Original

Relationship between Walking Speed Necessary for Road Crossing and 6-minute Walk Distance in the Stroke Patients

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Abstract

Objectives: The aim of this study was to determine the relationship between the walking speed necessary for road crossing and walking distance in patients with stroke.

Methods: Sixty-three stroke patients without higher cortical function disorder were involved in this study. Age, sex, walking speed (10 m maximal walking speed), and walking endurance (6-minute walk test) were the variables studied. For walking speed, the patients who walked more than 1.0 m/s were categorized as the >1.0 m/s group, and those who walked less than 1.0 m/s were the <1.0 m/s group.

Results and Conclusion: The results of this study showed that the >1.0 m/s group had a longer 6-minute distance than the <1.0 m/s group. In addition, the endurance was decreased for both the >1.0 m/s group and the <1.0 m/s group.

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Introduction

Walking speed and distance are important indicators of one's ability to walk in the community. Improving walking performance is an important goal for the rehabilitation of stroke. Walking speed and endurance are two critical assessments of locomotor capacity. The short 10-m walk test is used to test maximal walking speed, and the long 6-minute walk test is used for testing walking endurance.

Empirical data have shown that the gait velocity of patients with stroke of varying severities ranges from approximately 0.18 to 1.03 m/s[1-4], whereas that of healthy adults of similar ages averages 1.4 m/s[5]. Nojiri et al.[6] previously reported that a velocity of 1.0 m/s is necessary for Japanese pedestrian road crossings. In Japan, the acquisition of a walk speeds faster than 1.0 m/s is important to perform normal outdoor activities.

Decreased endurance also contributes to compromised functional walking after stroke[4]. Functional walk distances which are measured by using the 6-minute walk test and the 12-minute walk test in people with stroke have been reported to be approximately 42% to 50% of those of healthy older adults[7-9].

Flansbjer et al.[10] reported a strong relationship between the 6-minute walk test and a maximal 10-m walk test, while Eng et al.[11] found a similar relationship between comfortable walking speed and the 6-minute walk test in groups of patients with stroke. However, it is unknown whether endurance of walking speeds necessary for road crossing is adequate in patients with stroke. Therefore, the aim of this study was to determine the relationship between the walking speed necessary for road crossing and walking distance in patients with stroke.

Methods

Participants

63 patients, following their first known stroke, participated in this study after giving their informed consent. All stroke patients were admitted to the Rehabilitation Hospital.

The average ± standard deviation (SD) age at the time of the study was 66.4 ± 9.8 years. There were 43 men and 20 women; 41 patients were right hemiplegics, and 22 were left hemiplegics. The average time ± SD from stroke onset was 96.1 ± 63.6 days.

The exclusion criteria are a person accompanied with higher cortical function disorder.

Procedure

Age, sex, walking speed, and walking endurance were the variables studied.

For walking speed, subjects were timed walking in a room. The total distance was 14 m and the subjects were timed over the middle 10 m. Subjects were informed that they would be timed for part of the 14-m walk. The subjects were instructed to walk as fast and safely as possible without running. We measured walking speeds and adopted the fastest value. A walking speed of 1.0 m/s is required to cross pedestrian crossings with a signal in Japan. Therefore, the patients who walked more than 1.0 m/s were categorized as the >1.0 m/s group, and those who walked less than 1.0 m/s were the <1.0 m/s group.

Walking endurance was measured using the 6-minute walk test. The 6-minute walk test was carried out on flat, straight floor of 30 m. The subjects were instructed to walk as far as possible in 6 minutes and were told to walk continuously if possible. If necessary, they could slow down or stop, but were instructed to resume walking as soon as they felt they were able to do so. After 6 minutes had elapsed, subjects were instructed to stop walking and the total distance walked was measured in meters.

Data analysis

The differences between the >1.0 m/s group and <1.0 m/s group were compared using the Student's t-test and χ^2 test.

Statistical analysis was performed using IBM SPSS statistics 22.0. The results were considered to be statistically significant when the possibility of error (p) was less than 5%.

Results

The distance walked in 6 minutes was significantly different between the two groups (Table).

The >1.0 m/s group 6-minute test of the subjects was as follows: 201−300 m=14, 301−400 m=14, >401 m=20, and the <1.0 m/s group 6-minute test of the subjects was as follows: <200 m=6, 201−300 m=9 (Fig.).

Discussion

The purpose of this study was to determine the relationship between the 10-m gait speed and the 6-minute walk distance in patients with stroke. The results of this study showed that the >1.0 m/s group had a longer 6-minute distance than the <1.0 m/s group. In addition, the endurance was decreased for both the >1.0 m/s group and the <1.0 m/s group.

Gait speed is a reliable and objective measure of the recovery of walking ability[12] and walking performance[13,14]. Moreover, walking speed has been established as an important predictor of capability along a continuum from limited household ambulation to unlimited community ambulation[15]. Nancy found that the 6-minute walk distance was moderately correlated with gait speed[16]. Dalgas showed that walking speeds of both a short- and long walking test were strongly correlated in patients with stroke[17]. Nojiri et al.[6] reported that 1.0 m/s is necessary to cross a standard Japanese pedestrian crossing. The present study showed that the >1.0 m/s group had a significantly 6-minute walk distance longer than the <1.0 m/s group. The patients with walking speed decrease need assessment walking speed and endurance because the walking endurance may decrease.

Senzyu found that a person with less than a 400 m range is limited in going out, the patient less than 300 m will have difficulty going out, and with a range less than 200 m the patient is restricted to the home. In this study, only 20 of the 48 subjects of the >1.0 m/s group walked in excess of 400 m[18]. The number of patients in

Table　Comparison of valuables between the more than 1.0 m/s and less than 1.0 m/s groups (n = 63)

Variable	more than 1.0 m/s group (n = 48)	less than 1.0 m/s group (n = 15)	p value
Age (y)[a]	65.9 (10.2)	67.3 (8.8)	.536[c]
Sex: male/ female (n)[b]	34/14	9/6	.528[d]
Distance walked in 6 minutes (m)[a]	386.6 (112.0)	194.6 (59.2)	p<0.001[c]

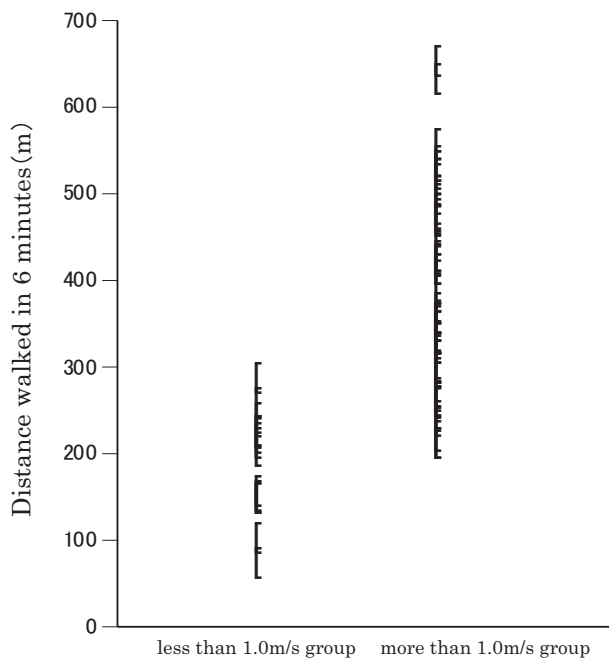[a]mean (SD), [b]proportion, [c]student *t*-test, [d]χ² test

Fig.　Relationship of the 6-minute walk distance and the walking speed

the <1.0 m/s group who walked in excess of 400 m was zero. Improvements in both 6-minute distance and 10-m gait speed in individuals after stroke have been reported following a 4-week circuit training[19]. Therefore, training that is likely to improve walking endurance, such as walking long distances, aerobic fitness, muscle strength training, and balance training, needs to be emphasized in clinical rehabilitation.

Further studies are required to assess walking speed and endurance, and if walking ability improves with exercise therapy.

There are some limitations associated with this study. The small sample size and the recruitment bias for the stroke patients may limit the generalizability of the findings. In addition, this study does not reflect real living conditions after discharge, because these patients were hospitalized. Further research is needed to determine.

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脳卒中患者における横断歩道を横断可能な歩行速度と 6 分間歩行距離の関係

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―キーワード―
歩行速度，耐久性，脳卒中

　目的：本研究は，脳卒中患者における横断歩道を横断可能な歩行速度と歩行距離との関係性について検討した．

　方法：高次脳機能障害を有していない脳卒中患者 63 名を対象とした．調査項目は，年齢，性別，歩行速度（10m 最大歩行速度），歩行耐久性（6 分間歩行テスト）とした．歩行速度は，1.0m/s 以上の症例は 1.0m/s 以上群，1.0m/s 未満の症例は 1.0m/s 未満群に分類した．

　結果および結論：本研究では，1.0m/s 以上群は，1.0m/s 未満群と比較して 6 分間歩行距離が有意に長かった．また歩行耐久性は 1.0m/s 以上群，1.0m/s 未満群ともに低下を認めた．

利益相反：利益相反基準に該当無し

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