Original Article

Levels of Community Ambulation Ability in Patients with Stroke Who Live in a Rural Area

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Submitted: 2 Jun 2015
Accepted: 12 Oct 2015

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Abstract

Background: **Community ambulation is essential for patients with stroke. Apart from treatments, an assessment with a quantitative target criterion is also important for patients to clearly demonstrate their functional alteration and determine how close they are to their goal, as well as for therapists to assess the effectiveness of the treatments. The existing quantitative target criteria for community ambulation were all derived from participants in a developed country and ability was assessed using a single-task test. To explore cutoff scores of the single-task and dual-task 10-meter walk test (10MWT) in ambulatory patients with stroke from rural areas of a developing country.**

Methods: **Ninety-five participants with chronic stroke were interviewed concerning their community ambulation ability, and assessed for their walking ability using the single- and dual-task 10MWT.**

Results: **A walking speed of at least 0.47 m/s assessed using the single-task 10MWT, and at least 0.30 m/s assessed using the dual-task 10MWT, could determine the community ambulation ability of the participants.**

Conclusion: **Distinct contexts and anthropometric characteristics required different target criteria for community walking. Thus, when establishing a target value for community ambulation, it needs to be specific to the demographics and geographical locations of the patients.**

Keywords: *cerebrovascular accident, community participation, physical therapy, walking, rehabilitation*

Introduction

More than 80% of the patients with stroke suffer from walking impairments that subsequently limit their ability to perform daily activities and participate in a community (1–3). The dramatically decreased length of stay in a hospital (4,5) may further affect their optimal ability at the time of discharge, and indicates the importance of outpatient rehabilitation strategies and effective monitoring methods with an appropriate target criterion. These measures will allow patients to clearly quantify their functional alteration and determine how far their current ability is from the goal, and for therapists to see the effectiveness of the treatment programs.

The existing methods of assessments for community ambulation can be carried out using self-reported questionnaires or functional tests (3,6–8). Self-report questionnaires can be used to roughly classify the ambulatory ability of the patients. For instance, Perry et al. (8) classify the ambulatory ability of individuals with stroke into six categories based on self-reported data, three of which are related to community ambulation. Moreover, Lord et al. (3) divided the community ambulation ability of patients with stroke into four categories, as follows: (I) inability to walk outside the home; (II) ability to walk outside home as far as the car or mailbox in front of the house without physical assistance or supervision; (III) ability to walk in the immediate environment (e.g., down the road, around the block) without physical assistance or supervision; and (IV) ability to walk to stores, visit friends or participate activities in the vicinity without physical assistance or supervision. The findings of such assessment can widely capture the walking ability of the patients but may lack sensitivity when it comes to detecting functional changes over time (9).

On the other hand, a functional test, which is mostly measured using walking speed, is commonly used as an objective indicator for walking ability after stroke (10). The results can clearly quantify functional alteration; therefore, it has been shown to be more responsive than self-reported data (9). Perry et al. (8) found that full community ambulation ability required a walking speed of at least 0.8 m/s. However, Taylor et al. (10) indicated that this minimum walking speed may be too high for community ambulation. Later, Van de Port et al. (11) reported an optimal walking speed for community ambulation at least 0.66 m/s, but the predictive ability of the cutoff point could be confounded by balance ability, motor function, endurance, and the use of a walking device. Nevertheless, these data were derived from a single-task test in participants with stroke from a developed country, that is, Ireland, the Netherlands, or New Zealand (3,8,11).

Lord and Rochester (12) reported that community ambulation involves the ability to integrate walking with other tasks in a complex environment. Thus, the researchers hypothesized that the incorporation of a dual-task test may improve diagnostic properties of the findings as compared to a single-task test. Moreover, living in a rural area of a developing country may require a lower level of walking ability to be involved in a community than that needed for a developed area. Therefore, this study investigated the optimal cutoff score for community ambulation ability in ambulatory patients with stroke from rural areas of a developing country using a single- and dual-task 10-meter walk test (10MWT).

Methods

Participants

The participants were independent ambulatory patients with chronic stroke (post-stroke time ≥ 6 months), aged 40–75 years, with a body mass index between 18.5 and 29.9 kg/m2. The eligible participants also needed to be able to walk independently over at least 10 m with or without a walking device, and good communication. Patients were excluded if they had any medical conditions that might affect their ability to participate in the study, such as uncontrolled underlying diseases (i.e., hypertension, heart disease, thyroid disease, etc.), deformity in the lower extremities, or pain of more than 5 out of 10 on a visual analog scale. From sample size calculation using rate of disease (community ambulation ability), this study required 95 participants (13). The protocol of the study was approved by the Khon Kaen University Ethics Committee for Human Research (HE 561273), and all participants gave their written informed consent before participating in the study.

Research procedure

The participants were interviewed and assessed for their demographic and stroke characteristics, as well as walking ability (ability to walk independently for at least 10 m with or without a walking device). They were then interviewed using a self-report questionnaire proposed by Lord et al. (3) concerning their walking ability. Participants who reported their walking ability in categories I–III were categorised as non–community ambulators, while those in category IV were considered community ambulators (11). After a sufficient rest period, participants were assessed for their walking speed using the single-task and dual-task 10MWT. Details of the tests are given below.

1. Single-task 10MWT: Participants walked at a comfortable speed along a 10 m walkway with or without their customary walking device. The time required to cross the middle 4 m was recorded. Then, the average findings over three trials were converted to a walking speed for the single-task 10MWT (14).
2. Dual-task 10MWT: Participants were tested using the method explained for the single-task 10MWT, while simultaneously counting backwards from 100 decreasing by one (15). Then, the average findings over the three trials were converted to a walking speed for the dual-task 10MWT.

Since people who live in a rural area commonly wear slippers, the participants were assessed for the 10MWT without shoes in order to minimize risk of injury and the effects of shoes on the outcomes. Participants had a lightweight safety belt around their waist and were accompanied by a physical therapist throughout the tests to ensure their safety and the accuracy of the tests. During the tests, participants were able to take a period of rest as needed, or until their heart rates returned to a baseline level.

Data Analysis

Descriptive statistics were applied to explain the characteristics of the participants and the findings of the study. The independent samples t test was utilised to analyse the differences between participants who were community ambulators and non–community ambulators. Then, the receiver-operating characteristic (ROC) curves were applied to determine the optimal cutoff score, sensitivity, specificity, and area under the curve (AUC) of the single- and dual-task 10MWT. The level of statistically significant difference was set at $P < 0.05$.

Results

Characteristics of the participants

Ninety-five independent ambulatory participants with chronic stroke from 36 rural communities in Thailand completed the study (Table 1). Most of them had highest graduation from primary school (81%) and lived with their family or spouse (96%), but they were usually alone in the daytime, since the family members had to carry out their own responsibilities. Three participants could walk only inside the house (category I); 10 could walk outside the house as far as the car parking spot or mailbox in front of the house (category II); 32 could walk in their immediate surroundings, such as down the road or around the block (category III); and 50 participants could walk in their communities, for example, to visit a friend or go to the temple, market, or community health service (category IV). Therefore, 45 participants were considered non–community ambulators, and the rest were categorized as community ambulators. Most participants walked with a walking device, particularly those who were non–community ambulators (89%; Table 1). In addition, participants who were non–community ambulators were significantly older than those who were community ambulators ($P < 0.05$; Table 1).

Walking speed when assessed using the single-task and dual-task 10MWT

The participants in both groups walked significantly more slowly when assessed using

Table 1: Characteristics of the participants

Variable	Group of participants			*P* value
	Total participants (n = 95)	Non–community ambulators (n = 45)	Community ambulators (n = 50)	
Age[a] (years)	62.1 ± 8.3 (60.4–63.8)	64.2 ± 7.8 (61.9–66.6)	60.1 ± 8.3 (57.8–62.5)	0.02*
Weight[a] (kg)	60.1 ± 9.0 (58.3–62.0)	61.2 ± 8.8 (58.6–63.9)	59.1 ± 9.2 (56.5–61.7)	0.25
Height[a] (m)	1.59 ± 0.2 (1.56–1.63)	1.57 ± 0.2 (1.50–1.64)	1.61 ± 0.1 (1.59–1.64)	0.23
Body mass index[a] (kg/m^2)	23.2 ± 3.0 (22.6–23.8)	23.8 ± 3.0 (22.9–24.7)	22.6 ± 3.0 (21.8–23.5)	0.06
Post-stroke time[a] (months)	73.8 ± 62.0 (61.1–86.4)	83.6 ± 70.4 (62.5–104.8)	64.9 ± 52.4 (50.0–80.0)	0.14
Mini–mental state examinationa (scores)	23.5 ± 4.68 (21.92–25.08)	21.88 ± 5.33 (19.04–24.71)	24.8 ± 3.74 (23.05–26.55)	0.09
Gender[b]: Male	50 (53)	23 (51)	27 (54)	0.78
Side of stroke[b]: Right	46 (48)	21 (47)	25 (50)	0.75
Walking device used[b]: Yes	60 (63)[c]	40 (89)	20 (40)	< 0.001*

Notes:
[a]The data are presented using mean ± standard deviation (95% confidence interval), and the comparisons between the groups were analysed using the independent samples *t* test.
[b]The data are presented using number (percent), and the comparisons between the groups were analyzed using the Chi-square test.
[c]Sixteen participants used a multiple-legged cane, 23 participants used a single cane, 13 participants used a modified walking stick, 6 participants used a walker, 2 participants used a single crutch.
*Indicates significant difference.

the dual-task 10MWT, and participants who were non–community ambulators walked significantly slower than those who were community ambulators when assessed using either the single-task or dual-task 10MWT (P < 0.001; Table 2). The differences in walking speed between the groups when assessed using the single-task 10MWT were clearly greater than when assessed using the dual-task test (Table 2). A walking speed of at least 0.47 m/s assessed using the single-task 10MWT showed excellent diagnostic properties, whereas a walking speed of at least 0.30 m/s assessed using the dual-task 10MWT had good diagnostic properties for community ambulation ability (Table 3 and Figure 1).

Discussion

Apart from rehabilitation programs, a quantitative monitoring method with an appropriate target criterion is important; on the one hand, this allows patients to clearly perceive their functional alteration and how far their current ability is from the goal, and on the other, it facilitates therapists' evaluation of effectiveness of the treatment programs. The findings of the current study suggested that walking speeds of at least 0.47 m/s and at least 0.30 m/s, assessed using the single-task and dual-task 10MWT, respectively, could indicate community ambulation ability. Comparing between the tests, the single-task 10MWT showed better diagnostic properties for community ambulation than the dual-task 10MWT did (Table 3 and Figure 1).

The lower cutoff scores of the present study as

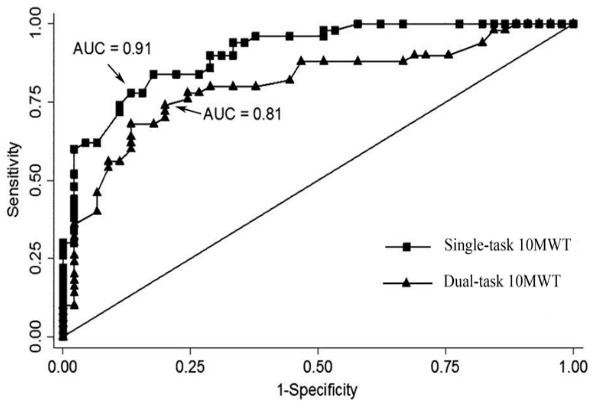

Figure 1: Receiver operating characteristic (ROC) curve and area under the curve (AUC) of the 10-Meter Walk Test (10-MWT) for ability of community ambulation.

Table 2: Walking speed of participants who were non–community ambulators and community ambulators when assessed using the single- and dual-task 10-Meter Walk Test (10MWT)

Variable	Non–community ambulators (n =45)	Community ambulators (n =50)	Mean differences (95%CI)	*P* value
Single-task 10MWT	0.31 ± 0.15 (0.27–0.35)	0.62 ± 0.20 (0.57–0.68)	0.31 ± 0.28 (0.24–0.39)	< 0.001*
Dual-task 10MWT	0.24 ± 0.12 (0.20–0.27)	0.42 ± 0.18 (0.37–0.47)	0.18 ± 0.22 (0.12–0.24)	< 0.001*

Notes:
Data are presented using mean ± standard deviation (95% confidence interval).
The differences between the groups were analyzed using the independent samples *t* test.
*Indicates significant differences.

Table 3: Cutoff scores and associated sensitivity, specificity, and area under the curve (AUC) of the 10-Meter Walk Test (10MWT) for community ambulation ability

Variable	Cutoff score (m/s)	Sensitivity (%)	Specificity (%)	AUC (95% CI)
Single-task 10MWT	≥ 0.47	84.00	82.22	0.91 (0.85–0.96)
Dual-task 10MWT	≥ 0.30	78.00	75.56	0.81 (0.72–0.90)

compared to previous reports (0.8 m/s and 0.66 m/s) (8,11) may relate to settings of the studies and anthropometric characteristics of the participants. Previous studies were conducted in developed countries, namely Ireland, the Netherlands, and New Zealand, and the participants who were community ambulators reported that they visited a places such as supermarkets, banks, and shopping malls (3,8,11). In contrast, participants in this study lived in a rural area, and they visited the places such as a friend's house, temple, market, rice field, or community health center. Robinett and Vondran (16) reported that the distance required for walking in a rural town was shorter than that in a big city, and thus pedestrians who lived in cities of different sizes required different walking distances and speeds to complete daily tasks. In other words, in order to participate in a community, patients who return to a rural area may require a lower level of walking ability than those who return to a metropolitan area.

The lower cutoff walking speed as compared to the existing values may relate to anthropometric characteristics of the participants. Samson et al. (17) indicated that anthropometric characteristics have a crucial influence on walking speed of individuals. The distinctive diet, habitat, nature of work, and geographical location of Thai populations significantly affect such characteristics. Although the Thai population nowadays is taller than in the past, people are still obviously smaller than those in developed countries (the average height of participants in this study was 1.59±0.2 m (Table 1), whereas that for people in Western countries ranges from 1.62 to 1.77 m (18,19). Thus, when establishing a target ability for community ambulation, health professionals may need to consider characteristics and the geographical location of the patients.

Since most participants in this study (81%) had only graduated from primary school and walked with a walking device, the researchers believed that using a simple dual-task test (counting backward from 100 by 1) may be more suitable than using a more difficult task, for instance, buttoning, tray-carrying, or counting backward from 100 by 7 (20). Since walking ability requires the involvement motor, sensory, and cognitive functions (21), the greater involvement of a cognitive function while performing the dual-task 10MWT can interfere with and reduce their motor activity. This is why the participants performed the dual-task test more slowly than the single-task test (Table 2). Similarly, Bowen et al. (22) reported that performing a cognitive task while walking adversely affected the balance and walking speed of patients with stroke. Yang et al. (20) also found that participants with stroke had difficulty performing two tasks concurrently.

Nevertheless, the findings contradicted a priori hypothesis of the study that the dual-task 10MWT would have better diagnostic properties for community ambulation than the single-task 10MWT (Table 3 and Figure 1). This contradiction may be associated with characteristics of the participants who had a long post-stroke duration (> 5 years; Table 1) in which they had interacted with others infrequently. Such characteristics may additionally retard cognitive functions of the participants independently of the stroke. Aminah et al. (23) found that age, depression, level of daily activities, and overall social and family support significantly influenced the cognitive functions of patients with stroke. Thus, having a long post-stroke duration with minimal cognitive activity after the stroke may further affect the ability of participants to perform a dual task, even if they are community ambulators. This assumption is associated with the finding that the differences in the dual-task test between the groups were obviously decreased in relation to those of the single-task test (Table 2). The researchers consider that having these characteristics confounded diagnostic ability of the dual-task 10MWT.

The findings of the study provide a quantitative target criterion for the community ambulation of ambulatory individuals with stroke from a rural community. However, the findings have some limitations. Participants were arranged into community ambulator and non–community ambulator groups according to self-report data, without observation of the actual ability of the participants. However, the researchers attempted to minimize the error in the information given by having the participants complete the distance walk task. Bijleveld-Uitman et al. (24) indicated that community ambulation requires a distance walk of at least 368 m (approximately the size of a football field), and the researchers used this distance for confirmation in the interview process. However, actual observation for community participation during a period of time would strengthen the findings. Second, participants who were non–community ambulators were significantly older than those who were community-ambulators (Table 1). Nonetheless, Rose and Gamble (25) indicate that gait deviation due to age and the deterioration process starts after 70 years of age. Therefore, the statistical significance may not clinically affect the walking ability of the participants between the groups. Third, the findings provide a target value for a training and monitoring process. An exploration on factors associated with community ambulation ability in these individuals may further direct methods to promote such ability among these patients. Finally, participants were tested without shoes in order to minimize the effects of improper shoes on the outcomes and the risk of injury to the participants. However, the findings may be different from (faster than) when they walk with their shoes (slippers) in their communities.

Conclusion

This study explored the cutoff scores of the single-task and dual-task 10MWT to determine community ambulation ability in participants with stroke from many rural communities in Thailand. The results indicated that a walking speed at least 0.47 m/s, assessed using a single-task test, had excellent ability to indicate the community ambulation ability of the participants. The findings established here may be used as a quantitative target criterion for patients with stroke who live in a rural community of a developing country.

Acknowledgement

The study was supported by the Improvement of Physical Performance and Quality of Life (IPQ) research group, and Khon Kaen University, Khon Kaen, Thailand.

Conflict of interest

None.

Funds

Improvement of Quality of Life Research Group, and Khon Kaen University, Thailand

Authors' Contribution

Conception and design: SA, TT
Analysis and interpretation of the data: SA, JC
Drafting of the article: JC
Critical revision of the article for important intellectual content, final approval of the article, obtaining of funding, administrative, technical, or logistic support: SA
Collection and assembly of data: JC, TT, KS, SP

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