Development of a Self-Efficacy Questionnaire for Walking in Patients with Mild Ischemic Stroke

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*Purpose:*This study aimed to develop a self-efficacy questionnaire, which particularly focuses on walking in patients with mild ischemic stroke and transient ischemic attack. *Methods:*We enrolled patients with acute ischemic stroke and transient ischemic attack who scored 0-2 on the modified Rankin Scale. The process of development of questionnaire on self-efficacy for walking with 7 items (SEW-7) was composed of 3 steps: (1) item generation; (2) item reduction; and (3) testing the final version. The measurement properties were assessed according to the COnsensus-based Standards for the selection of health Measurement INstruments (COSMIN) checklist. *Results:*A total of 168 patients (mean age 69.4 ± 10.1 years) were enrolled for testing the questionnaire on SEW-7. The total score of the SEW-7 ranged from 7 to 35 points. Internal consistency was acceptable with the Cronbach's alpha coefficient of .93. Test-retest reliability was good with intraclass correlation coefficient of .83 (95% confidence interval: .67-.91). The smallest detectable changes at individual and group levels were 8.0 and 1.5, respectively. The results of principal component analysis showed a single factor explaining 71.8% of the total variance. The SEW-7 questionnaire showed moderate to strong correlation with physical activity parameters (step counts: r = .596, $P < .001$; physical activity-related energy expenditure: r = .615, $P < .001$; low-intensity physical activity: r = .449, $P < .001$; moderate- to vigorous-intensity physical activity: r = .581, $P < .001$). *Conclusions:*We propose a simple self-report questionnaire for walking, with 7 items. The SEW-7 has adequate measurement properties and may serve as a time-saving tool for promoting physical activity in mild ischemic stroke patients.

Key Words: Self-efficacy—physical activity—stroke—walking—rehabilitation

Introduction

Stroke is a leading cause of long-term disability which progresses with stroke or vascular recurrence.[1,2] Patients with recurrent strokes are at higher risks than new stroke patients.[2] Even in patients with mild stroke, they have high risk of stroke recurrence as well as vascular events of approximately 20% during 3 years after the onset.[3-5] This indicates that secondary prevention should be considered as a major clinical concern in such patients.

Daily physical activity (PA) is an important component in preventing the recurrence of stroke and other cardiovascular diseases.[6,7] It has been reported that persons with lower PA are at a higher risk of incidence of stroke for the first time as compared to the more active ones.[8,9] We have demonstrated that lower PA is also one of the independent predictors of secondary vascular events,[10] and daily step count of approximately 6000 steps per day may be an initial target level for reducing the occurrence

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of vascular events in patients with mild ischemic stroke (MIS).[4] These evidences indicate that, when promoting PA in stroke patients, we need a precise methodology to avoid patients' psychological burden.

When promoting PA, psychobehavioral factors are the key components of intervention strategy.[11,12] Self-efficacy means the belief in one's capabilities to organize and execute the courses of action required to achieve given targets.[13] Self-efficacy is regarded as a more important predictor of behavior than ability, and is modifiable and can be the focus of intervention strategy for promoting PA in stroke patients.[13] Daily PA consists of walking, occupation or household work. Among those, walking is a main component in terms of favorable effects on vascular health. Walking is a popular, familiar, convenient, and free form of exercise that can be incorporated into everyday life more than any other type of exercise.[14] Moreover, initial judgments of self-efficacy for walking (SEW) may be more accurate than that of other specific exercises.[15] Although several questionnaires on walking self-efficacy have been reported,[16-21] there has been a lack of evidence for their applicability and psychometric properties in MIS. This study, therefore, aimed to develop a questionnaire on SEW to be included among tailor-made interventions for promoting PA in patients with MIS.

Methods

Study Population

We consecutively enrolled patients who were admitted to Aichi Medical University Hospital due to acute ischemic stroke and transient ischemic attack. In this study, we aimed to develop a SEW for promoting PA by walking. Therefore, we intended for the patients with less walking disability, no major neurological symptoms needing rehabilitation intervention, and no other limitations for examinations. The eligibility criteria were: Age older than 20 years; the score on the modified Rankin Scale from 0 to 2 at the time of discharge; absence of communication disability that was defined as an inability to respond to self-report questionnaire or telephone interview; those who directly returned home after discharge; and those who agreed to participate in this study. Patients with severe dementia (Mini-Mental State Examination score $\leq$17); those with a history of psychiatric disorder; those treated with extracorporeal dialysis; and those who had been considered for long-term hospitalization due to treatment for other diseases were excluded. All examinations were conducted at 3 months post discharge because of that patients were supposed to resume their prehospital daily life activities during this period. The Aichi Medical University research ethics committee approved this study (Approval No. 11-044), and all participants provided written informed consent.

Development of SEW

The process of development of the SEW was composed of 3 steps: (1) item generation; (2) item reduction; and (3) testing the final version of the SEW (Table 1). The patients' answers to the SEW were collected by mail. The measurement properties of the SEW were assessed according to the COnsensus-based Standards for the selection of health Measurement INstruments (COSMIN) checklist.[22-24]

Item Generation

The item generation included a review of the literature and discussion by the expert panel. Three physical therapists joined this expert panel, who had extensive clinical experience and expertise in conducting clinical research of secondary prevention program for stroke and other cardiovascular diseases at the university hospital and other research center. In a review of the literature, several self-efficacy questionnaires, which included assessment of walking self-efficacy, were surveyed to be the potential tools in patients with MIS.[16-21] Most of these questionnaires assessed different aspects of walking self-efficacy such as walking under challenging circumstances,[16,17] or under conditions of increasing walking distance[18-20] and duration.[21]

Table 1. *Flowchart of the study process*

Step	Psychometric property
1. Item generation	Content validity: Review of the literature and development of preliminary version of the SEW
2. Item reduction	Content validity: Determination of final version of the SEW (SEW-7)
3. Testing of the final version of SEW-7	Internal consistency: Cronbach's alpha coefficient
	Test-retest reliability: Intraclass correlation coefficient
	Measurement error: Smallest detectable change
	Structural validity: Explorative factor analysis
	Criterion validity: Spearman's correlation coefficient
	Interpretability: mean, standard deviation, distribution, floor and ceiling effects

SEW, self-efficacy for walking; SEW-7, self-efficacy for walking with 7 items.

In this study, the expert panel gathered requirements for SEW as follows: (1) measuring the SEW regardless of PA domains[25]; (2) for dimensions,[25] walking intensity (speed) and duration (minute) should be considered by referring 6000 steps per day, which indicated an appropriate cut-off value for the occurrence of vascular events among patients with MIS,[4,10] or brisk walking for 40 minutes for secondary prevention;[6,7] (3) minimizing the number of items and scale; (4) applicable for tailor-made home-based walking exercise for promoting PA. Based on these requirements, existing questionnaires were considered that lacking the graded items of walking intensity (speed)[16-21] and duration (minute),[16,17,19,20] and need to minimize the number of items and scale. As a result, the expert panel reached a conclusion that, not testing the psychometric properties of existing questionnaires, a new SEW questionnaire should be developed for MIS. We assumed that out of 6000 steps, 1500 to 2000 steps might be accounted for PA related to performing domestic activities,[26] and the remaining 4000 to 4500 steps might be accounted for PA related to activity of going outside regardless of reasons such as occupation or leisure. Based on this, the expert panel configured 40 minutes for the maximal duration of usual walking. The time frames were set as 10-minute intervals for ease in recalling and for minimizing the number of items. Subsequently, for guideline recommendations,[6,7] "fast pace walking for 10 to 40 minutes" were set likewise, and the preliminary version of the SEW with 8 items was developed.

In the standard methodology, self-efficacy has to be scored from 0 to 10 points or as percentage on the measurement scales.[13] However, previous reports have reported that stroke patients tend to have cognitive decline before the stroke which is accelerated after the stroke.[27,28] Therefore in this study, numeric 5-point Likert-type scale (ranged from 1 to 5 points: 1, not at all confident; 2, not very confident, 3, neutral; 4, confident; 5, very confident) was adopted to indicate total score for the strength of perceived self-efficacy.

Item Reduction

Item reduction was performed by using the following criteria: (1) an item which deviates from hierarchy, thus increasing the difficulty, was removed. Item difficulty was assessed by calculating the mean and distribution of score of each item. (2) An item which lacked unidimensionality in the principal component analysis was removed. (3) Approval of the expert panel for clinical and statistical importance was considered.

Internal Consistency

Internal consistency was assessed with the Cronbach's alpha coefficient and the value ranging from .70 to .95 was considered as an acceptable indication.[29]

Test-Retest Reliability

The test-retest reliability was assessed by using the intraclass correlation coefficient (ICC) based on a single measurement, absolute agreement, 2-way mixed effects model.[30,31] The ICC value above .70 was considered as the indication of good reliability.[29] A subgroup of patients (n = 30) completed the questionnaire twice at an interval of 2 weeks.

Measurement Error

The smallest detectable change (SDC) was calculated on the basis of standard error of measurement (SEM) of the test-retest reliability. The SEM was calculated as $SEM = SD_{baseline} \times \sqrt{(1\text{-}ICC)}$. The SDC was calculated both at the individual level ($SDC_{individual} = 1.96 \times \sqrt{2} \times SEM$) and at the group level ($SDC_{group} = 1.96 \times \sqrt{2} \times SEM / \sqrt{n}$).[30,32]

Structural Validity

Unidimensionality of the SEW was assessed by exploratory factor analysis by performing unrotated principal component analysis. Eigenvalues greater than 1.0 and parallel analysis were used to identify item clustering. The items of the factor structure were determined by attributing any items that had factor loadings greater than .4 for a specific factor.

Criterion Validity

Criterion validity was examined by assessment of the associations between the SEW and PA. Moreover, to confirm self-efficacy as a more important predictor of behavior than ability,[13] we estimated handgrip and knee extensor isometric muscle strength (KEIMS) as known correlates to PA.[33-37]

For estimating PA, an electrical accelerometer (Kenz Lifecorder; Suzuken, Nagoya, Aichi, Japan) was used for consecutive 7 days. The mean daily step counts, PA-related energy expenditure, and the time for low-intensity PA (<3 metabolic equivalents [METs]) and moderate- to vigorous-intensity PA (≥3 METs) were used (total counts for 7 days/7) as indices of PA. The METs were calculated from the activity level recorded by the accelerometer according to the previous report.[38] Handgrip strength was estimated twice for each hand by using the JAMAR hand dynamometer (Sammons Preston, Bolingbrook, IL). KEIMS was measured 2 times per leg by using a digital hand-held dynamometer (μ-Tas F1; Anima Corporation, Chofu, Tokyo, Japan), and the value was converted into Newton-meters per body weight (Nm/kg). The methodology of measurements has been described elsewhere.[39] The highest value of each strength was employed in the analysis. Spearman's correlation coefficients were used to assess the associations between the SEW, PA, and muscle strength. A correlation value of less than .3 was defined as

weak, from .3 to .5 as moderate, and of greater than .5 as strong.[40]

We hypothesized that the SEW will demonstrate at least .4 positive correlations with PA, because most of the previous reports have shown .2 to .4 correlations between self-efficacy and PA,[41-45] and higher correlation with PA than that between muscle strength and PA.

Interpretability

Interpretability included the mean, standard deviation, distribution, and floor and ceiling effects of the SEW. More than 15% of the respondents of the lowest or highest total scores possible after using the SEW were considered to present floor or ceiling effects.[29]

Patient Education for Desirable Lifestyle during Hospitalization

During hospitalization, all patients received individual education regarding desirable lifestyle to reduce stroke risk, including reduction in fat and salt intake, smoking cessation, alcohol reduction, and promoting PA, which achieves walking activity with fast pace for 30 to 40 minutes per day until the end of 3 months post discharge.[4,6,7,10] No patients received rehabilitation program post discharge that intended to reduce vascular events risk.

All statistical analyses except parallel analysis were performed by using the SPSS 24.0 software package (IBM Japan, Chuo-ku, Tokyo, Japan). Parallel analysis was performed by using the R software, version 3.2.2 (The R Foundation for Statistical Computing, Vienna, Austria). The value $P < .05$ was considered statistically significant.

Results

Study Population

A total of 168 patients (118 men and 50 women with mean age of 69.4 ± 10.1 years) were enrolled in this study. The patient characteristics are shown in Table 2.

Item Reduction

The mean and distribution of the score of each SEW item are listed in Table 3. Item-4 showed the lower mean score (3.2 ± 1.4) and the lower rate (23.8%) than those of item-5, which was the highest scorer, indicating that item-4 was perceived to be more difficult than item-5. Thus, since item-4 was considered to disturb the difficulty order of items, the expert panel decided to omit the item-4. However, similar scores were also reported for item-3 and item-5 subsequently. Although this overlapping of item difficulties showed some redundancy for hierarchical scale, the expert panel considered that item-3 was necessary for grading of own pace SEW and item-5 as the reference for fast pace SEW.

Structural Validity

The results of principal component analysis with 7 items except item-4 were obtained. Eigenvalues were greater than 1.0 in 2 components; however, all items loaded predominantly on the first component with an eigenvalue of 5.02 (proportion of variance, 71.8%), and item factor loadings ranged from .69 to .92. The eigenvalue of the second component was 1.09 (proportion of variance, 15.5%). Furthermore, the parallel analysis indicated that only 1 component should be retained. Finally, the expert panel decided to hold 7 items other than item-4 for the final version and named the questionnaire as "Self-Efficacy for Walking-7" (SEW-7) (see Appendix). The total score of the SEW-7 ranged from 7 to 35 points (the higher points, the better confidence).

Internal Consistency

The Cronbach's alpha coefficient of the SEW-7 was .93, indicating acceptable internal consistency.

Test-Retest Reliability and Measurement Error

The test-retest reliability of the SEW-7 for the subsample of patients demonstrated an ICC of .83 (95% confidence interval: .67-.91) indicating good test-retest reliability, and an SEM of 2.90. The $SDC_{individual}$ and SDC_{group} were 8.0 and 1.5, respectively.

Criterion Validity

The correlations between the SEW-7, PA parameters, handgrip strength, and KEIMS are shown in Table 4. The SEW-7 showed strong correlations with most of the PA parameters. As hypothesized, the correlations between the SEW-7 and PA were at least .4, and were higher than that between muscle strength and PA.

Interpretability

The mean and standard deviation of the SEW-7 total score was 24.9 ± 7.0. The SEW-7 showed no floor or ceiling effects (0% and 6.0%, respectively).

Discussion

We propose a simple self-report questionnaire, namely, SEW-7 as an appropriate intervention in promoting PA in patients with MIS. The findings in this study indicate that the SEW-7 has adequate reliability and validity following the COSMIN checklist, which is based on the international consensus with leading experts.[22-24] Added to this, SEW-7 has some differences and advantages compared to existing questionnaires, such as self-efficacy of walking intensity (speed) and duration (minute) are estimable to achieve a recommendation level of PA,[4,6,7,10] easy to answer by minimizing the number of items and scale, and thus may serve as a simple time-saving tool in promoting

Table 2. *Characteristics of participants*

	(N = 168)
Age (y)	69.4 ± 10.1
Sex (male), n (%)	118 (70.2)
BMI (kg/m^2)	23.0 ± 2.9
mRS (grade 0/1/2), n (%)	82/73/13 (48.8/43.5/7.7)
MMSE (score)	27.4 ± 2.6
Stroke subtypes and TIA, n (%)	
Atherothrombotic	83 (49.4)
Cardioembolic	39 (23.2)
Lacunar	30 (17.9)
Others	6 (3.6)
TIA	10 (6.0)
Medications, n (%)	
Antiplatelet agent	122 (72.6)
Anticoagulant agent	45 (26.8)
Statin	78 (46.4)
ACE/ARB	88 (52.4)
Calcium channel blocker	82 (48.8)
Beta blocker	25 (14.9)
Diuretic	19 (11.3)
Antidiabetic agent	28 (16.7)
Physical activity	
Step counts (steps/day)	5973 ± 3427
PAEE (kcal/day)	145.6 ± 107.7
Low-intensity physical activity (min/day)	48.1 ± 25.3
MVPA (min/day)	15.1 ± 17.9
Muscle strength	
Handgrip strength (kgf)	25.9 ± 9.7
KEIMS (Nm/kg)	1.5 ± .5

ACE, angiotensin-converting enzyme inhibitor; ARB, angiotensin II receptor blocker; BMI, body mass index; KEIMS, knee extensor isometric muscle strength; MMSE, mini-mental state examination; mRS, modified Rankin Scale; MVPA, moderate to vigorous-intensity physical activity; PAEE, physical-activity-related energy expenditure; TIA, transient ischemic attack.

Data are presented as means ± standard deviations or number of patients (%).

PA. To our knowledge, this study is the first report to develop a self-efficacy questionnaire that focuses on walking exercise in the MIS population. We, however, are expecting that the SEW-7 may also be applied to other populations such as cardiac patients or patients with diabetes mellitus. Further study is needed to verify the effectiveness of SEW-7 in such populations.

The SEW-7 showed acceptable internal consistency and test-retest reliability.[29] Changes above the SDC value can be considered as the real changes. In general, the results

Table 3. *The mean and distribution of each SEW item score*

Item number	Means ± SDs	Score*, n (%)									(N = 168)
		1		2		3		4		5	
1	4.7 ± .7	0	(0.0)	4	(2.4)	7	(4.2)	31	(18.5)	126	(75.0)
2	4.4 ± 1.0	4	(2.4)	7	(4.2)	14	(8.3)	42	(25.0)	101	(60.1)
3	3.8 ± 1.3	13	(7.7)	20	(11.9)	22	(13.1)	42	(25.0)	71	(42.3)
4	3.2 ± 1.4	21	(12.5)	35	(20.8)	36	(21.4)	36	(21.4)	40	(23.8)
5	3.8 ± 1.2	7	(4.2)	27	(16.1)	18	(10.7)	52	(31.0)	64	(38.1)
6	3.2 ± 1.4	27	(16.1)	29	(17.3)	29	(17.3)	47	(28.0)	36	(21.4)
7	2.7 ± 1.3	41	(24.4)	40	(23.8)	39	(23.2)	26	(15.5)	22	(13.1)
8	2.4 ± 1.2	53	(31.5)	43	(25.6)	42	(25.0)	20	(11.9)	10	(6.0)

*1: not at all confident; 2: not very confident; 3: neutral; 4: confident; 5: very confident.

Table 4. *Correlation between SEW-7 total score, PA, and muscle strength*

	1. SEW-7	2. SC	3. PAEE	4. LPA	5. MVPA	6. HS	(N = 168) 7. KEIMS
1. SEW-7	–	.596*	.615*	.449*	.581*	.339*	.432*
2. SC (steps/day)		–	.873*	.840*	.852*	.394*	.416*
3. PAEE (kcal/day)			–	.707*	.802*	.463*	.498*
4. LPA (min/day)				–	.526*	.354*	.392*
5. MVPA (min/day)					–	.396*	.373*
6. HS (kgf)						–	.673*
7. KEIMS (Nm/kg)							–

HS, handgrip strength; KEIMS, knee extensor isometric muscle strength; LPA, low-intensity physical activity; MVPA, moderate- to vigorous-intensity physical activity; PAEE, physical activity-related energy expenditure; SC, step counts; SEW-7, self-efficacy for walking with 7 items.

*$P < .001$.

of low SDC value at the group level and relatively high SDC value at the individual level have been reported to be common in patient-reported questionnaires.[46,47] Similar results were found in our results, that is, the changes in the SEW-7 must exceed 8.0 points to exclude measurement errors at the individual level, whereas must be only 1.5 points at the group level. Therefore, it may be forewarned that greater amount of change is needed to detect individual level changes in the SEW-7.

Criterion validity was confirmed according to a priori hypotheses. The correlations analysis showed that the SEW-7 strongly correlated with PA well above muscle strength. This result is in line with expert opinion that self-efficacy may be considered as a more valuable predictor of behavior than ability.[13] As stated before, among patients with cardiac diseases,[41] multiple sclerosis,[43,44] and chronic obstructive pulmonary disease,[45] the correlations between self-efficacy and objectively measured PA have been demonstrated as weak to moderate. We speculated that the advantage of the SEW-7 is the result of adequate item difficulties, which matched with self-efficacy and PA levels indicated as no floor and ceiling effects in patients with MIS.

Clinically, several practical applications of the SEW-7 can be assumed. The results of the strong association between the SEW-7 and PA suggest that the SEW-7 may be applied to identify an appropriate target group. Moreover, self-efficacy beliefs are constructed from 4 sources of information, such as mastery experiences, vicarious experiences, verbal persuasion, and physiological and affective states.[13] These sources are options of the intervention strategy to enhance self-efficacy, and particularly mastery experiences which are gained by goal achievements are the most influential sources.[13] Goals that provide an optimal level of challenge are motivating, whereas those that are too easy or unattainably difficult are demotivating.[13] To obtain such optimal goals, the SEW-7 can function to provide an appropriate walking level not by measuring subjects' objective PA but by speculating difficulty in performing at given walking levels. This probably allows us to guide subjects toward a recommendation level[4,6,7,10] which can be tailored in the individuals after repeated successful experiences. To this end, further study regarding responsiveness to SEW-7 will be needed.

Our study had the following limitations. First, although Item Response Theory (IRT) has some advantages over the Classical Test Theory,[24] we could not apply IRT because the SEW-7 items did not meet the assumption of IRT, such as local independence.[48] Second, because of this study being a cross-sectional study, a cause-effect relationship between the SEW-7 and PA could not be ascertained. Third, other confounding factors suggesting the association between the SEW-7 and PA may exist. In addition, the number of the subjects in this study was possibly small for generalization of the results. Further study will be needed to overcome these limitations. Nevertheless, the reliable and valid self-efficacy questionnaire, namely, SEW-7 has the possibility of being used widely for promoting PA because of the familiarity of its specific task.

Conclusions

In conclusion, the results of this study indicate that the SEW-7 questionnaire has adequate measurement properties and is likely to identify an appropriate target group. Further studies will be needed to generalize the use of SEW-7 in other populations, such as in patients with chronic heart failure or postcardiovascular surgery.

Appendix

Self-Efficacy for Walking-7 (SEW-7).

The following questions refer to your confidence for walking. Please mark the answer that best applies to you.

Can you walk as below?	Not at all confident	Not very confident	Neutral	Confident	Very confident
1. Walk continuously at your own pace for 10 min	1	2	3	4	5
2. Walk continuously at your own pace for 20 min	1	2	3	4	5
3. Walk continuously at your own pace for 30 min	1	2	3	4	5
4. Walk continuously at fast pace for 10 min	1	2	3	4	5
5. Walk continuously at fast pace for 20 min	1	2	3	4	5
6. Walk continuously at fast pace for 30 min	1	2	3	4	5
7. Walk continuously at fast pace for 40 min	1	2	3	4	5

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