DOI: 10.590/1809-2950/14484522022015

Gait speed and falls self-efficacy in individuals with hemiparesis after stroke

Velocidade de marcha e autoeficácia em quedas em indivíduos com hemiparesia após Acidente Vascular Encefálico

Velocidad de marcha y autoeficacia para las caídas en los sujetos con hemiparesia tras Accidente Cerebrovascular

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ABSTRACT | It is common that individuals after stroke show changes in the gait pattern, imbalance and more susceptibility to falls. This study aimed to assess the relationship between gait speed and self-efficacy for falls in hemiparetic subjects. The sample was composed of 23 individuals with hemiparesis due to stroke with a mean age of 60.6±11.26 years and 53.2±35.4 months of stroke evolution time. Participants were assessed for falls self-efficacy by the questionnaire Falls Efficacy Scale- International (FES-I). The normal and fast gait speed was calculated using the time spent to walk 10 meters. To verify the relationship between the FES-I and the gait speed were applied association and correlation tests. Among the participants, 39.1% used walking device and 30.4% reported falls in the previous year. The FES-I average was 30.3±8.4 points, the normal gait speed was 0.72±0.28m/s and fast gait speed was 1.00±0.40m/s. Participants were able to significantly modify the gait velocity (speed difference: 0.27±0.16m/s; paired t test: p<0.001). There was no correlation or association between the FES-I and the gait speed. A correlation was found between the FES-I and age (r=0.541; p=0.008); and association between use of walking device, both normal (p=0.048) and fast (p=0.037) gait speed. Although most individuals with hemiparesis from this study presented low self-efficacy for falls, yet they are able to modify the gait speed.

Keywords | Stroke; Gait; Self Efficacy; Accidental Falls.

RESUMO | Indivíduos após Acidente Vascular Encefálico (AVE) apresentam com frequência alterações no padrão da marcha, instabilidade e maior suscetibilidade para quedas. O objetivo deste estudo foi verificar a relação entre a velocidade de marcha e autoeficácia para quedas em indivíduos hemiparéticos. A amostra foi composta por 23 indivíduos com hemiparesia pós-AVE com idade média de 60,6±11,26 anos e tempo de evolução do AVE de 53,2±35,4 meses. Os participantes foram avaliados quanto ao senso de autoeficácia para quedas pelo questionário Falls Efficacy Scale – International (FES-I). A velocidade de marcha normal e rápida foi calculada pelo tempo despendido para percorrer 10 metros. Para verificar a relação entre a FES-I e a velocidade de marcha, foram aplicados testes de associação e correlação. Entre os participantes da pesquisa, 39,1% utilizavam dispositivo de auxílio para a marcha e 30,4% reportaram quedas no último ano. A média da FES-I foi de 30,3±8,4 pontos, e a da velocidade normal de marcha foi de 0,72±0,28m/s e rápida de 1,00±0,40m/s. Os participantes conseguiram modificar significantemente a velocidade da marcha (diferença da velocidade: 0,27±0,16m/s; Teste T pareado: p<0,001). Não foi verificada correlação ou associação entre a FES-I e a velocidade de marcha. Houve correlação entre a FES-I e a idade (r=0,541; p=0,008); e associação entre uso de dispositivo de auxílio para a

A study developed in the Movement Analysis Laboratory (MAL) of Doctor's and Master's Program in Physical Therapy from Universidade Cidade de São Paulo (UNICID) – São Paulo (SP), Brazil.
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marcha e maior lentidão na velocidade, tanto normal (p=0,048), quanto rápida (p=0,037). Apesar da maioria dos indivíduos com hemiparesia deste estudo apresentar baixa autoeficácia para quedas, estes ainda são capazes de alterar o padrão de marcha por meio da velocidade.
Descritores | Acidente Vascular Cerebral; Marcha; Autoeficácia; Acidentes por Quedas.

RESUMEN | Tras sufrir un Accidente Cerebrovascular (ACV) los sujetos tienen a menudo alteraciones en el patrón de la marcha, inestabilidad y aumento en la susceptibilidad para las caídas. En este estudio se buscó verificar la relación entre la velocidad de marcha y la autoeficacia para las caídas en los sujetos con hemiparesia. Participaron de la muestra 23 sujetos con hemiparesia pos-ACV teniendo promedio de edad de 60,6±11,26 años y un tiempo de evolución del ACV de 53,2±35,4 meses. Se evaluaron los participantes en relación al sentido de autoeficacia para las caídas utilizándose el cuestionario Falls Efficacy Scale – International (FES-I). Se calculó la velocidad de la marcha normal y rápida a través de la cantidad de tiempo empleado para recorrer 10 metros. Para verificar la relación entre la FES-I y la velocidad de la marcha se aplicó las pruebas de asociación y de correlación. Del total de participantes, un 39,1% hicieron uso del dispositivo de ayuda para la marcha y un 30,4% informaron que sufrieron caídas en el último año. El promedio de la FES-I fue de 30,3±8,4 puntos, y la velocidad normal de la marcha fue de 0,72±0,28m/s y la rápida 1,00±0,40m/s. Los participantes lograron cambiar significativamente la velocidad de marcha (la diferencia de la velocidad: 0,27±0,16m/s; Test T pareado: p<0,001). No se encontraron correlaciones entre la FES-I y la velocidad de marcha, pero hubo una correlación entre la FES-I y la edad (r=0,541; p=0,008) y una asociación entre el uso del dispositivo de ayuda para la marcha y la mayor lentitud en la velocidad tanto normal (p=0,048) como rápida (p=0,037). Aunque la mayoría de los sujetos con hemiparesia presentan baja autoeficacia para las caídas, todavía son capaces de modificar el patrón de marcha a través de la velocidad.
Palabras clave | Accidente Cerebrovascular; Marcha; Autoeficacia; Accidente por Caídas.

INTRODUCTION

Cerebrovascular accidents (CVA) are considered to be within the main causes for disability currently[1], and 80% of individuals who s uffer from start needing help to perform at least one functional activity[2]. After CVA take place, approximately 40% of individuals cannot walk independently in their communities[3], and they remain dependent on help for walking even after a significant global improvement with rehabilitation[2]. Sequelae such impaired motor coordination, restricted range of articular movement, spasticity, muscular weakness, sensory deficits, and cognitive alterations[4,5] affect body balance and orientation, leading to instability, altered gait, and falls in that population[6,7].

Gait in hemiparetic/hemiplegic individuals is typically characterized by reduced range of articular movements, lower speed, asymmetry in body weight transference, increased swing stage, instability in the support phase, higher energy spending, damaged rhythm, and slowed down adaptive adjustments due to distractions in the environment[7,8]. In a study that was conducted with post-CVA subjects during the chronic stage, a direct relationship was found between functional limitations and slowed gait, both in regards to household and community ambulation[9]. Hemiparetic individuals are found to have normal gait speeds that are approximately lower than half the speeds from healthy individuals[7,10]. Thus, gait speed has become an important, sensitive, and reliable marker for the functional deficit severity in post-CVA subjects[9,11].

Post-CVA gait alterations, combined with improper automatic reactions of protection in the affected hemibody, increase the prevalence of falls in that population[7]. Regardless of how severe lesions are, falls, their repeated occurrences, and the concern with new lesions and disabilities are factors that contribute to the development of a fear of falling[12,13]. Fear of falling may be defined as the concern with falling due to lost confidence (loss of self-efficacy sense) in body balance and mobility, which results in restricted daily activities[14]. In some cases, the fear of falling may be beneficial, as it promotes the execution of activities in a safer way[14]. However, most individuals are prone to a cycle which is started by fear, and it results in restricted activities, which in turn lead to diminished muscle strength and imbalance. That again leads to increased disability[14], and, also, to a higher risk of new falls.

Despite all the gait alterations and difficulties which are imposed by CVA, hemiparetic individuals are capable of adopting compensatory strategies that aim to improve their gait performances and to increase their

speeds[15] Self-efficacy sense in regards to falling may be one of the factors which determine the adoption of those strategies. In a study with 31 post-CVA subjects, a positive correlation between the falls self-efficacy sense and the maximum gait speed was verified[16]. That complex relationship between the fear of falling and gait speed has not been fully understood for post-CVA individuals. Its understanding may help map cases which deserve, besides conventional rehabilitation, a behavioral intervention that aims to increase the self-efficacy sense, and to improve gait independence in the process. Thus, this study aimed to check for a relationship among a falls self-efficacy sense, normal and fast gait speeds in post-CVA hemiparetic subjects.

METHODOLOGY

This research is a cross-sectional observational study which was approved by the Ethics Committee in Universidade Cidade de São Paulo, protocol no. 0049.0.186.000-06.

The convenience sample comprised hemiparetic subjects undergoing physical therapy treatment. To be included in the study, subjects had to fit a hemiparetic profile that was due to a single CVA event and ambulation either assisted or not by walking aids. The following subjects were excluded: The ones with bilateral or cerebellar CVAs, receptive aphasia and/or dementia which prevented simple orders from being understood, subjects dependent on wheelchairs, or subjects with other gait-interfering neurological or musculoskeletal diseases. Eligible subjects received information on the research, and the ones who were willing to take part signed a Consent Form (*Termo de Consentimento Livre e Esclarecido*).

The following data were collected through interviews with participants: gender, age, schooling, number of reported diseases, number of medications used, CVA progression time, hemiparetic side, history of fall over the previous year, use of walking aid devices, and mental state, through a Mini Mental State Examination (MMSE)[17].

In order to analyze gait speed, a 10-meter walking test was used, due to its convenience to clinical use and its robust psychometric quality in the evaluation of patients with neurological conditions[18]. The times required to travel 10 meters with normal and fast speeds were measured. A 14-meter course was marked with adhesive tape in a plane surface, the first and last meters of which being discarded, as they regarded gait speeding up and down periods. For subjects to be analyzed for their normal speeds, they were given the following verbal command: "when I say so, walk straight at a comfortable and safe speed"; for the fast speed, they were given the command, "imagine a bus is going by across the street and you need to catch up with it. When I say go, walk straight in a safe way, the fastest you can and without running". A single attempt was performed for each speed, in the order from normal to fast speeds, and individuals had shoes on and they were allowed using walking aids, in case they were used to it. The rater remained close to participants during the course in order to ensure their safety. Normal (m/s), fast (m/s) speeds, and the difference between speeds (m/s) were calculated through the use of distance (10 meters) and required times (seconds).

In order to check for self-efficacy in regards to falling, Falls Efficacy Scale International (FES-I) was used, in a version that had been translated and validated to Portuguese[19]. FES-I was developed to help elderly people; however, currently it is commonly applied in studies with post-CVA patients[12,20,21]. The questionnaire evaluates a subject's concern about falling during the performance of 16 tasks. In case a task is not performed, subjects have to answer how they would feel in regards to falling whilst doing that activity. Each activity has four alternatives, with scores from 1 (not a bit concerned) to 4 (extremely concerned). The total score ranges from 16 to 64 points; the higher the score, the lower the self-efficacy sense. The total score was used for this study; the ≥23-point classification meant a risk of sporadic falls, and the ≥31-point one for the risk of repeated falls[19]. The score was divided in low (<23 points) and high (≥23 points) concern[22].

Statistical analysis

A descriptive analysis of data was conducted through central trend frequencies and measures. The data were found to be normalized through Shapiro-Wilk test, and thus parametric tests were applied in the inference analysis. Independent T sample tests and/or ANOVA were used for the comparison among quantitative variables FES-I total score and gait speeds with FES-I classification variables risk of falling, FES-I concern, history of falls, hemiparetic side, and walking aid. Paired T test was applied in order to verify whether there were differences between normal and fast speeds. Pearson

product-moment correlation coefficient was used to test for correlations between FES-I and age, CVA time, normal gait speed, fast gait speed, and difference between speeds, considering r=0.90 - 1.00 as a very high correlation, 0.70 - 0.89 as high, 0.40 - 0.69 as moderate, 0.20 - 0.39 as slight, and 0.00 - 0.19 as none to slight correlation[23]. The statistical analyses were conducted through SPSS software, version 17, with a 5% significance.

RESULTS

The sample comprised 23 post-CVA hemiparetic subjects, most of which men (73.9%) of average 60.6±11.26 year of age (min-max: 33-89 years), and CVA progression time of 53.2±35.4 months. Among those who used walking aids (39.1%, n=9), 88.8% (n=8) used simple canes, and a single subject used forearm crutches. In regards to falls, 57.1% of subjects were found to fall sporadically and 42.9% of them reported repeated falls. The data for sample characterization are shown in Table 1.

Table 1. Characteristics of post-CVA hemiparetic subjects (n=23)

Variable	Average (SD)	N (%)
Gender		
Feminine		6 (26.1)
Masculine		17 (73.9)
Age (years)	60.6 (11.2)	
Schooling		
Incomplete elementary schooling		6 (26.1)
Complete elementary schooling		6 (26.1)
Incomplete high school education		2 (8.7)
Complete high school education		6 (26.1)
College schooling		3 (13.0)
Hemiparetic side		
Right		11 (47.8)
Left		12 (52.2)
CVA time (months)	53.2 (35.4)	
No. of diseases	1.3 (0.9)	
No. of medications	3.4 (2.0)	
Falls in the previous year		
Yes		7 (30.4)
Walking aid		
Yes		9 (39.1)
MMSE	24.0 (4.5)	

FES-I average was 30.3±8.4 points (min-max: 19-50 points), and not differences were found in regards to the right (30.0±8.6 points) and left hemiparetic sides (30.0±8.5 points) (p=0.842). Most hemiparetic subjects (87.0%, n=20) were found to be highly concerned with falls according to FES-I. In the FES-I classification for risk of falling, 10 subjects (43.7%) reached scores for risk of repeated falls, 10 (43.7%) for risk of sporadic falls, and 3 (12.6%) were found to reach the no risk category.

The average normal gait speed of subjects was 0.72±0.28m/s (min-max: 0.10-1.42m/s), and the average fast speed was 1.00±0.40m/s (min-max: 0.16-2.00m/s). No differences were found in regards to cases of right or left hemiparesia concerning normal gait speed (p=0.505) and fast speed (p=0.648). Hemiparetic subjects were able to significantly change their gait speed from normal to fast (speed difference: 0.27±0.16m/s; p<0.001).

Total FES-I score was found to have a significant moderate positive correlation with age (r=0.541; p=0.008), but no correlation was found among normal speed (p=0.383), fast speed (p=0.327) speed difference (p = 0.404), and CVA time (p=0.669). Neither the normal nor the fast speed was found to have a significant correlation with age (p=0,502; 0,583) , or CVA time (p=0,756; p=0,780).

No statistical differences were found between total FES-I averages for subjects with or without history of falls (p=0.778), or for those with or without use of walking aids (p=0.774) (Table 2). No statistical differences were found in the averages for normal or fast gait speeds with the history of falls (p=0.928; p=0.973); FES-I classification regarded risk of falling (p=0.485; p=0.634) and degree of concern through FES-I (p=0.560; p=0.413). Subjects who used walking aids were found to have slower speeds, both for normal (p=0.048) and fast (p=0.037) gait speeds, as compared to the ones who walked with no aids (Table 2).

Table 2. Association among variables with gait speeds and FES-I in post-CVA hemiparetic subjects (n=23)

Variable	Normal speed	Fast speed	FES-I total score
	Average±SD		
*History of falls			
no	0.74±0.30	≠1.04±0.43	30.68±8.44
yes	0.67±0.26	0.89±0.32	29.57±9.01
**FES-I risk of falling			
no risk	0.68±0.16	1.08±0.17	
sporadic falling	0.80±0.38	1.06±0.16	-
repeated falling	0.65±0.19	0.90±0.09	
*FES-I concern			
low concern	0.68±0.16	1.00±0.30	
high concern	0.73±0.30	0.99±0.42	-
*Walking aid			
no	0.81±0.29***	.13±0.40***	29.92±8.66
yes	0.57±0.22	0.78±0.30	31.00±8.51

*Test T, **ANOVA , *** p<0.05

DISCUSSION

This study revealed that most hemiparetic subjects were found to have a low falls self-efficacy sense, regardless of their history of falls and gait speeds. Corroborating this research, a study with 52 subjects in the chronic post-CVA phase found that 82.7% of the sample were highly concerned with falling as per FES-I, and that result was not accompanied by the falling frequency[12]. Those data suggest that the self-efficacy sense in hemiparetic subjects is smaller[12] as compared to results with community elderly people[22,24]. The negative perception and the body changes which are caused by CVA, as well as the fear of future falls, contribute to the prevalence of a low self-efficacy sense in hemiparetic patients. It may result in a further declined functional ability, slow down the rehabilitation process, leading subjects to be hospitalized again[14].

There is a variation between the studies[7,11,25] in regards to the normal gait speed of hemiparetic subjects, from 0.45m/s to 0.78m/s, and fast speeds range from 0.62m/s to 1.25m/s. The speed parameters that were found in that study are within the expected average for post-CVA subjects[7,11,25]. Reference data for the comfortable gait among men range from 1.33m/s to 1.46m/s, and the ones for women, between 1.27m/s and 1.41m/s[26]. The subjects in this study could not reach the reference values for normal gait, not even when they executed the fast gait. These results reveal the negative impact of CVA in the ambulation of the subjects who comprised the sample in this study. However, a study with chronic hemiparetic subjects revealed that the 0.66m/s speed, the value which was reached by our sample, is enough for the independent gait in a community environment[11].

The ability to change gait speeds is required for individuals to meet environment and daily activity demands. In some situations, such as crossing a busy street or picking up a ringing phone, faster gait is required; walking in a crowded place, in turn, requires slower gait[27]. In this research, the significant difference between normal and fast gait speeds of hemiparetic subjects reveals the ability to adapt, the adjustments, and compensatory strategies during ambulation. The ability to modulate gait speed in post-CVA subjects is related to the ability to increase the power of plantar and hip flexors in the hemiparetic side[25].

In this study, post-CVA subjects who used walking aids were found to have lower gait speeds as compared to the ones who ambulated independently. Although they reduce gait speeds, walking aids increase the walking ability in community environments[11], increase stability, reduce energy spending, and can also prevent falls[28].

The result regarding the absence of correlation between FES-I and the gait speeds in this study differs from other studies with elderly people[24,29] and post-CVA subjects[16]. Such disagreements may be due the characteristics of the sample and the evaluation instruments that were employed in our study, as compared to other studies[16,24,29]. The size of the sample and the fact subjects are receiving physical therapy treatment are limitations in this study. Besides that, possibly, the high prevalence of concern with falls through FES-I in our sample and the resulting ceiling effect in the questionnaire may have also influenced results herein. Other studies[16,29] suggest that self-efficacy evaluation in regards to falls in post-CVA subjects or proper functioning elderly people is favored, rather than using questionnaires with activities which require higher balance and mobility demands, in order to avoid the ceiling effect. Thus, new research may examine the several falls self-efficacy instruments in order to detect the most sensitive of all, aiming to indicate the variations among post-CVA subjects.

Hemiparetic subjects are commonly said to be able to increase their gait speeds through rehabilitation. However, in many cases, that improvement is not seen as substantial in regards to household mobility and community ambulation[27]. That may be related to the fact those individuals are capable of walking, but their everyday performances are limited by their low self-efficacy sense. Thus, the subjective assessment of patients in regards to their self-efficacy sense complements some ability tests[16], such as the gait speed test, and it is an important tool for rehabilitation prognosis and planning.

CONCLUSION

This study found no relationship between gait speed and falls self-efficacy. However, the results showed that post-CVA subjects, despite their low falls self-efficacy, are capable of altering their gait speeds wherever their damaged sides are.

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