Transcultural Adaptation and Validation of Kannada version of the National Institute of Health Stroke Scale (NIHSS)

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Abstract

Background and Purpose: The National Institute of Health Stroke Scale (NIHSS) is widely used in clinical practice to evaluate stroke-related neurological deficits. The aim of this study was to develop Kannada language version of the NIHSS (Ka-NIHSS) and determine its validity and reliability. Materials and Methods: In the first phase of the study, Ka-NIHSS was adapted based on cultural and linguistic peculiarities. In the next phase, 51 acute stroke patients were prospectively enrolled in the study. The concurrent validity of the Ka-NIHSS was evaluated by comparison with the Glasgow Coma Scale (GCS) and the modified Rankin Scale (mRS). The predictive validity was assessed by comparison with Barthel Index (BI) score and mRS at a 90-day telephonic follow-up. The reliability was evaluated using the kappa statistics for inter-rater agreement between two independent raters and intra-class correlation coefficient (ICC) analysis. The inter-rater agreement of videotaped assessment of items 9 and 10 for nine patients among four raters was 0.81 and 1 respectively. Results: Ka-NIHSS scores highly correlated with GCS ($P = -0.74 \ P < 0.001$) and mRS ($P = 0.85, P < 0.001$) at baseline. It moderately correlated with mRS ($P = 0.67, P < 0.001$) and BI ($P = -0.64, P < 0.001$) at 90 days follow up. Inter-rater reliability was high between the two examiners, with kappa values ranging from 0.66 to 0.95. The inter-rater agreements of the video assessment of items 9 and 10 for nine patients among four raters were 0.81 and 1 respectively. Conclusions: Ka-NIHSS is a valid and reliable tool for assessing neurological deficits in Kannada-speaking stroke patients.

Keywords: Kannada, National Institute of Health Stroke Scale, Kannada NIHSS, transcultural adaptation, validity, reliability

INTRODUCTION

The National Institute of Health Stroke Scale (NIHSS) is a clinical instrument used widely to quantify neurological deficits in acute stroke.¹ It was initially developed for use in clinical trials² and has now become a routine clinical assessment tool to measure the severity of stroke. It is used to evaluate a patients’ eligibility for reperfusion therapies and hence has surmounted clinical significance. NIHSS has proven to have a strong correlation with short-term and long-term outcomes after stroke.³ Thus it is a useful tool for prognostic stratification of acute stroke patients. It is a simple, highly reliable, and well-validated tool that can be administered by any trained health care provider including physicians, therapists, nurses, and research fellows.⁴,⁵

The NIHSS has 15 items that evaluate the effect of stroke on domains including the level of consciousness, eye movement, visual field, facial symmetry, motor strength, sensory function, speech-language function, coordination, and extinction. Each item is scored from 0 to 4 (or lesser in some items). The total score can range from 0 to 42. A trained rater takes up to 10 minutes for assessment of a patient using NIHSS.

The original NIHSS was developed for the English-speaking population. The items used to test aphasia and dysarthria are not culturally relevant or linguistically appropriate for non-English speaking population. Hence, it has been adapted to several non-English versions⁶,⁷ including Indian languages like Bengali⁸ and Hindi.⁹ Indian languages have substantial linguistic and cultural differences from English. Further, there exists a significant variation between the Indian languages. This study reports the development and validation of the Kannada (South Indian language) version of NIHSS (Ka-NIHSS).

MATERIALS AND METHODS

This study was undertaken at the National Institute of Mental Health and Neurosciences, (NIMHANS), Bangalore, India. NIMHANS is a tertiary hospital for Mental Health and Neurosciences. Kannada is the mother tongue of majority of patients attending emergency services in the hospital.

Development of Ka-NIHSS

The first phase of the study was the development of Ka-NIHSS by adapting the original NIHSS (English version). The
adaptation was required for items 9 and 10 which assess aphasia and dysarthria respectively. Item 9 includes the picture description, picture naming (six items), and reading/repetition (five phrases/sentences) tasks. Item 10 corresponds to the reading/repetition (six words) task [Figure 1]. The adaptation was performed in two steps. Two Kannada language experts who were oriented to the tool developed a preliminary list of words, sentences, pictures and scenarios.

The list was screened and a final tool was made. A panel of three speech and language pathologists, whose experience ranged between 12 to 40 years. In the case of words and phrases, the number of syllables and the word length were kept as similar to the English version as possible. Further, familiarity and cultural relevancy of the items too were accounted for. The consensus was reached between all three experts before finalization of the words and sentences [Figure 2a and b]. Following this, a language expert did a forward and backward translation and a certificate of translation was obtained.

Regarding the scenario for picture description task, the cookie jar picture (original NIHSS) was replaced with a culturally appropriate picture (Mane horage aduge). This is a familiar scenario in villages of Karnataka and was similar to the ‘Chullah’ picture in the Hindi version of NIHSS.\cite{9} The conceptualized ‘Mane horage aduge’ picture was drawn by a professional artist [Figure 2c]. The picture had adequate cues like, ‘the child falling from mango tree’ and ‘girl playing in a swing’ to prompt the picture description task. The naming card was prepared with pictures of six items that are familiar and commonly used in the Kannada culture [Figure 2d].

The adapted items were administered to five volunteers, all of whom were native Kannada speakers. The responses were observed and recorded to ensure that the intended meaning of the items are well retained. The adapted version was called Ka-NIHSS. The development of the Ka-NIHSS is schematically represented in Figure 3. In Table 1 the adapted items are given in Kannada and in the International Phonetic Alphabet (IPA) format. The rationale for the adaption too is discussed in Table 1.

**Validity and reliability of Ka-NIHSS**

The second phase of the study was to establish the validity and reliability of the Kannada version of NIHSS. The protocol for the study was approved by the Institute Ethics Committee. Written informed consent was obtained from the patients or primary caregivers.

**Subjects**

Acute ischemic stroke patients were considered for the study. All the patients were evaluated within 48 h of the onset of stroke. The socio-demographic information of the patients, Glasgow Coma Scale (GCS), and modified Rankin Scale (mRS) were assessed along with the Ka-NIHSS score.

**Validity**

The construct validity of Ka-NIHSS was evaluated by comparing the Ka-NIHSS score with the GCS and mRS. Both GCS and mRS scores of the acute stroke patients were assessed at the baseline along with Ka-NIHSS. GCS is well established as a reliable and objective tool for assessing a patients’ status in acute neurological conditions. mRS is a single-item scale used widely in patients after stroke. It is considered a highly reliable and valid tool to measure global outcome in stroke patients.\cite{10} Spearman’s correlation coefficient was calculated between Ka-NIHSS score and GCS as well as mRS to determine the validity.

The predictive validity of the Ka-NIHSS was determined by comparing the baseline Ka-NIHSS score with the 90-day
outcome of the stroke patients as measured using mRS and Barthel Index (BI) scores. The primary investigator acquired the 90 days mRS and BI scores by contacting the patients telephonically. Spearman correlation coefficient was used to estimate the relationship between the baseline Ka-NIHSS score and the BI and mRS scores at 90 days.

Reliability

The inter-observer reliability of Ka-NIHSS was determined by studying the agreement among two independent raters. Two investigators administered Ka-NIHSS on the same patient on the same day with a time gap of 1–3 h, blinded to each other. One of the raters was a neurologist who specialized in stroke. The other rater was an academic nurse who was specialized in Neuroscience Nursing. Both the raters were trained and were certified for NIHSS application through the American Stroke Association’s Online NIH Stroke Scale Training Program. The Ka-NIHSS scale was administered for all 51 patients by both the raters independently within 48 h of admission. For illiterate patients, item 9 was scored based on their responses to picture description and naming tasks. For scoring item 10 in illiterate patients, the words were read out to them and asked to repeat aloud.

Non-parametric tests were used as the item-wise scoring of NIHSS is an ordinal level data. The inter-rater agreement was estimated using Kappa statistics and intra class correlation coefficient for individual items and the total scores respectively. The agreement was defined as follows: $\kappa < 0.40$ shows poor agreement, $\kappa$ between 0.40 and 0.75 shows moderate agreement, and $\kappa > 0.75$ shows excellent agreement.[11] The ICC of 1 was defined as perfect reliability, 0.8 to 1 was considered excellent, 0.6–0.8 substantial, 0.4–0.6 as fair, and less than 0.4 as poor reliability.

To pursue the inter-rater agreement of the patient assessment, we sought to estimate the reliability of video recording of the Ka-NIHSS assessment. Four raters assessed the video recording of items 9 and 10 for nine patients. Out of the four raters, three were speech and language pathologists.
RESULTS

Patient characteristics

Fifty one acute stroke patients were enrolled in the study. The mean age of the patients was 49.5 (SD 14.9 years; range, 23 – 80 years). The demographic characteristics of the subjects are given in Table 2. The mean Ka-NIHSS score of the patients was 12.3 (SD 8.7). Out of the 51 patients, 17 patients had a Ka-NIHSS score less than 8, 28 patients had a score range of 8–24 and 6 had more than 24. Except for one, all patients could be followed up telephonically at 90 days after baseline assessment to determine their functional outcome using mRS and BI.

Construct validity

Ka-NIHSS scores were highly correlated with both GCS (P = –0.74, P < 0.001) and mRS (P = 0.85, P < 0.001) at the baseline. GCS score decreases when the severity of stroke increases; hence Ka-NIHSS and GCS are inversely correlated. The correlation of Ka-NIHSS scores with both GCS and mRS indicates the construct validity of the Ka-NIHSS.

Predictive validity

The telephonic follow-up assessment after 90 days revealed that 21% of the patients had mRS score 0, 42.3% had score 1 or 2, and 22.7% had score 3 to 5. Six (11.5%) patients were dead at 90 days follow-up.

Ka-NIHSS scores were moderately correlated with both mRS (P = 0.67, P < 0.001) and BI (P = –0.64, P < 0.001) at 90 days follow up. As Barthel index is inversely related to the severity of stroke, a negative correlation is observed between BI and Ka-NIHSS. The correlation of Ka-NIHSS scores with both mRS and BI measured at 90 days indicates that Ka-NIHSS has predictive validity.

Reliability

The intraclass correlation coefficient, between the two raters for the total Ka-NIHSS score was 0.991. The kappa value of each item of the Ka-NIHSS, is given in Table 3. In the same table, the scores have been compared with the kappa values of the study by original authors. Excellent inter-rater reliability was demonstrated in 12 items of the tool. Substantial reliability was seen in 3 items including limb ataxia, dysarthria, and visual field.

Reliability of Video recorded assessment

Kappa statistics were computed for each rater pair and then averaged to provide a single index of agreement. The resulting kappa indicated excellent agreement, κ = 0.81 for aphasia, and perfect agreement, κ = 1.00 for dysarthria.

DISCUSSION

The NIHSS is a clinical evaluation tool used widely to assess the severity of neurological impairment in stroke. The original NIHSS is in English and has limitations for use in Kannada speaking population. Therefore the present study was undertaken to adapt a Kannada version of NIHSS which was then tested and validated using standard methods.

Table 2: Demographic profile of stroke patients

| Characteristics     | Frequency (%) |
|---------------------|---------------|
| Gender              |               |
| Male                | 35 (68.6)     |
| Female              | 16 (31.4)     |
| Education           |               |
| Illiterate          | 7 (13.7)      |
| Primary school      | 24 (47.1)     |
| Secondary school and above | 20 (39.2) |
| Residence           |               |
| Urban               | 35 (68.6)     |
| Rural               | 16 (31.4)     |
| Type of stroke      |               |
| Ischemic            | 47 (92.2)     |
| Hemorrhagic         | 4 (7.8)       |
| Knowledge of English |           |
| Yes                 | 16 (31.4)     |
| No                  | 35 (68.6)     |
| Acute stroke intervention |         |
| Thrombolysis        | 20 (39.2)     |
| Endovascular intervention | 14 (27.5) |
| No                  | 17 (33.3)     |

Table 3: Inter-rater agreement of Ka-NIHSS in comparison with the original NIHSS

| Item                          | Kappa* | CI         | Kappa (study by original authors)[12] |
|-------------------------------|--------|------------|--------------------------------------|
| a. LOC                        | 0.952  | 0.857-1.00 | 0.457                                |
| b. LOC questions              | 0.868  | 0.745-0.991| 0.937                                |
| c. LOC commands               | 0.928  | 0.797-1.00 | 0.943                                |
| Best Gaze                     | 0.933  | 0.801-1.00 | 0.662                                |
| Visual                        | 0.731  | 0.544-0.919| 0.876                                |
| Facial palsy                  | 0.791  | 0.644-0.938| 0.742                                |
| a. Motor arm (left)           | 0.912  | 0.818-1.00 | 0.971                                |
| b. Motor arm (right)          | 0.878  | 0.765-0.991| 0.959                                |
| a. Motor leg (left)           | 0.947  | 0.877-1.00 | 0.947                                |
| b. Motor leg (right)          | 0.969  | 0.909-1.00 | 0.975                                |
| Limb ataxia                   | 0.638  | 0.034-1.00 | 0.690                                |
| Sensory                       | 0.841  | 0.694-0.988| 0.892                                |
| Best language                 | 0.916  | 0.824-1.00 | 0.841                                |
| Dysarthria                    | 0.718  | 0.552-0.884| 0.289                                |
| Extinction                    | 0.856  | 0.700-1.00 | 0.891                                |
| Total Ka-NIHSS score (ICC)    | 0.991  | 0.982-0.994| 0.969                                |

*P<0.001 for all values. Ka-NIHSS - Kannada version of National Institute of Health Stroke Scale, CI - Confidence interval, LOC - Level of consciousness, ICC - Intra class correlation.

Ka-NIHSS strongly correlated with baseline GCS and mRS. It also correlated moderately well with the 90-day outcome as measured by BI and mRS. This is in line with the properties of the original NIHSS, which has demonstrated a modest correlation of baseline NIHSS with 90 days BI score (P = –0.51) and mRS (P = 0.56).[13] The findings of our study establish that the Ka-NIHSS can effectively assess the severity of neurological deficits due to acute stroke. It can also predict the outcome of acute stroke patients at 90 days.

The study demonstrated excellent inter-rater agreement in 12 items of the scale. The items which showed moderate agreement were limb ataxia, dysarthria, and visual field. The
highest agreement was demonstrated in the items, level of consciousness, and motor power of the right leg.

In the reliability evaluation of the NIHSS by original authors, dysarthria and level of consciousness had fair to poor agreement between raters.[12] In comparison, the present study demonstrated dysarthria to have a moderate, and level of consciousness to have an excellent agreement. The inter-rater agreement of items of the present study is comparable to that of the original NIHSS [Table 3].[12] Across studies that have assessed the reliability of various language versions and videotape scoring of NIHSS, the items which consistently yield lower agreement include facial palsy, limb ataxia, dysarthria, and level of consciousness.[13] In the present study limb ataxia and dysarthria yielded a lower agreement. However level of consciousness was one of the items with the highest agreement in the present study. Direct patient examination as against scoring of video recording of the patient in most other studies would have resulted in this difference.

In the Hindi version developed by Prasad et al. 2012,[9], the inter-rater agreement (between a neurologist and non-neurologist) was substantial for all items of NIHSS. The present study, where one of the raters is a nurse, shows good agreement in all items. The video recording of items 9 and 10 showed excellent reliability among raters. As most of the raters were speech and language pathologists, their expertise in identifying abnormalities of aphasia and dysarthria could be considered as the best possible clinical assessment. Hence it can be concluded that video recording of Ka-NIHSS can be used reliability for assessment.

The major limitation of this study was the small sample size. Another limitation of the study was that the predictive validity was assessed using mRS and Barthel index at 90 days by a telephonic follow-up rather than direct assessment. As telephonic follow-up was practically more feasible than an in-person assessment, we opted for a telephonic assessment.

CONCLUSIONS

The Ka-NIHSS scale is culturally relevant for Kannada speaking population. It is a valid and reliable tool. It can be used by neurologists and non-neurologists alike.

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Statement on ethical issues

The institutional ethics committee has approved the protocol for the study. Written informed consent was obtained from participants.

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Conflicts of interest

There are no conflicts of interest.

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