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Original article

Cross-cultural adaptation and validation of the Sinhala version of Mississippi Aphasia Screening Test

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ABSTRACT

Background & Aim: Aphasia is an acquired language disorder that may result from various neurological conditions; however, it is most seen among patients with stroke, affecting nearly one-third of stroke survivors. Early identification is essential to initiate timely rehabilitation. The Mississippi Aphasia Screening Test (MAST) is a brief and reliable tool to detect receptive and expressive aphasia. Therefore, this study aimed to validate the MAST specifically for screening aphasia in patients with stroke. This study aims to cross-culturally adapt and validate the Sinhala version of MAST (MAST-S).

Methods: The study involved 60 participants (30 patients with aphasia and 30 controls) conveniently recruited from the National Hospital, Galle. Linguistic validation of MAST-S included forward and backward translation, expert committee review, and cognitive debriefing to ensure cultural relevance and linguistic equivalence. Discriminant validity was assessed by comparing mean total scores between the aphasia and control groups. Reliability testing included internal consistency (Cronbach's alpha) and inter-rater reliability (kappa).

Results: The mean (standard deviation, SD) age of patients with aphasia was 65.8 (9.4) years, with 66.7% (n=20) being male. The mean (SD) total scores of the MAST-S were 45.77 (28.02) for patients with aphasia and 97.73 (4.92) for the control group, demonstrating strong discriminant validity. MAST-S showed excellent internal consistency (Cronbach's alpha=0.92) and satisfactory inter-rater reliability (kappa=0.65) between the principal investigator and a speech-language pathologist.

Conclusions & Recommendations: MAST-S is a reliable and valid screening test to detect aphasia among Sinhala speaking patients with stroke.

Keywords: *aphasia, Mississippi Aphasia Screening Test, stroke, psychometric properties, validation*

Introduction

Stroke is a leading cause of adult disability worldwide, with an increasing prevalence in developing countries (1). Stroke causes numerous disabilities encompassing paralysis or impaired motor control, sensory disruptions such as pain, language-related challenges in comprehension and expression, cognitive deficits in thinking and memory, and emotional disturbances (2,3). Out of speech and language disorders, aphasia emerges as a prevalent language impairment, impacting approximately one-third of stroke survivors (4,5).

As long-term consequences, aphasia leads to isolation, frustration and depression which may impact the quality of life of stroke survivors (6,7). Moreover, these patients might experience problems of returning to work, reduction in their level of income, and productivity, and affect their role in the family and society (8).

Aphasia, often remains undiagnosed for several reasons, causing challenges in its subsequent management. Limited screening tests in healthcare settings is one of the challenges to screening patients with aphasia. Early detection of aphasia facilitates the timely implementation of rehabilitation interventions. Further, it is well known that prompt speech and language therapy is important to minimize the negative impact on the quality of life of patients with aphasia following a stroke (9-11).

The Mississippi Aphasia Screening Test (MAST) was initially developed and validated by Nakase-Thompson et al. in 2005 (12). It was developed in the United States as a brief bedside screening tool to rapidly identify receptive and expressive aphasia in adults with acquired brain injury. Although most commonly used among patients with stroke, it has also been applied in other neurological conditions. Previous studies, including the initial version, report strong psychometric properties, including high internal consistency, inter-rater reliability, and good sensitivity and specificity for detecting aphasia. Among many aphasia screening tools, the MAST is a simple screening test that can be administered within 5-10 minutes. MAST includes nine domains to assess both expressive and receptive language abilities. The MAST serves as a valuable resource for clinicians and researchers alike, facilitating prompt identification of aphasia in individuals across diverse clinical and research settings.

The MAST has been translated and validated into various languages. It was validated into Telugu by Nagendar & Ravindra in 2012 (13), expanding its applicability to South Asian populations. Similarly, the Persian version (MAST p), validated by Khatoonabadi et al. in 2015 (14), demonstrated excellent intra-rater reliability, affirming its utility for assessing language disabilities in Persian-speaking individuals post-stroke. Further, validation efforts include the Spanish version (MAST sp), validated by Romero et al. in 2012 (15), which exhibited good convergent validity, inter-observer validity, and test-retest reliability. In the Czech version (MAST cz), validated by Kostalova et al. in 2008 (16), high sensitivity and specificity were observed in discriminating between aphasia patients and controls, alongside high construct validity and acceptable inter-rater reliability. These validations underscore the MAST's reliability and validity across diverse linguistic and cultural contexts, highlighting its value as a reliable and effective screening tool for identifying aphasia in various populations.

In the Sri Lankan context, the absence of a standardized, concise screening test tailored for aphasia poses a significant challenge, impeding the timely identification and subsequent rehabilitation of affected individuals. As a screening test, the MAST has the ability to assess a wide range of language problems, including reading, writing, verbal fluency, etc. Long and complicated tests are not suitable during the acute stage of a stroke,

especially when patients have other disabilities. Brief screening tests are particularly advantageous, especially for healthcare professionals such as nurses, who may not possess specialized expertise in speech therapy. Therefore, this study was conducted to cross-culturally adapt and validate the MAST-S version and analyse the psychometric properties.

Methods

This study was a validation study to validate the MAST-S version. The ethical approval for this study was obtained from the Ethics Review Committee, Faculty of Medicine, University of Ruhuna (ref. 26.05.2015:3.15). Written informed consent was obtained from every participant before data collection. The validation comprised the following steps

1. Cross-cultural adaptation
2. Validation: content validity and discriminant validity
3. Reliability assessment

1. Cross-cultural adaptation of MAST-S

Cross-cultural adaptation guidelines by Beaton et al, 2000 were followed during the process of validation of MAST (17). The English version of MAST was initially translated into Sinhala (forward translation) by two persons, including a speech and language pathologist (SLP) and a nursing officer. Based on two translated versions, a single Sinhala version was synthesized (MAST-S1). The MAST-S1 was back translated to English (backward translation) by two different persons, including a nursing officer and a medical officer. These translated Sinhala versions and back-translated English versions were then evaluated by a panel of experts, including a neurologist, SLP, linguistic expert, nurse, and a medical officer.

Adaptations and modifications

During the adaptation of MAST-S, necessary changes were made in the relevant items of each subscale. During the translation and adaptation process, the phonology and syntax of the Sinhala language were considered. Then, semantics and the number of syllables were changed in order to assess the language proficiency (refer to the supplementary file 1).

2. Content validity

The translated and synthesized MAST Sinhala version was evaluated by ten experts, including two neurologists, two nursing officers working with stroke patients, two speech and language pathologists, and four university academics for content validity. Of the 49 items, 46 achieved universal agreement for relevance among experts, resulting in a Content Validity Index (CVI) of 0.94, indicating excellent content validity.

Validation study to assess the discriminant validity and reliability

Study design, setting, and participants

This validation study was conducted with the participation of 60 subjects, including 30 patients with Aphasia following a stroke and 30 healthy controls. Patients were selected from the medical wards at National Hospital, Galle, which is the major tertiary care centre in Southern Sri Lanka. A neurologist confirmed the diagnosis of aphasia. Healthy controls, those who were admitted due to other medical conditions such as hypertension, diabetes mellitus, gastritis, etc., were selected as the control group. Patients with behavioural or memory problems, known patients with major psychiatric illnesses or any other neurological disorders, patients with chronic ethanol abuse or narcotic abuse, patients who are on medication that can affect cognition, and subjects with intellectual disability and learning disabilities were excluded from this study.

Sample size and sampling method

G*power analysis was used to calculate the sample size. Assuming a large effect size between patients with aphasia and the control group (Cohen's d=0.80), α=0.05, and power=0.80, the required sample size was 26 participants per group (total=52). Therefore, we have taken 30 per each group.

After confirming the diagnosis, every consecutive patient with aphasia due to a stroke who fulfilled the inclusion criteria was invited to participate. Age-matched patients without other neurological impairments and exclusion criteria were randomly selected as the control group from the same setting.

Study instruments

An interviewer-administered questionnaire was used to assess the sociodemographic characteristics of the participants.

The MAST is a brief, screening test to detect aphasia which can be administered within 5-10 minutes. The MAST consists of two main subscales: the Expressive Index and the Receptive Index. Together, these subscales include nine domains. The Expressive Index comprises five domains: naming, automatic speech, repetition, verbal fluency, and writing. The Receptive Index includes four domains: object recognition, yes/no accuracy, following verbal instructions, and following written instructions. There are 45 items and a separate domain for verbal fluency. For each index, 50 marks have been allocated and the maximum score that a normal person can achieve is 100 (12).

Data collection

After obtaining ethical approval from the Ethics Review Committee, permission to collect data was obtained from the Director of the National Hospital, Galle. Informed written consent was then obtained from patients or their next of kin who met the inclusion criteria. First, a consultant neurologist clinically diagnosed patients with post-stroke aphasia. The principal investigator (a nursing lecturer) then administered the MAST-S to patients in both groups. Next, an SLP, blind to the test and control group, assessed the two groups using the MAST-S. Data quality was ensured through standardized, reproducible procedures. All assessments were conducted in accordance with the standardized administration and scoring guidelines of the MAST-S. The principal investigator and the speech–language pathologist (SLP) underwent prior training to ensure uniformity in test administration and scoring.

Statistical analysis and evaluation of the psychometric properties of the MAST-S

The data were analysed using SPSS version 26. Mean total score and subscales scores for both expressive and receptive indexes were separately calculated. The normality of continuous variables (MAST scores) was analysed using the Kolmogorov-Smirnov test. It was insignificant ($p>0.05$) for all the continuous variables [age ($p=0.32$), total MAST score ($p=0.96$), expressive index score ($p=0.29$), receptive index ($p=0.8$)], suggesting that the distributions are normal.

Description of MAST scores by socio-demographic characteristics

The socio-demographic characteristics of the study subjects are presented as frequencies or mean (SD). Mann-Whitney U test was used to detect the association between the total score of the MAST with age, gender, level of education, side of the lesion, type of stroke and other socio-demographic data. The significance level was kept at $p<0.05$.

Discriminant validity: As the control group scores for the MAST were not normally distributed Wilcoxon Signed-Rank test was used to analyse the difference between two groups. Discriminant validity was evaluated using an independent samples t-test to compare MAST-S scores between

patients with aphasia and age-matched healthy controls to determine the instrument's ability to differentiate between clinically distinct groups.

3. Reliability

The scores for the MAST-S by two raters were compared to determine the inter-rater agreement using Cohen's kappa. Internal consistency was assessed using Cronbach's alpha. Cronbach's alpha was calculated and interpreted; Cronbach alpha >0.9-excellent, >0.8-good, >0.7-acceptable, >0.6-questionable, >0.5-poor and <0.5-unacceptable (18).

Results

Socio-demographic and clinical characteristics of participants

The mean (SD) age of the patients with language problems following stroke was 65.8 (9.4) years (range 48-80 years) and 66.7% (n=20) of them were males. Of all patients with stroke, 80% (n=24) had ischemic strokes, and 70% (n=21) had lesions in the left cerebral hemisphere. The mean (SD) age of the patients in the control group (patients without stroke) was 63 (9.9) years (range 45-80 years), and 50% of them (n=15) were males. The socio-demographic factors, such as age, gender, level of education, and occupation, were not significantly different between the two groups ($p>0.05$). There was no significant association between the total scores of the MAST with age, gender, level of education, and handedness ($p<0.05$).

Discriminant validity

The overall mean score of the MAST (M=45.77, SD=28.02) for patients with stroke was significantly lower compared to the mean score obtained by the other group (M=97.73, SD=4.92). The mean (SD) scores for expressive and receptive indices (out of 50) were 16.32 (16) and 30.93 (13.72), respectively, for the patients. Mean (SD) scores of the expressive and receptive indices in the control group were 49.33 (2.54) and 48.40 (4.47), respectively (Table 1).

Table 1. Comparison of Mississippi Aphasia Screening Test (MAST-S) scores by group (n=60)

MAST subscale	Control group (n=30) Mean (SD)	Test group (n=30) Mean (SD)	*p* value
Naming	10.0 (0)	5.0 (4.30)	0.001*
Automatic speech	10.0 (0)	4.3 (4.30)	0.001*
Repetition	10.0 (0)	4.3 (4.00)	0.001*
Writing to dictation	10.0 (0)	1.0 (3.10)	0.001*
Verbal fluency	10.0 (0)	1.9 (3.10)	0.001*
Yes/No accuracy	18.7 (2.99)	12.9 (6.31)	0.001*
Object recognition	10.0 (0)	8.4 (3.48)	0.026*
Following written instructions	9.4 (1.49)	6.9 (2.80)	0.010*
Following verbal instructions	9.3 (1.92)	2.8 (4.30)	0.001*
Expressive index	49.3 (2.54)	16.3 (16.00)	0.001*
Receptive index	48.4 (4.47)	30.9 (13.72)	0.001*
Total score	97.7 (4.92)	45.8 (28.02)	0.001*

MAST: Mississippi Aphasia Screening Test

Data are presented as mean and standard deviation (SD)

** Statistically significant at p<0.05*

Table 2. Reliability of the MAST-S

Item	Cronbach alpha
Naming	0.886
Object recognition	0.991
Repetition	0.891
Yes/No accuracy	0.901
Automatic speech	0.882
Reading instructions	0.896
Verbal fluency	0.907
Writing to dictation	0.913
Following instructions	0.904

MAST-S: Sinhala version of Mississippi Aphasia Screening Test

Reliability

MAST subscales and total scores showed a high internal consistency (global Cronbach's alpha=0.92, $p<0.001$). All the items showed higher (range 0.88-0.99) item-total correlations (Table 2). Good inter-rater agreement (kappa-0.65) was obtained among two diagnostic methods (MAST-S and the speech pathologist's diagnosis) that were used in the study.

Discussion

The present study sought to validate a brief, reliable screening tool for the detection of aphasia in Sinhala-speaking patients. Our findings demonstrate that the Sinhala version of the Mississippi Aphasia Screening Test (MAST-S) is both valid and reliable for identifying aphasia in the acute phase of stroke. The MAST-S effectively differentiates aphasic patients from non-aphasic individuals, with significantly lower scores observed across all subscales in the aphasia group.

The results of our study are similar to the findings of initial validation of MAST by Nakase-Thompson et al (2005) (12). Patients with left hemisphere lesions performed significantly worse on the index and total scores compared to control group ($p<0.05$) (12). In our study, we also found the same result: significantly lower mean scores for the total and both indices of the MAST among patients with left hemisphere lesions.

Factors associated with the MAST test score

In our study, the side of the lesion had a significant association with the overall score of the MAST. There was no significant association between any other socio-demographic factors with the total test scores. Previous studies showed a significant association with age and level of education. In the initial validation of the MAST, factors such as age, level of education, and handedness were significantly associated with total test scores and with both expressive and receptive indices (12). In Spanish validation of MAST, there was a significant association with the age and total score while years of school attended were correlated with the score of the receptive score in the control group of the study (15).

Reliability and validity of MAST

Previous studies had shown that MAST has an excellent reliability and convergent validity (12,15). Our study also showed similar findings with the high internal consistency of all the items and high item-total correlations except for writing and object recognition. The difference of these two subscales may be due to both writing and object recognition require proper vision (13,15). The Persian version of

MAST had satisfactory internal consistency as the Cronbach's alpha was 0.64 (14). Compared to that study Sinhala version has better internal consistency. The current study showed satisfactory inter-rater reliability among two raters. The Czech version of the MAST showed an acceptable inter-rater reliability (16).

The Spanish version of MAST revealed that there was a good convergent validity. It was tested against Boston Diagnostic Aphasia Examination (BDAE) (15). Unavailability of a standardized validated tool in the Sri Lankan setting was a limitation in testing the convergent validity of the current study.

Sensitivity and specificity

There is no available gold standard screening test in the current setting to determine the sensitivity and specificity of the Sinhala version of MAST. The ROC analysis demonstrated an AUC of 0.995, indicating outstanding diagnostic accuracy of the Sinhala version of the MAST. This finding supports the excellent discriminative validity of the instrument and suggests that the MAST-S is highly effective in distinguishing individuals with aphasia from those without aphasia when compared with the Consultant Neurologist's clinical diagnosis. In its initial validation, the MAST found excellent sensitivity and specificity in detecting language impairment and correctly discriminating language impaired individuals (12). The MAST cz displayed high sensitivity and specificity (above 90%) in discrimination between patients with aphasia and healthy control subjects (16). In the Spanish version of the MAST, the sensitivity and specificity were analysed using ROC curve analysis (15). However, cut off value for the MAST was not determined in the previous studies.

Strengths and limitations

This study's primary strength lies in the successful linguistic and psychometric adaptation of the MAST for Sinhala-speaking populations, addressing a critical need in stroke rehabilitation in Sri Lanka. The tool demonstrated high internal consistency and inter-rater reliability, validating its robustness for clinical use. Furthermore, the study's focus on the acute phase of stroke ensures that the MAST-S can facilitate early detection and intervention, which are crucial for optimal recovery outcomes.

Nonetheless, several limitations must be considered. First, the short duration of hospital stays (3-4 days) constrained our ability to assess test-retest reliability. Patient fatigue further limited repeated assessments, and post-discharge follow-ups were challenging. Second, the absence of a standardized aphasia assessment tool in Sri Lanka precluded the evaluation of convergent validity, restricting our ability to compare MAST-S with other established tools. Third, the writing subscale posed challenges for patients with motor impairments due to left hemisphere lesions, reducing its applicability in this population. Finally, while the MAST-S can detect the presence and type of aphasia, it does not quantify aphasia severity, which is crucial for tailoring rehabilitation strategies.

Recommendations

Future studies examining the psychometric properties of MAST should determine the cut-off values for MAST. Not only for the overall cut-off value, but also each index needs a cut-off value to decide the type of aphasia. If possible, future studies should also consider cut-off values to determine the severity of aphasia.

Conclusions

The MAST-S is a reliable and valid screening test to detect aphasia among Sinhala speaking patients following stroke. The tool was psychometrically and linguistically validated to use to fill the gap in screening patients with aphasia. Moreover, it will be useful to screen patients to detect aphasia in the acute stages of stroke and initiate prompt rehabilitation.

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Author Declarations

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