does not estimate their perception regarding the level of difficulty or confidence of the patients in the suggested activities.

Regarding gait confidence, the only variable that showed a significant correlation and the only predictor found in the study, this is an ability that can precede the actual ability and influence the performance of daily activities[22]. In post-stroke individuals, even if they manage to increase gait speed, it may be that this improvement is not transferred to the home environment or to community walking, due to low confidence[18]. Individuals with low gait confidence also demonstrate lower performance[18]. The loss of confidence in gait generates fear of falling and, as a result, individuals restrict their daily activities,

generating a cycle that starts with fear and results in restriction, which consequently leads to decreased muscle strength and balance deficit, generating even more disabilities and greater risk of falls[23].

The main positive point of this study is the realization of an unprecedented research, which fills an important gap in the literature, with the use of low-cost, easy-to-handle, quick-to-apply instruments, with appropriate measurement properties and that can be used in the home environment. However, the use of a convenience sample is the main limitation of this article. Although this sample was large and drawn from many different locations, it was not randomly selected and therefore may not be fully representative of the general population.

CONCLUSION

The study findings showed that only gait confidence is directly related to the number of falls in post-stroke individuals, which is also the only variable that can be considered a predictor of this event in this population. Thus, rehabilitation, which aims to reduce the number of falls in post-stroke individuals, should focus on a plan that includes, mainly, training capable of increasing confidence in this activity, since gains only in capacity and performance possibly will not be able to significantly improve the number of falls in these individuals.

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