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The development and psychometric properties of the Chiang Mai Aphasia Screening Test for stroke

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ABSTRACT

Background: The aphasia screening test detects language and speech impairments, clarifying individuals' language and speech abilities before administering a standardized aphasia diagnosis test.

Objective: This study aimed to develop and validate an aphasia screening test for suspected cerebrovascular accident (CVA) patients with communication difficulties.

Materials and methods: The study underwent two phases: developing and assessing psychometric properties. Five experts established content validity across receptive language, expressive language, reading, and writing. The Chiang Mai Aphasia Screening Test (CMAST) was evaluated on 14 CVA patients with and 14 without aphasia.

Results: The content validity showed item-objective congruence ranging from 0.80 to 1.00. Sensitivity and specificity were 96.30% and 69%, respectively, with a maximum Youden's Index at 65.30% and a cut-off point of 43 points. Concurrent validity was high (phi coefficient =0.67), and significant score differences (p<0.001) in construct validity confirmed the tool's ability to distinguish aphasic from non-aphasic patients. Inter-rater reliability (ICC=0.99) and internal consistency (Cronbach's alpha =0.97, 95% CI 0.95-0.98) were observed.

Conclusion: The CMAST, comprising 45 items, exhibits sufficient validity and reliability for screening individuals suspected of aphasia due to CVA.

Introduction

Aphasia, characterized by language abnormalities affecting receptive, expressive, and overall linguistic abilities, often arises from neurological dysfunction.[1] These difficulties can profoundly impact various facets of life, including self-care, education, work, social engagement, and leisure activities.[2] The prevalence of aphasia is notable among individuals with traumatic brain injury, meningitis, and cerebrovascular accidents (CVAs), with an incidence ranging from 4-20% among CVA patients.[1, 3]

According to statistics from the Division of Non-Communicable Disease, Ministry of Public Health, Thailand, the prevalence of CVA patients in Thailand has consistently increased from 2016 to 2018, with an annual rate of 3.39 percent. In 2018, the incidence rates of CVA patients in Thailand and Chiang Mai province were as high as 506.20 and 490.59 per 100,000 population, respectively.[4]

Assessment and management of aphasia are integral aspects of rehabilitation, and Speech-Language

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Pathologists (SLPs) play a crucial role in these processes. Evaluation typically involves bedside screening and standardized tests, which may take 1 to 6 hours.[5-12] However, the exhaustive nature of these evaluations can pose challenges for patients experiencing weakness or fatigue during recovery. As such, briefer screening tests, lasting between 3 to 15 minutes, are often conducted when symptoms stabilize or within 2-3 days post-stroke onset.[13] These screenings aimed to differentiate between CVA patients with aphasia and those without, informing treatment planning, rehabilitation approaches, and patient and caregiver advice.

Various screening tests are currently available for assessing aphasia in different languages, such as the Frenchay Aphasia Screening Test (FAST), Mississippi Aphasia Screening Test (MAST), ScreeLing, Ullevaal Aphasia Screening Test (UAS), Bedside of Western Aphasia Battery-Revised, and Quick Aphasia Battery (QAB).[5-12] However, Speech-Language Pathologists in Thailand face limited options, with the Aphasia Screening Test Saraburi SD-SLP-01 being the only available tool.[14] Consequently, there is a pressing need to develop a new test or translate an existing international test into Thai to expand the range of assessment options for language and speech disorders within the Thai context.

In response to this need, the Chiang Mai Aphasia Screening Test (CMAST) has been developed as an assessment tool to address the identified gaps in screening options. The primary objective of this study is to create a Thai-language version of an aphasia screening test that comprehensively covers all four language aspects: receptive language (including auditory comprehension, word recognition, and sequential commands), expressive language (spontaneous speech, verbal fluency, repetition, and naming), as well as reading and writing abilities. By rigorously evaluating the psychometric properties of CMAST, including its validity and reliability, this initiative aims to significantly enhance the repertoire of assessment tools available to Speech-Language Pathologists in Thailand. This expansion of options will enable SLPs to conduct more comprehensive evaluations of language and speech abilities among individuals with neurological conditions, thereby facilitating more accurate identification and management of communication difficulties.

Materials and methods

The study involves research and development of an aphasia screening test, assessing its psychometric properties in two phases.

Phase 1 Developing a screening test and evaluating content validity.

The researchers established objectives, identified target groups, and defined established criteria. We then explored information, including concepts, theories, and existing literature, to shape the content of the screening test and clinical expertise and experiences. Finally, we designed and created the first version of the aphasia screening test.[15] The screening questionnaire is formulated using concise and clear language. Each question is designed to have a singular and unambiguous interpretation, utilizing the Thai language appropriately. The questions that cover all four language aspects,[15] namely (1) receptive language comprises auditory comprehension 37 items, word recognition 17 items, and sequential commands 11 items (2) expressive language comprises spontaneous speech 5 items, verbal fluency 12 items, repetition 13 items, and naming 17 items (3) reading 12 items and (4) writing 10 items. Total 134 items. Scoring criteria: 1 point for correct, 0 for incorrect. Content validity is evaluated by five experts, each with over ten years of clinical experience. The panel comprises two SLPs specialized in aphasia screening, one communication disorders professor, one Occupational Therapist focusing on CVA care, and one rehabilitation physician. Subsequently, questions with an IOC value of 0.8 or higher will be retained, and those below 0.8 will be excluded. Questions in each category were chosen through the quota sampling method. The revised communication disorder screening questionnaire will be administered to individuals with 3 CVA without aphasia to explore image size and clarity issues. Based on these results, a comprehensive version of the aphasia screening test called the Chiang Mai Aphasia Screening Test (CMAST), will be created in Appendix 1.

Phase 2 The validation phase assesses psychometric properties.

Thai individuals aged 20 and above in the province of Chiang Mai, Thailand, who have been diagnosed with CVA by a rehabilitation physician and are currently receiving speech therapy. These facilities include 1) the Speech Therapy Clinic, Faculty of Associated Medical Sciences, Chiang Mai University; 2) PROMPT Health Center, Chiang Mai University; 3) the Community Health Clinic, Nong Pa Khrang; and 4) the Disability Service Center; Nong Kwai. The computed sample size is 12 participants. To enhance the study's reliability and address potential dropouts, we added 15% more participants. Consequently, the final sample size comprises 14 individuals with aphasia and 14 without aphasia.

CVA without aphasia. Inclusion criteria: (1) fluency in Thai language, (2) literacy in Thai before CVA, (3) normal or corrected vision and hearing, and (4) determination of non-aphasia through the Saraburi Aphasia Screening Test: SD-SLP-01, with SLPs requiring a score of 27 or higher.[14] Exclusion criteria: (1) neurological abnormalities unrelated to cerebral vascular disease, (2) incomplete assessment during research, (3) desire to withdraw from ongoing research, (4) inability to write due to hand muscle issues, and (5) blood pressure exceeds 180/110 mmHg.[13]

CVA with aphasia. Inclusion criteria: (1) fluency in Thai language, (2) literacy in Thai before CVA, (3) normal or corrected vision and hearing, (4) aphasia is determined through screening with the Saraburi Aphasia Screening Test: SD-SLP-01,[16] and (5) diagnosed with language and/or speech abnormalities resulting from CVA for at least 6 months.[17, 18] Exclusion criteria: same as described above.

Procedures

Before commencing data collection, it is essential to obtain consent and permission from the subjects to participate in the research, which should be documented through signed consent forms. The research project has received ethical approval from the ethical committees of the Faculty of Associated Medical Sciences, Chiang Mai University, with reference number AMSEC-64FB-005. A comprehensive assessment involved 14 individuals with aphasia, evaluated using CMAST and the Thai version of the Western Aphasia Battery (Thai WAB),[19] and 14 non-aphasia individuals who underwent CMAST evaluation. Two SLPs assessed the video recordings of all 28 participants. An expert in aphasia screening scored recordings using a 1-point criterion, while Thai WAB [19] determined aphasia presence. Statistical analysis assessed reliability and validity.

Data analysis

SPSS Version 25 is used for analysis, employing descriptive statistics for demographic characteristics. Validation involves sensitivity, specificity, and construct validity using the Known-groups technique analyzed with the Mann-Whitney U test and concurrent validity. Reliability is assessed using the Intraclass Correlation Coefficient (ICC) with the Two-way random effect model and internal consistency using Cronbach's alpha coefficient.

Results

The demographic characteristics of each group are presented in Table 1. Participants were divided into two groups: one with aphasia and one without aphasia. The aphasia group included 8 males and 6 females, with mean ages of 60 (SD=10.64) for males and 60 (SD=10.36) for females. All had been diagnosed with cerebrovascular accident (CVA) for over 6 months. The non-aphasia group also consisted of 8 males and 6 females, with mean ages of 59.75 years (SD=8.41) for males and 46.33 years (SD=17.65) for females. None of these individuals had aphasia.

Table 1 Demographic characteristics.

Participant group	N	Type of aphasia	Gender	Number of participants	Mean age (year)	Medical diagnosis	Onset (month)
With aphasia	01	Broca's	Male	8	60.70 (SD=10.36)	Cerebrovascular Accident (CVA)	>6
	02	Broca's					
	03	Anomic					
	04	Wernicke's					
	05	Broca's					
	06	Anomic					
	07	Global					
	08	Transcortical Motor	Female	6			
	09	Anomic					
	10	Global					
	11	Anomic					
	12	Anomic					
	13	Anomic					
	14	Global					
Without aphasia			Male	8	59.75 (SD=8.41)		
			Female	6	46.33 (SD=17.65)		
Mean age of the 28 participants =57.04 years (SD=12.56) with age range 20-76 years.							

Phase 1: Develop a screening test and evaluate content validity and trials.

The questions that cover all four language aspects, namely (1) receptive language comprises auditory comprehension 37 items, word recognition 17 items, and sequential commands 11 items (2) expressive language comprises spontaneous speech 5 items, verbal fluency 12 items, repetition 13 items, and naming 17 items (3) reading 12 items and (4) writing 10 items. Total 134 items. The study results indicate that this screening tool demonstrated content validity in receptive language, expressive language, reading, and writing, with an IOC of 0.80-1.00. Evaluations were conducted in receptive language, expressive language, reading, and writing to assess language and speech abilities in individuals with aphasia. Additionally, the CMAST was tested on those with CVA without aphasia. The findings indicated a clear understanding of questions, legible letter reading, and appropriately sized images, leading to using the CMAST.

Phase 2 The validation phase assesses psychometric properties.

The CMAST was compared to the diagnosis results obtained from the gold standard using the Thai WAB.[19] This comparison aimed to calculate sensitivity and specificity. The sensitivity and specificity results indicate the accuracy of diagnosing individuals with and without the condition, as demonstrated in Table 2. The highest Youden's index value[20] of 65.30% and a cut-off point of 43 points indicate CMAST's 96.30% sensitivity in detecting aphasia and 69% specificity in distinguishing individuals with and without aphasia.

The Phi correlation statistic yielded 0.67, indicating CMAST's high concurrent validity with gold standard examination results at a significant level.[21] Mann-Whitney U Test results (Table 3) revealed a $p<0.001$, signifying significant differences in Mean Rank between aphasia and non-aphasia groups.

Table 2. Cut-off, sensitivity, specificity, Youden, and phi value of CMAST.

Cut-off	Sensitivity (%)	Specificity (%)	Youden (Se+Sp-1) (%)	Phi value
24	7.4	100	7.4	0.2
25	14.8	100	14.8	0.29
26	22.2	100	22.2	0.36
28	25.9	100	25.9	0.39
33	29.6	100	29.6	0.42
34	44.4	100	44.4	0.54
36	48.1	100	48.1	0.57
38	55.6	89.7	45.3	0.48
39	70.4	89.7	60.1	0.61
40	77.8	86.2	64.0	0.64
41	81.5	79.3	60.8	0.61
42	85.2	75.9	61.1	0.61
43	96.3	69.0	65.3	0.67
44	100	55.2	55.2	0.61

Table 3. Result of construct validity by using the Mann-Whitney U test.

Participant group	N	Mean rank	Z	*p* value
With aphasia	14	8.75	3.74	<.001
Without aphasia	14	20.25		
Total	28			

Thus, CMAST demonstrates construct validity, effectively discerning between CVA with and without aphasia.[22] The results showed inter-rater reliability for each question, with ICC values ranging from 0.76 to 1.00, signifying good to excellent agreement. The overall CMAST score's ICC value was 0.99, indicating highly consistent inter-rater reliability,[23] detailed in Table 4. Internal consistency assessment yielded a Cronbach's alpha coefficient of 0.97 for CMAST (Table 5), indicating excellent consistency among item scores,[24] indicating consistent content across the items.

Table 4. Result of inter-rater reliability.

Item number	Intraclass correlation[b]	95% Confidence interval	
		Lower bound	Upper bound
Spontaneous speech			
1	0.862	0.700	0.936
2	0.884	0.749	0.946
Verbal fluency			
3	0.881	0.745	0.945
4	1.000		
5	1.000		
Auditory comprehension			
6	0.760	0.479	0.889
7	1.000		
8	1.000		
9	0.794	0.559	0.904
10	1.000		
11	0.794	0.559	0.904
12	0.834	0.639	0.924
13	0.867	0.715	0.938
14	1.000		
15	1.000		
16	1.000		
17	1.000		
18	1.000		
19	1.000		
20	1.000		
Sequential commands			
21	1.000		
22	0.794	0.559	0.904
23	0.802	0.572	0.908
24	0.794	0.559	0.904
Naming			
25	0.932	0.854	0.968
26	0.942	0.876	0.973
27	1.000		
28	0.832	0.637	0.922
29	0.932	0.854	0.968
30	0.765	0.499	0.891
Repetition			
31	1.000		
32	1.000		
33	1.000		
34	1.000		
35	0.838	0.654	0.925
Word recognition			
36	1.000		
37	1.000		
38	1.000		
39	0.794	0.565	0.903
40	1.000		
41	0.794	0.565	0.903
Reading			
42	1.000		
43	0.962	0.918	0.982
Writing			
44	1.000		
45	0.964	0.923	0.983
Total	**0.993**	**0.985**	**0.997**

Note: a: two-way random effects model where both people and measures effects are random,
b: type A intraclass correlation coefficients using an absolute agreement definition.

Table 5. Result of internal consistency.

Subtypes of CMAST	Number of items	Cronbach's alpha coefficient	internal consistency	95% Confidence interval	
				Lower bound	Upper bound
Expressive language	16	0.95	Excellent	0.92	0.97
Receptive language	25	0.97	Excellent	0.94	0.98
Reading and Writing	4	0.88	Good	0.79	0.94
Total	**45**	**0.97**	**Excellent**	**0.95**	**0.98**

Discussion

The CMAST has an IOC value of 0.80-1.00, with a sensitivity of 96.30% in detecting aphasia and a specificity of 69%. Furthermore, it can be compared to the results of the Saraburi Aphasia Screening Test: SD-SLP-01,[14] which has sensitivity and specificity values of 92.50% and 84.62%, respectively[18] It's important to note that sensitivity and specificity depend on the population tested. Testing in a patient group compared to a control group of normal individuals would likely yield higher true positives in the patient group and true negatives in the control group, resulting in higher sensitivity and specificity than in reality.[27] Concurrent validity is high, as indicated by a substantial phi coefficient of 0.67 from the correlation analysis. This can be compared to the results of the Saraburi Aphasia Screening Test: SD-SLP-01,[14] which has a concurrent validity of 0.97.[18]

In summary, CMAST demonstrates high concurrent validity, showing a strong relationship with the diagnosis results obtained from the gold standard examination at a significant level.[23] It can be compared to the results of the Saraburi Aphasia Screening Test: SD-SLP-01.[14] The $p<0.001$ indicates significant differences between the aphasia and non-aphasia groups. Therefore, CMAST demonstrates construct validity by distinguishing between individuals with CVA and with or without aphasia.[24] The inter-rater reliability for the overall CMAST score with an ICC value of 0.99 indicates highly consistent inter-rater reliability.[25] This suggests that CMAST is reliable, allowing for consistent results even when assessed by different evaluators. The internal consistency using Cronbach's Alpha yielded a value of 0.97, indicating excellent reliability.[26] Additionally, it highlights the comparison with the Saraburi Aphasia Screening Test: SD-SLP-01,[14] where both tools demonstrate consistent alignment within their content, as indicated by similar Cronbach's Alpha values.[18] The psychometric properties of CMAST, which demonstrate content validity, sensitivity, specificity, construct validity, concurrent validity, and reliability, are excellent. This includes excellent inter-rater reliability (r=0.99) and high internal consistency (Cronbach's Alpha =0.97). Therefore, CMAST is deemed suitable for screening individuals with CVA and aphasia.

Conclusion

The newly developed CMAST is a valuable tool for screening language skills, including all four language aspects, namely (1) receptive language comprises auditory comprehension, word recognition, and sequential commands (2) expressive language comprises spontaneous speech, verbal fluency, repetition, and naming (3) reading and (4) writing. The criteria are well-defined, making result interpretation easy, and the screening takes only 10-15 minutes. CMAST has undergone thorough testing, ensuring it is both valid and reliable. This makes it suitable for clinical use in screening CVA with aphasia. These findings are crucial for shaping treatment plans and rehabilitation approaches and guiding patients and their caregivers.

Limitation

Collecting data from a small sample group of individuals with CVA in Chiang Mai, using the Thai language for screening, may result in assessment differences compared to evaluating patients in different contexts. Factors such as geographical region and hospital characteristics (government or private) can contribute to variations in the assessment outcomes. Moreover, it was observed that when screening individuals with CVA with aphasia, despite framing questions with predefined responses or speech targets, patients' responses varied. Therefore, when used for screening in individual cases, the answers obtained may differ from the anticipated responses. Scoring in that specific subtest may depend on the evaluator's discretion. The researcher suggests conducting further studies with a larger sample size of CVA patients with aphasia to differentiate between types of aphasia and assess severity. This comparison could be made using the Thai WAB.[13]

Statement of ethics

This study was approved by the Research Ethics Committee of the Faculty of Associated Medical Sciences, Chiang Mai University (Approval ID: AMSEC-64FB-005)

Conflict of interest

The authors have declared that no competing interests existed at the time of publication.

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Appendix 1

Example of Chiang Mai Aphasia Screening Test (CMAST)

ภาคผนวก ข

แบบคัดกรองภาวะเสียการสื่อความฉบับสมบูรณ์

ข้อคำถาม	เกณฑ์การให้คะแนน		หมายเหตุ
	ถูก (1)	ผิด (0)	
การพูดโต้ตอบ			
1. บอกที่อยู่อาศัย			
2. อธิบายรูปภาพ (ภาพกิจกรรมในครัว)			
การพูดคล่อง			
3. นับเลข 1-10			
4. ไก่งามเพราะขน คนงามเพราะ..(แต่ง)..			
5. เกลือมีรส...(เค็ม)...			
การฟังเข้าใจภาษา			
6. คุณชื่อจันทร์ใช่หรือไม่			
7. คุณชื่อ.....(ชื่อผู้ป่วย)..... ใช่หรือไม่			
8. คุณอาศัยอยู่ที่...(ไม่ใช่จังหวัดที่ผู้ป่วยอาศัย)....ใช่หรือไม่			
9. ที่นี่คือโรงพยาบาลใช่หรือไม่			
10. คุณเป็นหมอใช่หรือไม่			
11. ไก่ตัวใหญ่กว่าวัวใช่หรือไม่			
12. พระอาทิตย์ขึ้นทางทิศตะวันตกใช่หรือไม่			