

Evaluation of Intra-Rater & Inter-Rater Reliability of Indian Stroke Scale Measuring Participation in Daily Activities among Stroke Patients in India

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Abstract: Background: Stroke can lead to limitations in mobility, self-care, domestic activities, and participation in daily life. Assessment of participation is important for planning and monitoring rehabilitation. The Indian Stroke Scale (ISS) was developed to assess participation in daily activities among individuals with stroke in the Indian sociocultural context. However, limited evidence is available regarding its intra-rater and inter-rater reliability. Aim: To evaluate the intra-rater and inter-rater reliability of the Indian Stroke Scale in assessing participation in daily activities among patients with stroke. Methods: A correlation study was conducted on 60 post-stroke patients selected by convenient sampling from the Neurosciences OPD of Shree Siddheshwar College of Physiotherapy. The ISS was administered by physiotherapy interns under standardized conditions. Inter-rater reliability was assessed by comparing scores obtained by two different investigators. Intra-rater reliability was assessed by repeated administration by the same investigator with an interval of one week. The collected data were statistically analysed using correlation and paired-samples statistical tests. Results: The study included 60 participants. A strong positive correlation was observed between Investigator 1 and Investigator 2 scores ($r = 0.885, p < 0.001$), indicating good inter-rater agreement. A strong positive correlation was also observed between Week 1 and Week 2 scores ($r = 0.836, p < 0.001$), indicating good intra-rater agreement. A statistically significant difference was observed between inter-rater and intra-rater difference scores ($t = -4.698, p < 0.001$). Conclusion: The findings indicate that the Indian Stroke Scale demonstrates good consistency between different raters and across repeated assessments by the same rater. The ISS may therefore be a useful outcome measure for assessing participation in daily activities among individuals with stroke in the Indian clinical and rehabilitation setting.

Keywords: Stroke, Indian Stroke Scale, Reliability, Intra-rater reliability, Inter-rater reliability, Activities of daily living, Physiotherapy

1. Introduction

Stroke is a neurological condition that occurs suddenly and results in the loss of specific brain functions. It may occur due to an interruption of blood supply to the brain or bleeding within the brain. Stroke can result in impairments in movement, balance, communication, cognition, and the ability to perform activities of daily living. Severity of neurological deficits depends upon the extent of brain injury. These impairments may affect an individual's ability to perform household tasks and participate in social and community activities. The residual neurological impairments are those that last longer than 3 weeks and can lead to severe disability. Stroke is increasingly recognized as a major public health concern in India. The number of individuals experiencing stroke and those living with its consequences has increased considerably.^[1]

A review of stroke data from India reported that the annual incidence of stroke ranged from 108 to 172 per 100,000 population, while the prevalence ranged from 26 to 757 per 100,000 population. The review also reported that approximately 18% to 42% of individuals with stroke died within one month of the event. These findings emphasize the need for reliable and consistent data to understand the burden and impact of stroke in India.^[1]

Another review of stroke in India reported an annual incidence ranging from 105 to 152 per 100,000 population and a prevalence ranging from 44.29 to 559 per 100,000 population. The review also identified several methodological

limitations, including variations in study methods, small sample sizes, and a lack of standardized reporting procedures. Overall, these findings indicate that stroke represents a significant health concern in India and emphasize the importance of appropriate assessment and rehabilitation for stroke survivors.^[2] Assessment of functional outcomes following stroke is an important component of rehabilitation. Outcome measures assist physiotherapists in identifying functional limitations, establishing appropriate treatment goals, monitoring changes over time, and determining the effectiveness of rehabilitation interventions. However, different outcome measures assess different aspects of recovery. A review identified 48 different outcome measures used to assess upper-limb function following stroke and reported considerable variation in their measurement properties. The authors emphasized the importance of selecting outcome measures that demonstrate adequate reliability, validity, objectivity, and clinical relevance.^[3]

Stroke rehabilitation should not be limited to the management of physical impairments. It should also address limitations in activities of daily living and restrictions in participation in social and community life. A review identified 36 different outcome measures used to assess participation following stroke. However, none of the identified measures comprehensively addressed all aspects of participation described within the International Classification of Functioning, Disability and Health (ICF) framework. The review therefore emphasized the need for assessment tools that consider the individual's everyday experiences and comprehensively evaluate the impact of stroke on

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participation.^[4] For an outcome measure to be useful in both clinical practice and research, it should demonstrate adequate reliability and validity.

Reliability refers to the consistency with which a measurement tool produces similar results when the same construct is measured under similar conditions. In other words, a reliable measurement should provide consistent results when repeated. Reliability can be assessed using different approaches, including intra-rater and inter-rater reliability. Intra-rater reliability refers to the consistency of measurements obtained by the same assessor when the assessment is repeated under similar conditions. Inter-rater reliability refers to the consistency of measurements obtained when the same patient is assessed by different assessors. Establishing both forms of reliability is important because variations in scores should reflect actual changes in the patient's condition rather than differences or errors associated with the assessor or measurement process. The importance of establishing reliability has been demonstrated in several studies involving stroke outcome measures.

Two physiotherapists independently assessed the participants, and repeated assessments were performed by the same physiotherapist to determine intra-rater reliability. The findings demonstrated the importance of establishing the reliability of outcome measures used to assess patients following stroke.^[5] Similarly, colleagues investigated the inter-rater reliability of the Reaching Performance Scale in individuals with stroke. The study reported strong inter-rater reliability, with correlation coefficients of 0.951 for the close target and 0.946 for the far target. These findings highlight the importance of establishing inter-rater reliability when an outcome measure is administered by different assessors.^[5]

Indian Stroke Scale

Many outcome measures used in stroke rehabilitation have been developed outside India. Therefore, their applicability and relevance within the Indian sociocultural context may be limited. Differences in language, culture, lifestyle, environmental conditions, and the activities considered important in daily life may influence how patients perceive and perform functional activities. Consequently, an outcome measure developed in another cultural setting may not fully represent the experiences and participation needs of individuals living with stroke in India.

To address this concern, **Prakash and Ganesan** developed the Indian Stroke Scale (ISS), specifically considering the sociocultural and linguistic context of individuals with stroke in India. The authors highlighted that commonly used post-stroke outcome measures may not adequately account for sociocultural differences within the Indian population.^[6] The development of the ISS was therefore aimed at providing an outcome measure that was relevant to the daily activities and participation of individuals living with stroke in the Indian context. The published development and validation study describes the ISS as a 25-item patient-reported outcome measure designed to assess participation in daily activities among individuals with stroke in India.^[6] During its initial psychometric evaluation, the ISS was administered to 377 individuals with stroke recruited from two tertiary-care hospitals and five physiotherapy outpatient rehabilitation

centres in India. The ISS also demonstrated construct validity through significant associations with activities of daily living, social participation, and the Barthel Index.^[6]

These findings provide preliminary evidence supporting the reliability and validity of the ISS as a measure of post-stroke participation in the Indian context. The ISS therefore provides a culturally relevant approach for assessing participation in daily activities among individuals with stroke in India. Its development highlights the importance of using outcome measures that consider the sociocultural background, daily activities, and participation needs of the population being assessed. Although the initial psychometric evaluation of the ISS demonstrated good internal consistency, construct validity, and test-retest reliability, further investigation of its reliability is warranted. In particular, establishing intra-rater and inter-rater reliability is important when the ISS is used in clinical practice and research settings where assessments may be performed repeatedly by the same physiotherapist or by different physiotherapists.

Consistent scores across repeated assessments and between different assessors are necessary to determine whether observed differences in scores represent genuine changes in the patient's participation or variability related to the measurement process. Therefore, there is a need to investigate the intra-rater and inter-rater reliability of the Indian Stroke Scale. Establishing these reliability properties may provide additional evidence regarding the consistency of the ISS when used by physiotherapists and may strengthen its applicability as an outcome measure for individuals with stroke in the Indian clinical and research setting. Hence, the present study aims to determine the intra-rater and inter-rater reliability of the Indian Stroke Scale in individuals with stroke.

There are many assessment tools which can be used to determine the extent of impairment. For example, Glasgow Coma Scale (GCS), Mini Mental State Examination (MMSE) scales to assess the level of consciousness, Berg Balance Scale (BBS) for balance assessment, Dynamic Gait Index (DGI) to assess the gait impairments and many more. But there very few assessment tools to assess the functional ability of the stroke patients. And there are further less scales to assess the functional ability of stroke patients in Indian sociocultural contexts⁵

2. Materials and Methodology

The present study was designed as a correlation study involving post-stroke patients. The study was conducted at SSCOP and the CNS Neuro Physiotherapy Department over a period of six months. A convenient sampling method was used to recruit a total of 60 patients for the study. The sample size was determined using an appropriate calculation formula. The materials used for data collection and assessment included the Indian Stroke Scale scoring sheet in both Marathi and English, a pen, a chair, and a plinth.

Selection Criteria

The study included patients diagnosed with stroke, irrespective of gender, including males, females, and transgender individuals, aged above 45 years. Patients with a history of transient ischemic attack (TIA), pre-existing

disabilities due to any neurological disorder, or concomitant severe systemic illness were excluded from the study. Additionally, patients with impaired ability to understand the questionnaires and those who were uncooperative during the assessment were excluded.

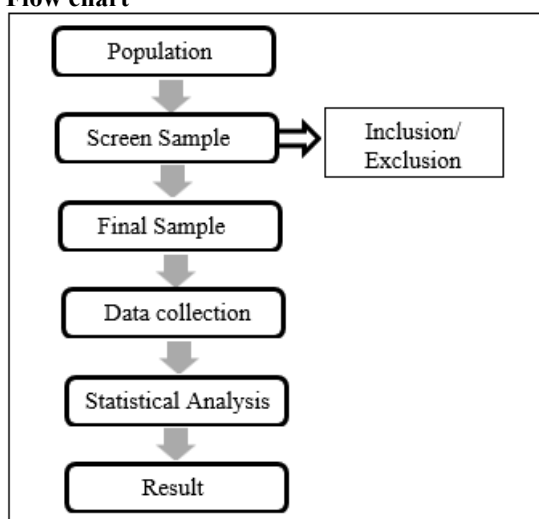
Outcome Measure

Indian Stroke scale (Marathi and English) scoring sheet. The Indian stroke scale is a simple clinical tool developed in India to assess the severity of stroke and monitor recovery.

Procedure

Ethical approval was taken from Institutional ethical committee of SSCOP. A 60 post stroke patients were selected from Neurosciences OPD across solapur. The patients were screened through inclusion and exclusion criteria. An informed consent was taken from the patient before the starting of the study. As a procedure is a double-blind one-time study in order to prevent scoring error, three successive readings were noted and a separate seat is used for the two examiners and examiners unaware of each other results. Intra rater reliability, the Indian Stroke Scale independently administered twice by the same physiotherapy interns to a separate sample of 60 participants, during both administration and instruction provided to both interns and patients will be kept same. The time interval between the administration will be one week. The readings will be tabulated for statistical analysis.

Flow chart



Picture: Patients at SSCOP OPD during rehabilitation sessions



Statistical Analysis and Data Presentation

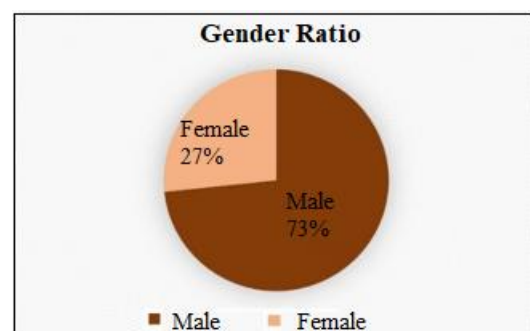


Figure 1: Gender Distribution

Interpretation: The gender distribution shows that out of 60 participants, 16 (27%) were female and 44 (73%) were male. Figure 2. Age Distribution

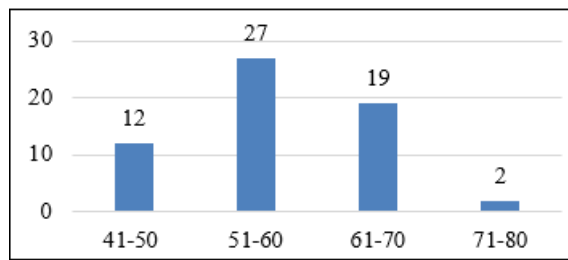


Figure 4: Age Group

Interpretation: The bar chart shows the age distribution of the 60 study participants. The highest number of participants were 27 in Age group 51-60, followed by 19 in age group 61-70. Participants of age group 41-50 were 12, while 2 participants accounted for 71-80 years of age group.

Table 1: Spearman's Rank Correlation Between Investigator 1 and Investigator 2 Indian Stroke Scale Scores.

Comparison	N	r	P
Investigator 1 vs. Investigator 2	60	0.885	< .001

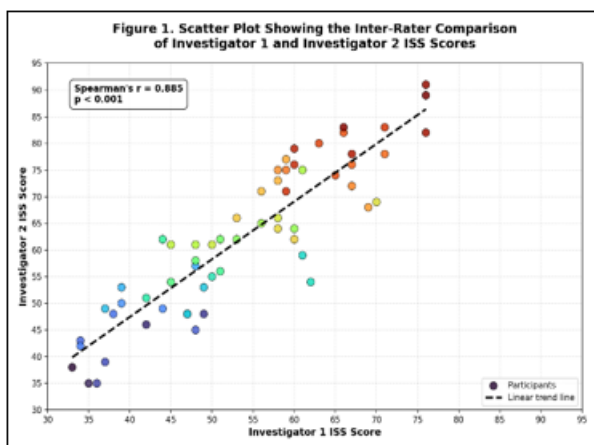


Figure interpretation: The scatter plot demonstrates a strong positive association between Investigator 1 and Investigator 2 ISS scores, consistent with the Spearman correlation coefficient ($r = 0.885$, $p < .001$).

Table 2: Spearman's Rank Correlation Between Investigator 2 Week 1 and Week 2 Indian Stroke Scale Scores

Comparison	N	r	P
Week 1 vs. Week 2	60	0.836	< .001

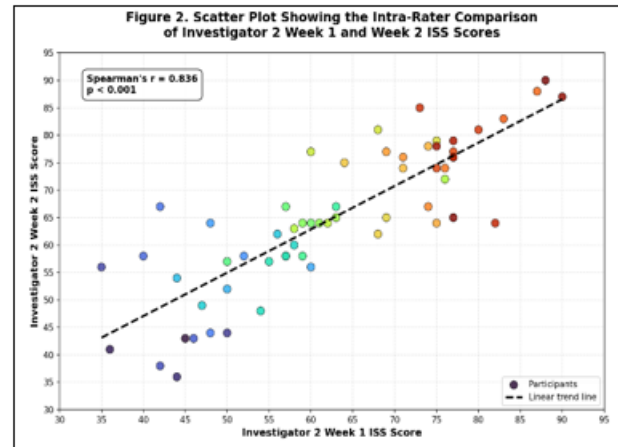


Figure interpretation: The scatter plot demonstrates a strong positive association between Investigator 2 Week 1 and Week 2 ISS scores, consistent with the Spearman correlation coefficient ($r = 0.836$, $p < .001$).

Table 3: Paired-Samples t-Test Comparing Inter-Rater and Intra-Rater Difference Scores.

Comparison	Mean Difference	t	df	p-value
Inter-rater vs Intra-rater differences	-6.300	-4.698	59	< .001

Table interpretation: The paired-samples t-test showed a statistically significant difference between the inter-rater and intra-rater difference scores, $t(59) = -4.698$, $p < .001$.

3. Results

Inter-rater reliability

Among 60 participants, Investigator 1 had a mean ISS score of 53.850 ± 11.763 , while Investigator 2 had a mean score of 62.433 ± 14.163 . The Indian Stroke Scale (A,1) was 0.727 (95% CI: $-0.02-0.91$; $p < 0.001$), indicating moderate-to-good inter-rater agreement. A strong positive correlation was observed between the two investigators (Spearman's $r = 0.885$, $p < 0.001$). The paired t-test showed a statistically significant difference between the scores ($t(59) = -10.579$, $p < 0.001$).

Intra-rater reliability

For Investigator 2, the mean ISS score was 62.767 ± 13.945 at Week 1 and 65.050 ± 13.166 at Week 2. The Indian Stroke Scale (A,1) was 0.825 (95% CI: $0.72-0.89$; $p < 0.001$), indicating good intra-rater agreement. A strong positive correlation was observed between Week 1 and Week 2 scores (Spearman's $r = 0.836$, $p < 0.001$). The paired t-test showed a statistically significant difference ($t(59) = -2.268$, $p = 0.027$). Comparison of inter-rater and intra-rater differences

The mean inter-rater difference was -8.583 , whereas the mean intra-rater difference was -2.283 . The paired t-test demonstrated a statistically significant difference between the two difference scores ($t(59) = -4.698$, $p < 0.001$), indicating that the magnitude of the inter-rater difference was greater than the intra-rater difference.

4. Discussion

This study evaluated the intra-rater and inter-rater reliability of the Indian Stroke Scale (ISS) for assessing participation in daily activities among 60 post-stroke patients in India. The ISS was administered by physiotherapy interns under standardized conditions, with independent and blinded scoring used to minimize observer bias.

The inter-rater indicated **good** agreement between the two assessors. This suggests that, when administered using a standardized procedure, the ISS can yield consistent scores across different raters. This is clinically relevant because stroke rehabilitation assessments are often performed by different clinicians, and reliable inter-rater agreement supports continuity of care and comparability of scores across assessors.

The intra-rater ICC, obtained **moderate** stability of ISS scores when the same rater reassessed participants. This finding supports the use of the ISS for repeated monitoring of participation during rehabilitation, as stable scores are more likely to reflect true changes in the patient's functional status rather than measurement error.

These results are consistent with the original validation study by Prakash and Ganesan, which reported good test-retest reliability for the ISS (ICC = 0.80), along with good internal consistency and construct validity. The present findings extend this evidence by examining both intra-rater and inter-rater reliability in a clinical outpatient setting. However, reliability estimates may vary with participant characteristics, stroke severity, rater training, testing interval, and the ICC model used; therefore, direct comparison with previous studies should be interpreted cautiously.

The one-week test-retest interval was appropriate for reducing recall bias while limiting the likelihood of substantial natural recovery. Nevertheless, some change in participation cannot be entirely excluded in a post-stroke population.

Overall, the findings provide preliminary support for the reliability of the ISS as a culturally appropriate outcome measure for assessing participation in daily activities among Indian patients with stroke. A reliable ISS may be useful in routine physiotherapy practice and research for monitoring rehabilitation outcomes and evaluating changes in participation over time.

5. Conclusion

Strong positive associations were observed for both inter-rater and intra-rater comparisons. The study analysis demonstrated good inter-rater agreement between Investigator 1 and Investigator 2 and good to moderate intra-rater agreement for Investigator 2 across Week 1 and Week 2. Statistically significant differences were observed in the paired raw **Indian Stroke Scale** scores for both inter-rater and intra-rater comparisons, as well as between the inter-rater and intra-rater score differences. The Indian Stroke Scale showed consistent measurement of participation in daily activities among the studied post-stroke participants.

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Conflict of Interest: No conflict

Ethical Clearance: The research study is given clearance under ethical committee headed by Prof. Dr. Sureshkumar Principal, SSCOP, Solapur.

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Indian Stroke Scale

During the past 2 weeks, to what extent do you feel limited in doing following activities?		1. Completely limited 2. A lot limited 3. Somewhat limited 4. A little limited 5. Not at all limited
1.	Get out of bed	
2.	Stand without support for 5 minutes	
3.	Stand up from an armchair	
4.	Stand up from a low or soft couch	
5.	Move around inside your home	
6.	Walk outside of your home e.g. on the streets	
7.	Walk on slippery ground e.g. bathroom floor	
8.	Walk a long distance such as a kilometer or for 10-15 minutes	
9.	Walk fast for a short distance e.g. crossing a busy road or catching a bus	
10.	Climb stairs or steps e.g. entering your home	
11.	Toileting	
12.	Taking a bath	
13.	Getting dressed	
14.	Eating with preferred hand	

Are the following activities important to you, if yes, during the past 4 weeks, to what extent do you feel limited in doing these activities?		0. Not important 1. Completely limited 2. A lot limited 3. Somewhat limited 4. A little limited 5. Not at all limited
15.	Pour liquid from a container/bottle into a glass	
16.	Reach and retrieve an object (e.g. container) from above your head	
17.	Sit down on the floor and get up	
18.	Wash dishes and utensils	
19.	Prepare a meal	
20.	Clean your house e.g. sweeping or dusting	
21.	Wash clothes by hand	
22.	Carry a bag of groceries or vegetables from the shop or market	
23.	Travel on a public transport vehicle e.g. Bus, auto, train	
24.	Attend social ceremonies e.g. weddings, get-togethers with family and friends	
25.	Visit friends', relatives' or neighbors' homes	
ISS total score = (sum of n responses ÷ n) – 1 * 25 where n is equal to the number of completed responses ISS Total Score /100		