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The Ability to Manage Stairs for Chronic Stroke Survivors Improves with Increases in Physical Activity Levels

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Abstract

Background: The ability to manage stairs has been recognized as the best predictor of physical activity levels in the community, when compared to walking speed and walking capacity. In addition, one third of stroke survivors require some assistance to manage stairs at six and 12 months post-stroke. Therefore, the aim of this study was to compare the ability to manage stairs for a large sample of chronic stroke survivors, based upon by their physical activity levels.

Methods: The participants were recruited from the general community and had their general levels of physical activity assessed by the Human Activity Profile (HAP). Their physical activity levels were classified based upon their HAP's adjusted activity scores as impaired (<53), moderately active (53-74), or active (>74). The ability to manage stairs was determined by the stair ascent and descent cadences (stairs/s). One-way analyses of variance (ANOVAs), followed by LSD *post-hoc* tests, were employed to compare the differences between the groups regarding their stair cadences.

Results: Ninety-five chronic stroke survivors were evaluated with a mean age of 55.74 ± 12.3 years, a mean time since the onset of stroke of 64.4 ± 5.6 months, and a mean gait speed of 0.92 ± 0.35 m/s. Twenty five participants were classified as impaired, 53 as moderately active, and 17 as active. Thirteen participants used handrails to perform the stair tests, three from the impaired group and 10 from the moderately active group. ANOVAs revealed significant differences between the impaired, moderately active, and active groups for both stair ascent and descent cadencies [F=18.49 (2,92); p<0.01 and F=16.06 (2,92); p<0.01, respectively], indicating that increases in cadences were observed with increases in physical activity levels.

Conclusions: Chronic stroke survivors with different physical activity levels demonstrated different abilities to manage stairs. Increases in stair ascent and descent cadences were 3 observed with increases in physical activity levels.

Keywords: Stroke, Hemiparesis, Stair management, Physical activity levels

Introduction

Hemiparesis is the most common impairment after stroke and interferes with walking capacity and other motor activities of stroke survivors [1,2]. It is reported that approximately 50% of subjects after stroke remain dependent on others for some activities, 54% show limitations in carrying out activities of daily living, and 65% report restrictions in reintegration into community activities [3]. In this sense, rehabilitation programs for these individuals usually aim at primarily motor function improvements, so that they can satisfactorily return to life in the community [4]. Interestingly, a recent study reported the ability to manage stairs as the best predictor of physical activity levels in the community, when compared to walking speed and walking capacity [5]. This finding could be explained by the fact that the increased demands related to muscular strength, balance, coordination, and cardiorespiratory fitness are required to perform stair management, compared to other clinical measures [5]. Furthermore, the accessibility in many countries, such as Brazil, is limited and stairs are commonly found in most of the external places which are frequented by stroke survivors [6]. Additionally, it is well known that at least one third of stroke subjects still require some assistance to manage stairs at both six and 12 months after the onset of stroke [7,8]. Nevertheless, few studies have investigated aspects related to this activity, which could be better explored and emphasized within clinical contexts, due to its importance for the individuals' reintegration into community activities [9].

Given the need to use simple measurements, which are able to produce transferable information from clinical practice to societal life, the aim of this study was to compare the ability to manage stairs for a large sample of chronic stroke survivors, stratified by their physical activity levels.

Materials and Methods

Participants

Stroke survivors were recruited from the general community, based upon the following criteria: (1) had diagnoses of a unilateral stroke for at least six months; (2) were older than 20 years of age; (3) demonstrated residual muscular weakness and/or increased tonus of the lower limb; (4) had ability to walk with or without assistive devices; and (5) had no signs of cognitive deficits, as assessed by the cut off scores on the Mini-Mental Status Examination [10,11]. The participants were stratified into three groups, based upon their

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physical activity levels. All participants provided written consent, based upon approval from the University ethical review committee.

Instruments and procedures

Data were collected by trained researchers in the University laboratory, shortly after recruitment. Firstly, the participants underwent physical examinations and interviews for the collection of their demographic, anthropometric, and clinical data, such as age, gender, body mass, height, time since the onset of stroke, paretic side, and the use of medication. Additionally, their gait speeds were obtained, according to previous recommendations for characterization of their functional levels [12].

Physical activity levels

The Brazilian version of the Human Activity Profile (HAP) was used to determine the participants' physical activity levels [13]. This is a self-reported 5 questionnaire, which showed appropriate validity and reliability for individuals with stroke [13,14]. The HAP adjusted activity scores (AAS) provided information regarding the subjects' current activity levels. The physical activity levels were classified based upon the AAS as impaired (<53), moderately active (53–74), or active (>74) [15].

Ability to manage stairs

The participants' ability to manage stairs was assessed by their stair ascent and stair descent cadences, which demonstrated appropriate reliability values for stroke survivors [16,17]. The participants were asked to ascend and descend a flight of stairs with 30-second rest intervals, preferably in a step-through pattern. The stairs had six standardized dimension steps (110 cm wide, 15 cm high and 30 cm deep) with rails on both sides. Before starting, the subjects were allowed to decide whether or not to use the handrails. The times, in seconds, from the moment when the first foot left the ground until the second foot touched the ground on the last step were separately measured for both stair ascent and descent. The means of three trials were recorded and the cadences (stairs/sec) were calculated and stored for analyses [16].

Data analyses

Descriptive statistics and tests for normality (Kolmogorov-Smirnov or Shapiro- Wilk) and homogeneity of variance (Levene) were carried out for all outcome variables. One way analyses of variance (ANOVAs), followed by the least significant difference (LSD) *post-hoc* tests were carried out to investigate differences between the groups regarding their stair ascent and descent cadencies. All statistical analyses were performed with the SPSS for Windows (release 17.0) with a significance level of 5%.

Results

Ninety-five chronic stroke survivors, 48 men and 47 women, were assessed. They had a mean age of 55.74 ± 12.3 years, a mean time since the onset of stroke of 64.4 ± 5.6 months, and a mean gait speed of 0.92 ± 0.35 m/s. Their demographic, anthropometric, and clinical characteristics are reported in table 1. According to their HAP scores, 25 individuals were classified as impaired, 53 as moderately active, and 17 as active. Thirteen participants used handrails to perform the stair ascent and descent tests (three from the impaired group and 10 from the moderately active group).

Table 2 shows the comparisons between the impaired, moderately active, and active groups regarding their stair ascent and descent cadencies. As illustrated in Figure 1, between-groups differences were observed for both stair ascent and descent cadences [F=18.49 (2,92); p<0.01 and F=16.06 (2,92); p<0.01, respectively), indicating that increases in cadences were observed with increases in physical activity levels.

Characteristic	n=95
Age (years), mean (SD)	55.7 (12.3)
Gender, men (%)	51 (53.7)
Body mass index (Kg/m^2), mean (SD)	25.9 (4)
Paretic side, right (%)	54 (56.8)
Time since the onset of stroke (months), mean (SD)	64.4 (54.6)
Number of medications, mean (SD)	3 (2)
Associated pathologies, mean (SD)	2 (1)
Gait speed (m/s), mean (SD)	0.92 (0.35)

SD: Standard Deviation

Table 1: Demographic, clinical, and anthropometric characteristics of the participants.

Variable	Impaired	Moderately active	Active	F (p)
Stair ascent	0.67 (0.34)[a]	1.08 (0.40)[b]	1.37 (0.38)[c]	18.49 (<0.01)
(stairs/seg)	[0.18-1.59]	[0.43-2.07]	[0.64-2.17]	
Stair descent	0.66 (0.36)[a]	1.08 (0.47)[b]	1.50 (0.64)[c]	16.06 (<0.01)
(stairs/seg)	[0.15-1.53]	[0.24-2.20]	[0.65-2.75]	

Data are reported as means (standard deviations) and range [minimum-maximum]. For each line, different letters indicate statistically significant differences between the groups (p<0.05).

Table 2: Comparison of the stair ascent and stair descent cadences between the impaired (n=25), moderately active (n=53), and active (n=17) groups.

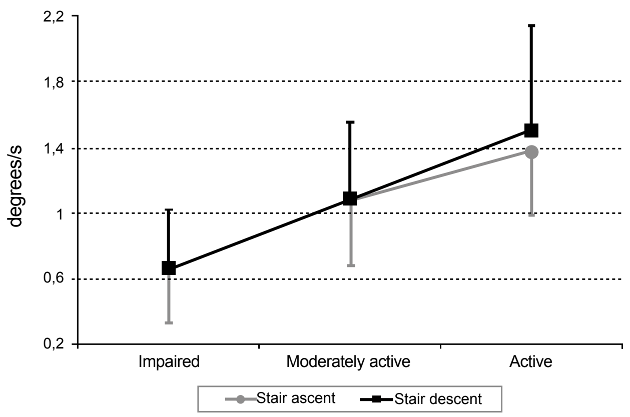

Figure 1: Stair ascent and descent cadences, in degrees/s, (means and standard deviations) for the impaired, moderately active, and active groups.

Discussion

To the best of our knowledge, this was the first study that described the ability to manage stairs for a large sample of chronic stroke survivors, considering their physical activities levels. The findings demonstrated that chronic stroke survivors demonstrated different abilities to manage stairs, according to their physical activity levels and higher cadences were found for higher levels of physical activity. Alzahrani et al. [5] evaluated people with chronic stroke and found cadences ranging from 0.13 to 1.60 stairs to perform both activities in sequence, i.e, stair ascent and descent. These values were similar to those found in the present study, but only for the impaired group (ranging from 0.15 to 1.59 stairs/sec). However, the 7 moderately active and active groups showed higher cadences. These differences may be explained by the higher functional levels of the participants in the present study, who walked at speeds of 0.92 m/s, compared to 0.80 m/s reported by Alzahrani et al. [5]. Faria et al. [17] reported similar values for the stair ascent and descent cadences, 1.13 and 1.11 stairs/s, respectively, to those found for the moderately active group of the present study (1.08 stairs/s for both tests). Despite that high incidence of falls in older adults during stair management was reported in previous studies and it has been suggested that handrail use could implement safety during the performance of this activity [18], only 13% of the participants in the present study chose to use the handrails to perform the tests, which may be explained by their high functional levels and the fact that the individuals were at chronic stages after stroke and were adapted to their physical conditions. Novak and Brouwer [19] observed that chronic stroke survivors had stair ascent and descent cadences reduced by 29%, independent of handrail use, compared to a control group of healthy people. Higher stair ascent and descent cadencies were found for the participants with higher physical activity levels. These findings corroborated those observed by Alzahrani et al. [20], who demonstrated that the ability to manage stairs predicted free-living physical activity in stroke patients. Better ability to manage stairs, i.e., higher cadences, could lead to better participation in community activities, since several places which are frequented by stroke survivors have stairs, such as churches, supermarkets, gyms, and parks. In addition, the ability to manage stairs was among the top five tasks, which community-dwelling older adults rated as being the most difficult to perform [21]. If physical disability is superimposed on normal aging, the ability to safely manage 8 stairs could be seriously affected, which could be a crucial factor related to the loss of independence in older adults [22]. As life expectancy of stroke survivors is increasing [23], this reinforces the need to address stair ability training in intervention programs to ensure the maintenance of functionality and community participation. Freedom to engage in physical activity in the community may be increased if attention is paid to improve the ability to manage stairs during rehabilitation post-stroke. However, interestingly, stair training has not been commonly included in community-based group programs for people with chronic stroke [24]. The findings of this study have some implications for stroke rehabilitation. Due to the importance of the retained ability to manage stairs for community reintegration [5], this ability should be addressed within clinical contexts to better understand and improve the community activities, since the main goal of neurological rehabilitation includes the restoration of mobility [25]. Moreover, many tests were employed to assess mobility [17] and if time allows only one measurement to be collected, then the ability to manage stairs should be the first choice, since it best predicted free living physical activity [5] and also was related with higher levels of physical activity. Furthermore, despite of the large variability commonly found in motor and functional parameters with chronic stroke survivors, the ability to manage stairs was sensitive to detect differences between the three groups. In a recent study which investigated muscular strength measures of chronic stroke survivors, based upon their physical activity levels, the moderately active and active groups demonstrated similar lower limb and respiratory strength values [26]. These findings indicated that strength measures were not able to detect differences between the groups stratified by their physical activity levels [26].

This study had some limitations, due to its design, causal relationships could not be determined. Data was not equally distributed between the three physical activity levels and this also could have influenced the findings. Moreover, the results of this study reflected the performance of chronic stroke survivors with high functional levels, and may not be generalizable to a population with different functional characteristics.

In conclusion, people with chronic stroke with various physical activity levels demonstrated different abilities to manage stairs. Increases in stair ascent and descent cadences were both observed with increases in physical activity levels.

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