Title: Assessment of the Psychometric Properties of the Frailty and Injuries: Cooperative Studies of Intervention Techniques – 4 in People with Stroke

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Abstract

Background: The Frailty and Injuries: Cooperative Studies of Intervention Techniques – 4 (FICSIT-4) is a measure that assesses standing balance ability. However, the psychometric properties of the FICSIT-4 have not been examined in people with stroke.

Objectives: To investigate the psychometric properties of the FICSIT-4, including its internal consistency, test–retest reliability, concurrent validity, and known-group validity, and identify the cut-off score on the FICSIT-4 that discriminates people with stroke from healthy older people.

Methods: Sixty-two participants with stroke and 49 age-matched healthy controls were recruited. The FICSIT-4 was administered twice, on days 1 and 2, with a 1-week interval, to the participants with stroke to examine test–retest reliability. Various health-related measures were also administered to the stroke participants on day 1. The FICISIT-4 was only administered once, on day 1, to the healthy participants.

Results: The FICIST-4 was found to exhibit fair internal consistency, good test–retest reliability and significant correlations with various health-related outcome measures. It also demonstrated known-group validity, and a score of 25 was found to distinguish people with stroke from healthy older people.

Conclusion: The FICISIT-4 is a reliable and valid measure for assessing the standing balance ability of people with stroke.

Keywords: Stroke rehabilitation, balance disorders, standing balance ability, psychometric testing, FICSIT-4

INTRODUCTION

Impaired standing balance ability is the inability to maintain the line of gravity within the base of support (BOS) and is one of the most common sensorimotor consequences of stroke[1]. As such, impaired standing balance ability plays a key role in problems of mobility and postural control that have profound effects on the independent living, fall risks,[2] and quality of life of people with stroke[3]. Therefore, improving standing ability to enhance motor function and independent living is a primary recovery goal of stroke rehabilitation.

Numerous measures are used to assess standing balance ability, but each has limitations[4]. Force-plate technology is a commonly used measure to assess standing ability based on weight bearing and sway characteristics[2]. However, its validity is limited because increased body sway combined with an exaggerated corrective ankle mechanism during standing changes the centre of pressure (COP). In addition, COP change data collected in a controlled environment may not reflect the dynamic complexity of postural control in real-world settings[2].

Another way to measure standing ability is via functional performance tests. In a scoping review, Sibley et al.[5] attempted to identify a core outcome set that could be recommended for adult populations, but multiple functional performance tests commonly used in people with stroke were excluded. The Functional Reach Test[6] and Limits of Stability (LOS) Test[7] were not recommended because of insufficient overall suitability and low psychometric properties, respectively. The Berg Balance Scale (BBS)[8] and Mini Balance Evaluation Systems Test (Brief BESTest)[9] were recommended, but they have some limitations in their ability to assess the standing balance of people with stroke. The BBS consists of 14 items and may be redundant when only a standing balance parameter is targeted[10]. Moreover, it has demonstrated floor and ceiling effects in people with stroke[11]. The Brief BESTest involves the assessment of stance while standing on foam with eyes closed and thus, may present safety problems in people with stroke (Redfern et al, 1997; Miyatake et al, 2012). These practical problems could limit the use of the BBS and the Brief BESTest in people with stroke in clinical settings.

Rossiter-Fornoff et al.[12] developed the Frailty and Injuries: Cooperative Studies of Intervention Techniques – 4 (FICSIT-4) to assess standing balance based on the ability to maintain balance over a progressively reduced BOS in eight clinical trials. The FICSIT-4 consists of seven items that require participants to attempt four stances, namely a feet closely together stance (eyes open/closed), a semi-tandem stance (eyes open/closed), a tandem stance (eyes open/closed), and a single-leg stance with eyes open. The FICSIT-4 rates a participant's performance on a 5-point scale from 0 to 4, and a score of 0 on an item indicates that the participant is not required to adopt the remaining stances. A score of 28 reflects full advanced balance function. The FICSIT-4 has been widely used in adult populations, such as people with dementia[13] and rheumatoid arthritis[14]. However, although the FICSIT-4 has demonstrated good test–retest reliability in people with dementia and mild (intraclass correlation coefficient [ICC] = 0.82) and moderate (ICC = 0.80) cognitive impairment[13], its psychometric properties have not been assessed in people with stroke.

Given that the FICSIT-4 is easy and safe to administer in clinical settings[12], this study aimed to examine the psychometric properties of the FICSIT-4 in a cohort of community-dwelling people with stroke and healthy older people. The objectives were to (i) investigate the internal consistency, test–retest reliability, concurrent validity, and known-group validity of the FICSIT-4 and (ii) identify the cut-off score for the FICSIT-4 that distinguishes people with stroke-specific impairments from healthy older people.

Methods

Sample size calculation

As no previous study has investigated the reliability of the FICSIT-4 in people with stroke, we estimated the sample size based on a previous study that demonstrated that the FICSIT-4 has good test–retest reliability (ICC = 0.79) in people with dementia[13]. We conservatively assumed that an ICC of 0.9 would be required for people with stroke. Thus, to achieve a significance level of 0.05 and a power of 80%, a sample size of 50 would be required. With reference to a previous study that found a moderate correlation (r = -0.45) between the FICSIT-4 and functional mobility of older adults[15], we assumed that there would be a moderate correlation (ρ = 0.35) between the FICSIT-4 and other health-related outcome measures in people with stroke. Thus, to achieve a significance level of 0.05 and a power of 80%, a sample size of 46 would be required. To enhance the robustness of our findings, we adopted a power of 90% and the sample size was finally set to 62.

Participants

Sixty-two people with stroke were recruited from self-help groups via poster advertisements from January to June 2021. The inclusion criteria were (i) at least 6 months post-stroke; (ii) aged over 50; (iii) medically stable; (iv) able to walk for 10 m with or without walking aids, and (v) a score ≥7 on the Abbreviated Mental Test (AMT)[16]. The exclusion criterion was having any other neurological (e.g., parkinsonism) and musculoskeletal disorders (e.g., osteoarthritis) that might have affected the assessment. Forty-nine healthy participants were also recruited using the same inclusion and exclusion criteria, except a history of stroke was not a criterion.

This study was approved by the Ethics Committee of The Hong Kong Polytechnic University (HSEARS20210110002-01) and conducted according to the guidelines of the Declaration of Helsinki. Informed written consent was obtained before the study began. The findings are reported in accordance with the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement (Erik et al, 2007).

Testing procedures

The FICSIT-4 was conducted twice (on day 1 and 2) within 7–10 days (Fig. 1). Five raters were trained and given clear guidance, and each participant with stroke was assessed independently by the same randomly selected rater on day 1 and day 2. All the participants with stroke completed the sociodemographic data sheet, FICSIT-4 and other outcome measures in random order on day 1 and completed the FICSIT-4 on day 2. A 3-min rest interval was provided each trial of the outcome measures to minimize the possible fatigue effects. The healthy participants completed the sociodemographic data sheet and FICSIT-4 on day 1 only.

Outcome measures

The FICSIT-4 is described in the Introduction. The sequence of assessment followed the number of items, and item 7 was performed with the non-affected leg to alleviate safety concerns.

Eight other measures were used as references to examine the concurrent validity of the FICSIT-4, as described below.

1. The Fugl–Meyer Assessment (FMA) was used as a measure of motor impairment[17]. It consists of five domains, namely motor function, sensory function, joint pain, range of motion, and balance domains, and has two subscales, namely the lower extremities (LE) and upper extremities (UE) subscales. The FMA previously demonstrated excellent intra-rater reliability (ICC = 0.96) in people with balance impairment[18].
2. The Five-Times-Sit-To-Stand (FTSTS) test was used as measure of functional muscle strength of the LE[19]. The mean time required to complete five sit-to-stand movements as quickly as possible with arms crossed from a chair with a height of 45 cm was recorded. The FTSTS test was previously found to be reliable (ICC = 0.97–1.00) in people with stroke[19].
3. The Limits of Stability (LOS) test was conducted using a computed dynamic posturography system (Bertec Corporation, Columbus, OH, USA) and was used as a measure of the ability to

control the centre of gravity (COG) within a fixed BOS[20]. The participants were fitted with a harness and initially faced a computer screen with their feet on two separate force platforms. They were then instructed to shift their COP by following a cursor on the screen to designated targets as quickly as possible without changing the positions of their feet. Their LOS reaction time (LOS-RT), movement velocity (LOS-MV), endpoint excursion (LOS-EE), maximal excursion (LOS-ME), and directional control (LOS-DC) were evaluated. The LOS test previously demonstrated good-to-excellent reliability in people with stroke (ICC = 0.76–0.93)[21].

4. The BBS was used as a measure of functional balance[8]. It consists of 14 items that test both static and dynamic balance during activities of daily living (ADLs) and has a total possible score of 56. The BBS previously demonstrated excellent reliability (ICC = 0.95–0.98) in people with stroke[22].
5. The Timed Up and Go (TUG) test was used as a measure of functional mobility[23]. The participants were required to stand up from a chair, walk 3 m forwards, turn around, and then walk back to the chair and sit down, using a normal walking speed during the whole process. The TUG test was previously shown to have excellent reliability (ICC > 0.95) in people with stroke[24].
6. The Activities-Specific Balance Confidence Scale in Cantonese (ABC-C) was used as a measure of subjective confidence in maintaining balance during 16 daily functional activities[25]. The ABC was previously shown to have good test–retest reliability (ICC = 0.85) in people with stroke[26].
7. The Community Integration Measure – Cantonese Version (CIM-C)[27] was used as a measure of community integration. It consists of 10 items and was previously demonstrated to have good test–retest reliability (ICC = 0.84) in people with stroke[27].
8. The 12-Item Short-Form Health Survey (SF-12) was used to measure health-related quality of life (HRQoL)[28]. Scores on the SF-12 can be converted into physical component summary and mental component summary scores. The SF-12 was previously found to have good reliability (ICC = 0.80–0.81) in people with stroke[29].

Statistical analysis

Data were analysed using Statistical Products and Software Solutions version 26 (IBM Corp., Armonk, NY, USA). Descriptive statistics were used to summarise sociodemographic information. Data normality was assessed using the Kolmogorov–Smirnov test. Between-group differences and known-group validity were determined using an independent Student's t-test for parametric data and the Mann–Whitney U test and chi-square test for non-parametric data. The significance level was set to 0.05. Internal consistency was evaluated using Cronbach's alpha (Cronbach's α) coefficient, with values ≥ 0.90, 0.80-0.89, 0.70-0.79, 0.60-0.69, and <0.60 representing very good, good, fair, weak, and unacceptable, respectively (Pereira et al, 2019). ICCs ($ICC_{2,1}$) were computed to measure test–retest reliability. ICCs greater than 0.75, 0.60–0.75, 0.40–0.60, and less than 0.4 were defined as excellent, good, moderate, and poor, respectively[30]. Item-level agreement was evaluated using weighted kappa coefficients, with 0.81-0.99, 0.61-0.80, 0.41-0.60, 0.21-0.40, and ≤0.20 indicating almost perfect agreement, substantial agreement, moderate agreement, fair agreement, and poor agreement, respectively (Wyrwich et al, 2005). Standard error of measurement (SEM) was calculated as standard deviation (SD) x $\times \sqrt{(1 - r)}$ (Stratford, 2004), where r denotes the test-retest reliability coefficient. In relation to the total score, SEM values <5%, 5-10%, >10-20%, and >20% indicating very good, good, doubtful and negative precision of the FICSIT-4 (Ostelo et al, 2004)

The correlations between the FICSIT-4 and measures representing the International Classification of Functioning, Disability, and Health (ICF) domains were examined, where the measures were (i) a motor impairment measure (FMA) and (ii) five functional balance measures (the FTSTS, LOS, BBS, TUG, and ABC-C) representing the body structure domain; (iii) a community participation measure (the CIM-C) representing the activity and participation domain; and (iv) a quality of life measure (the SF-12). We expected that standing ability would have at least fair correlations with the outcome measures representing the body structure domain, and no or weak correlations with the outcome measures representing the activity and participation domain and quality of life. Pearson's *r* or Spearman's ρ was calculated for parametric data or nonparametric data, respectively. Spearman's ρ and Pearson's *r* values of 0.8–1, 0.6–0.8, 0.6–0.3, 0.3–0.1, 0–0.1, and 0 were defined as representing perfect, very strong, moderate, fair, poor, and no correlations, respectively[31]. The level of significance was adjusted to 0.013 (0.05/4) after Bonferroni adjustment for four groups of outcome measures. A receiver operating characteristic (ROC) curve was plotted to determine the cut-off FICSIT-4 score that best distinguished people with stroke from healthy adults, with a balance between sensitivity and specificity determined by Youden's index.

Results

Participants

The sociodemographic data are presented in Table 1. The participants with stroke and the healthy participants differed significantly in terms of sex and body mass index (BMI).

Reliability

All the participants with stroke (*n* = 62) completed the FICSIT-4 on both days. The FICSIT-4 demonstrated fair internal consistency (Cronbach's α = 0.775) and all the items demonstrated acceptable item-total correlations (r > 0.30) except for item 1 (a feet closely together stance with eyes open, r = 0.000). Although the results suggested an increase in Cronbach's α would result from deleting item 1, it's removal could only increase the alpha value by 0.022. Thus, all the items were worthy for retention. The FICSIT-4 items and FICSIT-4 overall had poor-to-excellent ($ICC_{2,1}$ = -0.210–0.756) and good test–retest reliability ($ICC_{2,1}$ = 0.676), respectively (Table 2). The range of weighted kappa values of item 3 to 7 was 0.208-0.519, indicating fair to moderate item-level agreement. Calculation of weighted kappa value was not applicable to item 1 as all the participants obtained the highest possible score across day 1 and day 2. Item 2 (a feet closely together stance with eyes closed) has insignificant kappa value. The SEM 2.983 (SD = 5.241) was 10.65% in relation to the total score indicating good precision of measurement.

Correlations with other outcome measures

The mean overall score on the FICSIT-4 was not correlated with the mean scores for the CIM-C, SF-12, or LOS-RT, but was moderately to very strongly correlated with the mean scores on the FMA-UE, FMA-LE, FTSTS, BBS, TUG, and ABC-C and on the remaining LOS domains (Table 3).

Known-group validity

FICSIT scores differed significantly between the participants with stroke and the healthy participants (Table 4).

Cutoff scores

The best FICSIT cut-off score for distinguishing between the participants with stroke and healthy participants was 25. The ROC for FICSIT revealed that the area under curve was 0.848, the sensitivity was 88%, and the specificity was 68% ($p < 0.001$; Fig. 2).

Discussion

This was the first study to examine the test–retest reliability and concurrent validity of the FICSIT-4 with various health-related measures with reference to the ICF framework and quality of life in a cohort of community-dwelling ambulatory and cognitively intact people with stroke. Furthermore, this study established the known-group validity and cut-off scores for the FICISIT-4 in the abovementioned cohort and a healthy adult cohort.

We calculated the Cronbach's α to evaluate the ability of FICIST-4 to measure standing ability. Given the minimal to mild lower limb impairment (FMA-LE mean score 26.68) and relatively young age (mean 64.02 years), all our study participants attained the highest score in item 1 (a feet closely together stance with eyes open) and the FICIST-4 only demonstrated fair internal consistency. These findings suggested that item 1 could be redundant in measuring the standing ability of people with young age and minimal to low level of lower limb impairment. However, we considered it is worth to retain item 1 in FICIST-4 for clinical use.

The mean FICSIT-4 score of participants with stroke in the present study (22.47 on day 1 and 22.77 on day 2, respectively) was lower than the mean FICSIT-4 score of the participants with stroke in Lee et al.[32] (29). However, the functional balance of the participants with stroke in the present study (mean TUG test time, 16.20 s; mean BBS score, 51.23 was better than that of the participants with stroke in Lee et al.32 (mean TUG test time, 23.06 s; mean BBS, 39.00). Moreover, the majority of participants in the present study (*n* = 50, 80.6%) were able to complete item 7 (single-leg stand with eyes open) in the FICSIT-4. Thus, the high FICSIT-4 scores of the participants with stroke in the present study may be attributable to their low level of limb impairment and balance disorders. We also calculated the weighted kappa values to examine the item-level agreement of the FICIST-4. This closer examination revealed that the test-retest reliability item 2 (a feet closely together stance with eyes close) was not established in hemiplegic people. However, the SEM value we obtained suggested that the overall FICIST-4 score is adequately precise in assessing the standing ability of community-dwelling, ambulatory and cognitively intact in people with stroke

The present study revealed that the FICSIT-4 has good test–retest reliability overall (ICC = 0.676, 95% confidence interval 0.515-0.792, similar to the findings of Blankevoort et al.[33] in a cohort of people with dementia (ICC = 0.79, 95% confidence interval 0.79–0.87). We believe that there are two possible reasons for the good repeatability of the FICSIT-4. First, the FICSIT-4 items are easy to perform. Therefore, provided that operators receive standardised training with pre-written protocol, operator error can be minimised during administration. Second, the test–retest interval in both the present study and Blankevoort et al. study[33] was approximately 1 week, which seems sufficient to minimise learning effects and the appearance of significant changes in standing balance ability. The minimisation of operator error and the short test–retest interval can ensure the repeatability of the FICSIT-4.

We found that standing ability measured by the FICSIT-4 was moderately correlated with the construct of bodily impairment measured by the FMA. From a physiological perspective, levels of upper-limb and lower-limb impairment[34] both contribute significantly to standing balance. Moreover, the FMA-LE assesses lower-limb sensation, motor control, and coordination. Lower-limb sensation is required for static balance during the FICSIT-4, as the foot sole sense and the joint position sense of the lower-limb joints provide intrinsic feedback regarding the COG and body posture, allowing a participant to adjust and maintain static standing balance. The moderate correlation between the FMA-LE and the FICSIT-4 suggests that the sensation, motor control, and coordination of the lower limb are key factors determining static standing balance.

Expectedly, the FICSIT-4 exhibited moderate to very strong correlations with the construct of functioning under the ICF framework as measured using the functional performance tests that operationalised functional balance in items measuring both static balance and dynamic balance. For example, the TUG test involves a series of functional tasks requiring the ability to maintain the COG within the BOS and to maintain dynamic balance during walking and turning. However, Sell et al.[35] found that there was no statistically significant correlation between static postural stability measured using a single-leg standing task and dynamic postural stability measured using a single-leg landing task. This explains why moderate-to-very strong but not perfect correlations were identified between the FICSIT-4 and the functional performance tests, i.e., the FICSIT-4 items focus on assessing standing balance, whereas the functional performance tests assesses both static and dynamic balance simultaneously.

In addition, we examined the correlation between the FICSIT-4 and subjective balance confidence using the ABC-C. Consistent with a previous study using the FICSIT-4[36] in healthy older adults, we found that standing balance ability was correlated with subjective balance confidence but the correlation was weaker than that between functional balance and standing ability. This finding echoes a recent finding that the aetiology of impaired subjective balance confidence is multifactorial and impaired balance ability is only one such factor[37]. Moreover, the ABC-C measures the subjective balance confidence in a hypothetical community setting and the FICSITS-4 measures standing balance ability in a controlled laboratory environment. This may explain why the FICSIT-4 and ABC-C scores were only weakly correlated.

The FICSIT-4 did not exhibit a significant correlation with the CIM-C or SF-12, which measure the subjective level of community integration and HRQoL, respectively. Although standing balance ability is the prerequisite for mobility and ADLs, our participants were cognitively intact and ambulatory people with chronic stroke recruited from self-help groups. Thus, they were active members in the community providing informal mutual support to other people with stroke. They had also developed habitual compensatory strategies to minimise obstacles to their community engagement and maximise their quality of life. Thus, the effects of impaired standing balance ability on our participants might have been minimal, such that associations between community integration and quality of life were not detected.

The known-group validity of the FICSIT-4 was demonstrated, confirming its ability to discriminate between the standing balance ability of people with stroke and that of those without stroke. In addition, the optimal cut-off score for distinguishing between these two populations based on standing balance performance was identified and exhibited an accuracy of 84% of doing so.

Limitations

Several limitations of this study need to be acknowledged. First, the generalisability of the findings is limited to those who met our inclusion criteria. Second, the literature reports varying scoring methods (5-point, 9 point and 28-point) and the present study used only the 28-point scale. Third, there was a wide range of time since stroke of our study participants. This data heterogeneity may represent the variations of performance in the standing ability of this cohort of community-dwelling people with stroke. Four, there was a significant difference between the sex ratio and BMI of the participants with stroke and those of healthy controls. We recommend large-scale future studies including stroke populations with diversified forms of stroke-specific impairment to increase the robustness of findings. Lastly, the sample size of 62 was barely enough for test-retest reliability and correlational analyses. Further studies therefore were recommended to examine the factor structure of the FICSIT-4 using factor analysis."

Conclusions

The FICSIT-4 is a reliable and valid measure to assess the standing balance ability of people with stroke. It is safe and easily administered in clinical settings.

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Declaration of interest

The authors report there are no competing interests to declare.

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Tables

Table 1 Characteristics of the stroke participants and healthy participants

Characteristics	Stroke participants (n=62)	Healthy participants (n=49)	*p*-value
Age (year), mean±SD	64.02±6.30	61.90±7.29	0.07
Sex (male/female), n	40/22	14/35	**<0.001**
Body mass index, mean±SD	24.38±3.21	22.53±3.18	**0.003**
Stroke type (ischemic/ Hemorrhagic), n	41/21		
Time since stroke (month), mean±SD	91.42±58.76		
Paretic side (left/right), n	31/31		
FMA-LE, mean±SD	26.68±4.56		

FMA-UE, mean±SD	45.06±18.46
FTSTS completion time (s), mean±SD	16.72±7.98
LOS-RT time (s), mean±SD	
Forward	1.57±0.45
Backward	1.66±0.46
Affected side	1.52±0.48
nonaffected side	1.45±0.49
Composite	1.55±0.43
LOS-MV (deg/s), mean±SD	
Forward	2.27±1.20
Backward	1.69±1.18

Affected side	2.59±1.66
Nonaffected side	2.76±1.44
Composite	2.29±1.00
LOS-EE (%), mean±SD	
Forward	36.69±22.08
Backward	33.05±22.30
Affected side	40.79±22.35
Nonaffected side	47.47±22.21
Composite	39.10±18.87
LOS-ME (%), mean±SD	
Forward	51.15±25.99

Backward	48.10±28.39
Affected side	52.48±22.20
Nonaffected side	60.39±25.14
Composite	53.27±22.53
LOS-DC (%), mean±SD	
Forward	49.79±23.58
Backward	27.02±22.10
Affected side	44.70±22.96
Nonaffected side	50.85±21.72
Composite	40.73±20.26
BBS score, mean±SD	51.23±4.60

TUG completion time (s), mean±SD	16.20±10.06
ABC-C score, mean±SD	66.64± 21.12
CIM-C score, mean±SD	40.89±7.23
SF-12 overall score, mean±SD	88.50±15.54
SF-12 physical component summary, mean±SD	39.33±8.38
SF-12 mental component summary, mean±SD	49.18±11.37

n, number

SD, standard deviation

FMA-LE, Fugl-Meyer Assessment- Lower Extremity.

FMA-UE,Fugl-Meyer Assessment- Upper Extremity.

FTSTS, Five Time Sit to Stand.

LOS-RT, Limit of Stability-Reaction Time.

LOS-MV, Limit of Stability-Movement Velocity.

LOS-EE, Limit of Stability-Endpoint Excursion.

LOS-ME, Limit of Stability-Maximum Excursion.

LOS-DC, Limit of Stability-Directional Control.

BBS, Berg Balance Scale.

TUG, Timed Up and Go.

ABC-C, Activities-specific Balance Confidence Scale - Cantonese Version.

CIM-C, Community Integration Measure - Cantonese Version.

SF-12,12-Item Short Form Survey.

Table 2 Test-retest Reliability of FICSIT-4 (stroke participants, n=62)

	Day 1 (mean±SD)	Day 2 (mean±SD)	Test-retest - ICC2,1	Test-retest – weighted kappa value
Item 1	**4.00±0.00**	**4.00±0.00**	ICC=1.000 (95%CI 1.000to 1.000)	/
Item 2	**3.94±0.51**	**3.95±0.22**	ICC=-0.210 (95%CI -0.267 to 0.228	-0.012, p=0.820
Item 3	**3.71±0.84**	**3.84±0.58**	ICC=0.383 (95%CI 0.149 to 0.576	0.519, p<0.001
Item 4	**3.26±1.14**	**3.52±0.94**	ICC=0.461 (95%CI 0.241 to 0.636	0.225, p=0.004
Item 5	**2.77±1.49**	**2.73±1.54**	ICC=0.617 (95%CI 0.436 to 0.750	0.464, p<0.001
Item 6	**2.18±1.40**	**2.18±1.44**	ICC=0.602 (95%CI 0.416 to 0.739	0.446, p<0.001
Item 7	**2.61±1.67**	**2.56±1.63**	ICC=0.756 (95%CI 0.626 to 0.846	0.502, p<0.001
Total	**22.47±5.24**	**22.77±4.80**	ICC=0.676 (95%CI 0.515 to 0.792)	0.208, p<0.001

CI, confidence interval.

Table 3 Correlations between FICSIT-4 and variables of interests (n=62)

	FICSIT-4	
	rho	p-value

FMA-LE	0.42	0.001
FMA-UE	0.31	0.013
FTSTS	-0.45	<0.001
LOS-RT, composite	-0.23	0.073
LOS-MV, composite	0.41	0.001
LOS-EE, composite	0.36	0.004
LOS-ME, composite	0.35	0.005
LOS-DC, composite	0.35	0.006
BBS	0.73	<0.001
TUG	-0.62	<0.001
ABC-C	0.38	0.003
CIM-C	0.18	0.162
SF-12, composite	0.25	0.055
SF-12 physical component summary	0.22	0.091
SF-12, mental component summary	0.18	0.158

FMA-LE, Fugl-Meyer Assessment- Lower Extremity.

FMA-UE,Fugl-Meyer Assessment- Upper Extremity.

FTSTS, Five Time Sit to Stand.

LOS-RT, Limit of Stability-Reaction Time.

LOS-MV, Limit of Stability-Movement Velocity.

LOS-EE, Limit of Stability-Endpoint Excursion.

LOS-ME, Limit of Stability-Maximum Excursion.

LOS-DC, Limit of Stability-Directional Control.

BBS, Berg Balance Scale.

TUG, Timed Up and Go.

ABC-C, Activities-specific Balance Confidence Scale - Cantonese Version.

CIM-C, Community Integration Measure - Cantonese Version.

SF-12,12-Item Short Form Survey.

Table 4 Known-group validity of FICSIT-4

	Stroke participants (n=62)	Healthy participants (n=49)	*p*-value
FICSIT-4 score (Day 1), mean±SD	22.47±5.24	27.08±1.73	<0.001

SD, standard deviation.

Figure 1. Testing procedures examining the test-retest reliability of FICISIT

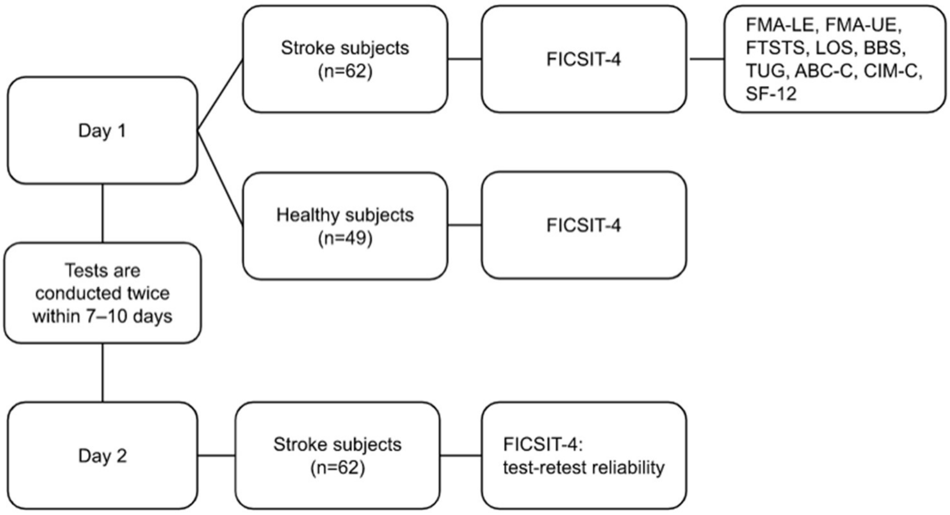

Figure 2 Receiver Operating Characteristic (ROC) Curve for FICSIT-4 Total Scores