Research Protocol

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Physiotherapy Section

Hindi Translation, Validation and Reliability Testing of the Dynamic Gait Index in Stroke Patients with Residual Weakness: A Research Protocol for a Psychometric Validation Study

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ABSTRACT

Introduction: Stroke is one of the primary causes of lifelong disability, and typically an individual will experience some type of walking/gait impairment, a decreased ability to shift their weight, and altered balance. Since walking is one of the most critical aspects of performing everyday tasks, gait assessment must be performed accurately so rehabilitation can occur appropriately.

Need of the study: The Dynamic Gait Index (DGI) is a well-established measure to assess dynamic balance among stroke survivors, and has been translated into several languages, including Brazilian, Portuguese, Turkish, Arabic, Icelandic, and Urdu. There is presently no published version of the DGI in Hindi, restricting its use among the vast number of Hindi-speaking individuals in India and elsewhere.

Aim: To translate the DGI into Hindi and assess its validity and reliability for use in stroke rehabilitation.

Materials and Methods: A psychometric validation study involving 51 stroke patients will be conducted at Maharishi Markandeshwar Institute of Physiotherapy and Rehabilitation, Mullana, Ambala, Haryana, from January 2026 to December 2026. The Translation and cultural adaptation procedure will be performed according to Beaton's Guidelines (forward translation, synthesis, back translation, expert committee review, pretest, and finalization) to ensure linguistic clarity and cultural appropriateness. Content Validity will be evaluated by using the Item-level Content Validity Index (I-CVI) and Scale-level Content Validity Index (S-CVI/AVE). Reliability analysis will be performed using the intraclass correlation coefficient (ICC) and Cronbach's alpha to determine the internal consistency. Agreement between measurements will be assessed using Bland-Altman plots.

Statistical analysis will be conducted to evaluate the psychometric properties of the translated scale, including internal consistency (Cronbach's alpha) and test-retest reliability (intraclass correlation coefficient), with significance set at $p<0.05$.

Keywords: Walking, Dynamic gait index, Stroke rehabilitation, Linguistics, Survivors

INTRODUCTION

Stroke often results in permanent disability and significant deficits in gait, balance, and motor functions [1]. After a stroke most survivors carry weaknesses and lower dynamic balance, which greatly affects their ability to walk by themselves and safely [2]. To enhance functional outcomes and reduce fall risk in this population, effective rehabilitation coupled with accurate gait and balance assessments is essential [3]. Prior research confirms that even in patients with visual impairments, the DGI maintains its dependability [4].

Numerous conditions, such as hemiparesis following a stroke, spasticity, proprioceptive impairments and vision issues, will result in impaired dynamic stability. The functional balance measured by the DGI during gait exercises resembles the mobility needs of the actual world [5].

The DGI shows numerous studies to have outstanding validity and reliability in stroke populations. Previous studies have reported excellent test–retest and inter-rater reliability for the total DGI score in ambulatory chronic stroke patients, with ICC values ranging from 0.96 to 0.98, while individual item reliability ranged from moderate to good. Stroke survivors are verified by significant correlations with the Timed Up and Go test (TUG) and the Berg Balance Scale (BBS), and that shows concurrent validity and exceeds other balance scales [6,7].

The DGI's slightly better reaction to change during rehabilitation enhances its capacity to record recovery. Beyond stroke, its validity is demonstrated by the DGI's broad application in neurological and vestibular populations, such as those with eye movement disorders in post-stroke patients ,multiple sclerosis, Parkinson's disease, and cerebellar diseases [4]. Despite its widespread use, the DGI presents difficulties when used in people with different cultural and linguistic backgrounds. There is currently no validated Hindi version of the DGI available, even though the Hindi-speaking population in India makes up a sizable clinical group impacted by stroke. Accurate clinical evaluation may be hampered by the lack of validated regional language versions, which also restricts equal access to standardised gait assessment methods [8,9].

The DGI is naturally equipped to identify the functional effects of visual and motor impairments since it evaluates gait adaptation, considering head movements and obstacle negotiation [7].

Complex neuroplastic changes brought about by motor learning and adaptive training are a part of stroke therapy. A key component of rehabilitation is functional gait assessment, which aims to restore safe, effective movement to increase independence [10].

With the use of trustworthy instruments like the DGI, longitudinal evaluations allow physicians to track advancement, spot obstacles, and forecast recovery paths. The DGI's documented minimal detectable change makes it easier to separate measurement error from real advances [5].

Standardised stroke examinations are severely lacking for the large number of patients in India who speak Hindi. Maintaining the semantic integrity of test items and providing clear instructions are both made more difficult by the language barrier [11]. Physiotherapists

and rehabilitation professionals will be able to perform accurate gait and balance assessments with a language suitable DGI version, improving patient involvement and adherence.

REVIEW OF LITERATURE

Stroke, a leading cause of long term disability, often impairs gait, balance, and mobility. Dynamic balance testing is therefore critical in stroke rehabilitation, as gait adaptation and postural control directly influence fall risk and ambulation [5]. The Dynamic Gait Index (DGI), developed by Shumway Cook and Woollacott, evaluates gait performance under varying demands such as head turns, obstacle avoidance, and stair climbing. With strong psychometric properties, the DGI has been widely studied in neurological populations, particularly stroke survivors. However, limited availability of authorized regional translations restricts its use in linguistically diverse communities, underscoring the need for cross cultural adaptation to enhance patient comprehension and clinical accuracy.

Jonsdottir and Cattaneo (2007) [1] validated the DGI in ambulatory chronic stroke patients, reporting excellent test retest and inter-rater reliability (ICC = 0.96) and strong correlations with the Berg Balance Scale (BBS) and Timed Up and Go (TUG). While the study confirmed the DGI's clinical utility, its findings may not generalise to severely disabled patients. Alghwiri (2014) [12] translated and validated the DGI into Arabic, demonstrating strong cross-cultural validity and reliability, though applicability is limited to specific regions. An et al. (2016) [13] showed that both the original and shortened DGI versions predicted fall risk, highlighting its practical value in clinical fall prevention strategies despite the observational design. Similarly, Alghadir et al. (2018) [14] found the DGI highly reliable and responsive in chronic stroke patients, outperforming static balance tests, though results may not extend to acute or subacute cases. Matsuda et al. (2014) [7] confirmed the construct validity of the modified DGI across neurological disorders, broadening its applicability beyond stroke, while Marchetti and Whitney (2006) [15] developed a shortened four item DGI that retained validity and reliability, offering a rapid alternative for busy clinical settings.

Collectively, these studies establish the DGI as a reliable, valid, and clinically meaningful tool for assessing dynamic balance, gait performance, and fall risk in stroke and other neurological populations. Evidence also emphasises the importance of linguistic adaptation to ensure accessibility. Although versions exist in several languages, no official Hindi translation is available. Given India's large Hindi speaking population and rising stroke prevalence, translating and validating the DGI into Hindi is essential to support standardised gait assessment in Indian clinical practice.Thus the present study aims to translate the DGI into Hindi and assess its validity and reliability for use in stroke rehabilitation.

Primary objective: To translate, validate, and establish the reliability of the Hindi version of the Dynamic Gait Index (HDGI) in stroke patients with residual weakness.

Secondary objectives: To determine the cultural appropriateness and clinical applicability of the Hindi Dynamic Gait Index in Hindi-speaking stroke patients.

MATERIALS AND METHODS

This psychometric validation study will be conducted at the Maharishi Markandeshwar Institute of Physiotherapy and Rehabilitation, MM (DU), Mullana, Ambala, Haryana, India, from January 2026 to December 2026, following ethical approval from the Institutional Ethical Committee (IEC-3442). The trial has been registered with the Clinical Trials Registry of India (CTRI/2026/01/101148). Written informed consent will be obtained from all participants prior to enrollment.

Inclusion criteria: Males and females aged 18 years and above; confirmed diagnosis of ischaemic stroke with residual weakness ; basic understanding of Hindi; and sufficient cognitive function to follow instructions.

Exclusion criteria: Presence of other neurological or musculoskeletal conditions; uncontrolled co-morbidities; dementia or severe cognitive impairment; psychiatric disorders; uncooperative behaviour; and non-native Hindi speakers.

Sample size calculation: The sample size will be calculated using the formula applied is: $n=Z^2\times P(1-P)/d^2$.

where

- n= required sample size
- Z= standard normal deviate at 95% confidence level = 1.96
- P= estimate proportion= 0.50
- d= absolute precision= 0.14

Substituting the values into the formula.

$n=(1.96)^2\times 0.50(1-0.50)/(0.14)^2$

$1-0.50=0.50$

$0.50\times 0.50=0.25$

$(1.96)^2=3.8416$

$3.8416\times 0.25=0.9604$

$(0.14)^2=0.0196$

$n=0.9604 /0.0196=49$

Thus, the minimum required sample size will be 49 participants.

To compensate for an anticipated 4% dropout rate, the final sample size is 51 participants.

A sample of 51 participants will be recruited, which is also supported by Beaton's guidelines [8] for cross-cultural adaptation, which recommend a minimum of 30-40 subjects for the pretesting phase and additional subjects for reliability testing.

Forward Translation

Two independent forward translations will be conducted to adapt the scale from English to Hindi. The first translation (HDGI T1) will be performed by a translator with a medical background who is familiar with the concepts underlying the scale. The second translation (HDGI T2) will be carried out by a translator without a medical background. Because non medical translators tend to read the content more naturally, they often select language that resonates with the target community and highlight sections of the original scale that may be confusing. This version is commonly referred to as the "naïve" translation.

For this phase to be successful, both translators must be fluent in Hindi and English. Any discrepancies between the two forward translations (HDGI T1 and T2) will be addressed through a structured reconciliation process. The two translators and the principal investigator will convene a formal meeting to review all divergent items. Each discrepancy will be documented in a reconciliation log, which will include the original item, both translated versions, the nature of the disagreement, and the final agreed wording with its justification.

Consensus will be reached through discussion, guided by the principle of preserving the conceptual equivalence and cultural appropriateness of the original scale. All reconciliation decisions will be formally recorded to ensure transparency and methodological consistency throughout the adaptation process.

Stage of synthesis: The synthesis of the two forward translations (HDGI T1 and T2) will be carried out through a formal reconciliation meeting involving both translators and the principal investigator. All discrepancies will be systematically documented in a structured reconciliation report, capturing the nature of each disagreement, the options considered, and the rationale for the final decision. Communication will occur only through formal, documented channels; informal platforms will not be used. The reconciled version (HDGI T1-T2) will be finalised once all discrepancies have been resolved and recorded, ensuring methodological rigor and reproducibility.

Stage of Backward Translation

The synthesised version (HDGI T1-T2) will then be back-translated into English by HDGI BT1 and BT2, who will work entirely from the T1-T2 version without any prior knowledge of the scale or translation process. This helps ensure that the translated version identifies confusing or inaccurate terminology and aligns conceptually with the agreement between the back translation and the original version which indicates consistency, but it does not necessarily guarantee accuracy considering the forward translation errors may also persist. Any differences identified between the two back-translated versions (HDGI BT1 and BT2) and the original English DGI will be systematically reviewed during a formal meeting involving the primary investigator, both back-translators, and at least one member of the expert committee. Discrepancies will be documented in a structured reconciliation report, and decisions regarding retention, modification, or rejection of specific items will be recorded with explicit justification. All consensus meetings will be minuted to ensure transparency and traceability of the adaptation process.

By limiting information bias and highlighting potential misinterpretations, back translation by two non medical English-speaking translators increases the possibility of finding significant gaps.

Content Validation Procedure

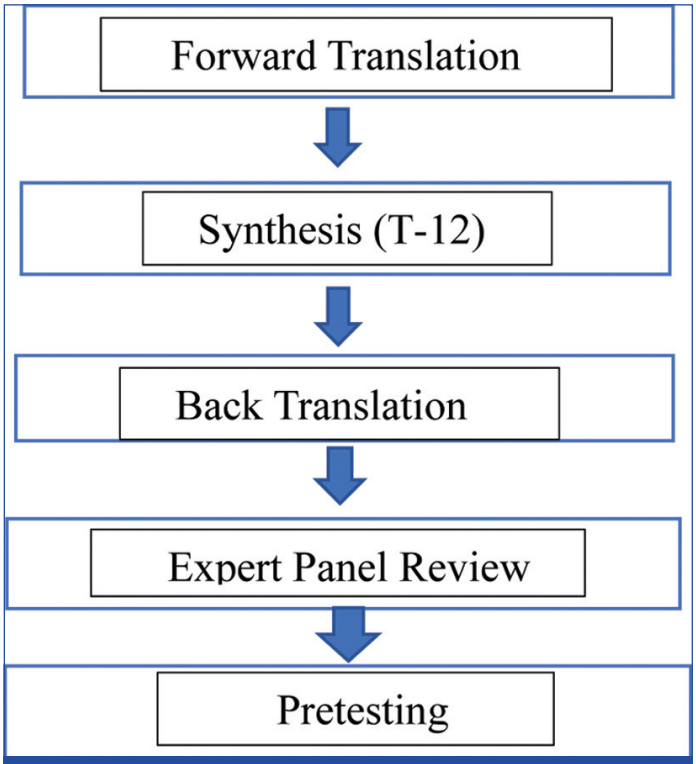
Expert committee review: The completion of the HDGI translation into Hindi will rely on input from an expert review committee using an online Delphi process. Experts with medical profession with at least five years of experience in handling stroke patients in India. A different panel will be invited if a second Delphi round is needed. The expert committee will comprise 6-10 professionals, including physiotherapists, neurologists, and linguists, each with a minimum of five years of clinical experience in stroke rehabilitation in India. Experts will independently evaluate each item using a four-point relevance scale via a structured online Delphi process. Consensus will be defined as an I-CVI of ≥0.78 and S-CVI/AVE of ≥0.90, per Lynn's (1986) criteria[16]. If consensus is not achieved in the first round, a second Delphi round will be conducted with a revised or expanded panel, and all deliberations, modifications, and decisions across rounds will be formally documented.

1. Not relevant
2. Needs revision
3. Relevant but needs a small correction
4. Very relevant

In content validation, these grading techniques are commonly used. The final documentation and reasoning for the Hindi version will be informed by the opinions of experts. Significant reflective queries consist of: Do the terms have the same meaning? Can there be more than one interpretation? Are there any grammatical or linguistic problems?

Phase of Review of the Final Translated HDGI

The draft Hindi DGI (HDGI) will be administered to a pilot sample of 30–40 Hindi-speaking stroke patients, in accordance with Beaton's guidelines. Each participant will be asked to complete the scale and subsequently respond to a structured feedback questionnaire assessing: (1) clarity of instructions, (2) comprehensibility of individual items, (3) cultural appropriateness of language used, and (4) any difficulty encountered in interpreting specific items. Responses will be recorded using a standardised proforma. The primary investigator will document the proportion of participants who had trouble with each item (>15% difficulty threshold, per Beaton's recommendations). Items flagged by ≥15% of participants will be reviewed by the expert committee for linguistic modification. All modifications, their rationale, and the consensus reached will be formally documented. A second pretest round will be conducted if substantial revisions are made, ensuring that the final HDGI version achieves adequate comprehensibility before proceeding to formal validation [Table/Fig-1].



[Table/Fig-1]: A flowchart depicting the translation and cultural adaptation process for the Dynamic Gait Index.

Transmission of Documents Records for Submission

Following the pretest, all participant feedback will be reviewed by the expert committee. Items reported as unclear or ambiguous by 15% or more of participants will be linguistically revised, and the rationale for each modification will be formally documented. If substantial changes are made, a second pretest round will be conducted to confirm adequacy of the revised items before finalising the HDGI for formal validation.

Study Participants and Setting

According to Beaton's Guidelines, 51 individuals with acute, subacute, or chronic ischaemic stroke with residual weakness will be selected from Maharishi Markandeshwar Institute of Physiotherapy and Rehabilitation, Mullana, Ambala, Haryana, to assess the validity of the final Hindi HDGI [8]. Males and females above the age of 18 who have had a stroke, can understand Hindi, and have sufficient cognitive function to understand the scale will be eligible to participate. Patients with other neurological or musculoskeletal conditions, uncontrolled co-morbidities, dementia, severe cognitive impairments, or an inability to follow spoken instructions will be excluded.

Primary Outcome

Validation: The Item- level Content validity Index (I-CVI), will be used to assess each scale item. Initial validation will be undertaken utilising the Delphi technique via email. The I-CVI and scale-level Content Validity Index (SCVI) will be computed using the Averaging approach (S-CVI/AVE). Lynn's (1986) criteria state that the S-CVI/AVE should be at least 0.90 six to 10 experts, while the lowest acceptable I-CVI value for the strong content validity is 0.78. The total scale level content validity in the current study will be evaluated using the S-CVI average approach method. The Hindi version of the scale will continue to be improved till these thresholds reached. If necessary, more Delphi rounds will be held, maybe with a new panel of experts. There will be ongoing improvements to an updated version in the original language.

Reliability

To assess test-retest reliability, participants will be examined twice, and correlation values improved will be calculated to ensure consistent results across time. Through numerous evaluations, this procedure verifies that the scale delivers consistent, reliable findings.

Relative reliability (the consistency of responses over time) will be assessed based on the ability to calculate the intra-class correlation coefficient (ICC).Shrout and Fleiss (1979) classify the ICC (Intraclass correlation coefficient) in relation to reliability as poor (<0.5), moderate (0.5 to 0.75), good (0.75 to 0.90), or excellent (>0.90) [17].

The reliability of form internal consistency will be assessed by Cronbach's alpha which can take any value between 0 (a lack of consistency) and 1 (complete consistency between observations) [18].

The application of Bland-Altman plots will be a method for assessing the agreement of the measurements to determine possible systematic bias and the variability of the measurements [19].

Secondary outcome: Cultural appropriateness and clinical applicability of the HDGI in Hindi-speaking stroke patients.

STATISTICAL ANALYSIS

Data will be analysed using Statistical Packages for Social Sciences (SPSS) version 26.0. Content validity will be assessed using I-CVI and S-CVI/AVE. Relative reliability will be evaluated using ICC and Pearson's or Spearman's correlation depending on data distribution. Internal consistency will be assessed using Cronbach's alpha. Bland-Altman plots will be used to assess absolute agreement between repeated measurements.

REFERENCES

[1] Balasubramanian CK, Clark DJ, Fox EJ. Walking adaptability after a stroke and its assessment in clinical settings. Stroke research and treatment. 2014;2014(1):591013.

[2] Alvarenga MT, Avelino PR, DE Menezes KK, Texeira-Salmela LF, Faria CD, Scianni AA. Deficits in dynamic balance were the motor impairments that best explained limitations in community ambulation after stroke. Eur J Phys Rehabil Med. 2023;59(2):145-51.

[3] Li S, Francisco GE, Zhou P. Post-stroke hemiplegic gait: New perspective and insights. Frontiers in physiology. 2018;9:1021.

[4] Batool S, Zafar H, Gilani SA, Ahmad A, Hanif A. Intrarater and interrater reliability of the dynamic gait index in post stroke patients with eye movement disorders. J Bodyw Mov Ther. 2023;35:38-42. Doi: 10.1016/j.jbmt.2023.04.015. Epub 2023 Apr 14. PMID: 37330797.

[5] Behera DK, Rahut DB, Mishra S. Analyzing stroke burden and risk factors in India using data from the Global Burden of Disease Study. Scientific reports. 2024;14(1):22640.

[6] Jonsdottir J, Cattaneo D. Reliability and validity of the dynamic gait index in persons with chronic stroke. Archives of physical medicine and rehabilitation. 2007;88(11):1410-15.

[7] Matsuda PN, Taylor CS, Shumway-Cook A. Evidence for the validity of the modified dynamic gait index across diagnostic groups. Physical therapy. 2014;94(7):996-1004.

[8] Beaton DE, Bombardier C, Guillemin F, Ferraz MB. Guidelines for the process of cross-cultural adaptation of self-report measures. Spine. 2000;25(24):3186-91.

[9] Guillemin F, Bombardier C, Beaton D. Cross-cultural adaptation of health-related quality of life measures: Literature review and proposed guidelines. Journal of clinical epidemiology. 1993;46(12):1417-32.

[10] Wrisley DM, Kumar NA. Functional gait assessment: Concurrent, discriminative, and predictive validity in community-dwelling older adults. Physical therapy. 2010;90(5):761-73.

[11] Langhorne P, Coupar F, Pollock A. Motor recovery after stroke: A systematic review. The Lancet Neurology. 2009;8(8):741-54.

[12] Alghwiri AA. Reliability and validity of the Arabic Dynamic Gait Index in people poststroke. Topics in Stroke Rehabilitation. 2014;21(2):173-79.

[13] An SH, Jee YJ, Shin HH, Lee GC. Validity of the original and short versions of the dynamic gait index in predicting falls in stroke survivors. Rehabil Nurs. 2017;42(6):325-32. Doi: 10.1002/rnj.280.

[14] Alghadir AH, Al-Eisa ES, Anwer S, Sarkar B. Reliability, validity, and responsiveness of three scales for measuring balance in patients with chronic stroke. BMC neurology. 2018;18(1):141.

[15] Marchetti GF, Whitney SL. Construction and validation of the 4-item dynamic gait index. Physical therapy. 2006;86(12):1651-60.

[16] Lynn MR. Determination and quantification of content validity. Nursing research. 1986;35(6):382-86.

[17] Shrout PE, Fleiss JL. Intraclass correlations: Uses in assessing rater reliability. Psychological bulletin. 1979;86(2):420.

[18] Wrisley DM, Marchetti GF, Kuharsky DK, Whitney SL. Reliability, internal consistency, and validity of data obtained with the functional gait assessment. Physical therapy. 2004;84(10):906-18.

[19] Bland JM, Altman D. Statistical methods for assessing agreement between two methods of clinical measurement. The lancet. 1986;327(8476):307-10.

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