Original Article

Construct Validity and Internal Consistency Reliability of the Thai Version of the Telephone-Based Cognitive Screening Tool

Watthanaree Ammawat,[1] Nonticha Thavornpaiboonbud,[1] Attapol Attanak,[2] Keerathi Oanmun[3] and Thitiya Wangkawan[1]

[1]Division of Occupational Therapy, Faculty of Physical Therapy, Mahidol University, Nakhon Pathom; [2]Language Institute, Khon Kaen University, Khon Kaen; [3]Physical Therapy Center, Faculty of Physical Therapy, Mahidol University, Bangkok, Thailand

ABSTRACT

Objectives: To affirm the construct validity and internal consistency reliability of the Thai version of the Telephone-Based Cognitive Screening Tool (Thai-TeBCOG).

Study design: A cross-sectional study.

Setting: Health-promoting hospitals, elderly schools in Bangkok, Chiang Mai, Khon Kaen, Chon Buri, and Nakhon Si Thammarat, Thailand.

Subjects: Participants of the study were 225 healthy adult volunteers between the ages of 23 and 80 and were from Thailand's city of Bangkok and provinces of Chiang Mai, Khon Kaen, Chon Buri, and Nakhon Si Thammarat. The volunteers were evaluated and assessed to be free of dementia, cognitive impairment, and depression.

Methods: Participants' demographics and information were gathered using a number of instruments and two main procedures. Firstly, items on the screening instruments were addressed through face-to-face interviews lasting on average approximately 15 minutes. Secondly, the Thai-TeBCOG was administered remotely over the phone for about 20 minutes. Cronbach's alpha was used to measure internal consistency, and exploratory factor analysis (EFA) was applied in assessing the questionnaire's construct validity.

Results: There were 13 items on the Thai version of the Telephone-Based Cognitive Screening Tool. The internal consistency and the construct validity of the screening tool were examined by using Cronbach's alpha coefficient and exploratory factor analysis, respectively. The results showed that the Thai-TeBCOG's internal consistency was acceptable with a Cronbach's alpha of 0.75. The construct validity of the tool was evaluated using EFA, and four extracted factors accounted for 54.48% of the total variance.

Conclusions: Four domains of individual differences were investigated. This study contributes to a growing body of knowledge aimed at increasing the effectiveness of cognitive screening tools for adults in different contexts.

Keywords*:* cognitive screening, telephone survey, interviews, exploratory factor analysis

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Introduction

The Coronavirus pandemic (COVID-19) and recent economic crises have had significant impacts on the lifestyles of adults, as well as leading to stress and memory loss among adult populations. While the majority of people who contract COVID-19 are likely to recover, they may be affected in the long term with memory or attention problems.[1,2] To be specific, a decline in cognitive processes, attention, memory, executive function, and organizing & planning abilities has been shown to occur in otherwise recovered patients.[3] Additionally, upon the spread of COVID-19, many countries, Thailand among them, implemented social distancing policies and stay-at-home orders, restricting their population's movements. As a result, individuals may have lost connection to health-tracking systems, health promotion initiatives, and information about how to prevent cognitive decline. While a number of cognitive performance screening tools, such as the Thai version of the Montreal Cognitive Assessment (MoCA),[4] the Abbreviated Mental Test (AMT),[5] and the Rowland Universal Dementia Assessment Scale-Thai version,[6] are presently available, a limitation of these tests is that face-to-face interactions are required. During times of pandemic and for those who live in remote areas, face-to-face interactions are not always suitable. These limitations could be transcended with the development of a telephone interview for cognitive performance screening.[7] However, few cognitive evaluation methods have been shown to be adequate for Thai contexts. In order to address this research gap, the present study undertook a literature review, which informed the creation of a novel questionnaire designated as the Telephone-Based Cognitive Screening Tool (Thai-TeBCOG). Providing health services remotely and through online social networks in Thailand reduces repetitive tasks, saves time and travel expenses, and facilitates effective health services. The objective of this study was to conduct a preliminary investigation into the cognitive components of the Thai-TeBCOG by utilizing Exploratory Factor Analysis

Correspondence to: Watthanaree Ammawat, PhD, Division of Occupational Therapy, Faculty of Physical Therapy, Mahidol University, 999 Phuttamonthon 4 Road, Salaya, Nakhon Pathom, 73170, Thailand Email: watthanaree.ama@mahidol.ac.th

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(EFA). It is possible that an effective screening tool could be implemented as an initial step before administering a more intensive intervention program. Such a tool would increase the usefulness of clinical evaluations in a variety of health-care settings.

Literature review

Domains of cognitive functions in adults

Clinical assessments examine the various domains of cognitive functions to assess a person's cognitive state. Cognitive domains or functional systems in the brain include attention, memory, language, perception, and executive function.[8] Depending on the research objective, studies have handled domain classification differently. Liaison studies have discussed domains of cognitive functions in terms of regional brain functions, referring to the functioning of the frontal lobe, the temporal lobe, or other brain regions. The complexity of the operation, based on hierarchical cognitive domains, has also been used to classify cognitive domains, leading to 'top-down' versus 'bottom-up' designations. Bottom-level domains refer to simpler operations, such as sensing stimuli through sensory modalities and perceptions. In contrast, top-level domains are the most complex, such as reasoning and problem solving. In bottom-up strategies, the cognitive domains are primarily sensation, perception, motor skills & construction, attention & concentration, memory, executive functioning, processing speed, and language/verbal skills.[9]

Research has attributed age-related cognitive decline to various domains of cognitive function. Brain shrinkage has been shown to take place over time, particularly in the prefrontal regions.[10] The prefrontal cortex appears to be involved in the cognitive control of the following components: sustained attention, selective attention & inhibitory control, working memory, and multi-tasking & task switching.[11] Some of these cognitive control components appear in the Unity and Diversity Model of Executive Functions, proposed by Miyake et al. (2000),[12] which encompasses a wide range of higher-order cognitive processes, such as updating, inhibiting, and set-shifting. Lacreuse et al. (2020) agree that age-related decline in executive functions is caused by changes in the prefrontal areas.[13] Harvey (2019) argues that although simple working memory tasks activate the frontal lobe, they do not entail problem solving or cognitive resource management and suggests that the term "executive functioning" should be broadly used to refer to reasoning and problem solving.[9] In line with this definition, inductive reasoning could be classified as executive functioning. Meanwhile, age-related brain shrinkage has also been observed in medial temporal regions, where the hippocampus is embedded,[10] potentially hampering collaboration between working memory and long-term memory. Similarly, a person with atrophy in the medial temporal regions may exhibit language deficits due to the inaccessibility of long-term memories, particularly, semantic memories where linguistic information is stored. Another indicator of overall cognitive performance is processing speed. Individuals with both cortical and frontostriatal degeneration, or those with severe mental illness, may have slower processing speeds.[9]

Widely used cognitive assessment tools, such as the Mini-Mental State Examination (MMSE) and the Montreal Cognitive Assessment (MoCA), assess orientation and calculation, among other cognitive components. In cases of mild cognitive impairment or dementia, time, place, and person orientation play an important role in predicting overall decline. Disorientation to time in elderly hospital patients is a useful indicator of the presence and severity of dementia, and a patient's inability to correctly identify the month or year is a strong enough indicator of dementia to warrant a more thorough cognitive assessment.[14] Calculation, meanwhile, is used to assess concentration, attention, and working memory. In addition, the MoCA includes an abstraction aimed at evaluating multi-faceted executive functions.[15]

Based on the literature, cognitive screening tools engage numerous cognitive domains to assess a patient's cognitive state. The researchers focused the current study on attention & concentration, memory, executive functioning, processing speed, language/verbal skills, and orientation. These cognitive components could be assessed through a number of cognitive tasks that were included on the Thai-TeBCOG. The Thai-TeBCOG was tested on the Thai population and its validity was investigated with EFA.

Methods

Participants

The participants in the present study were community-dwelling adults ranging in age from 23 to 80 years (mean = 48.96, standard deviation = 15.71) residing in Bangkok, Chiang Mai, Khon Kaen, Chon Buri, and Nakhon Si Thammarat, Thailand. The study made extensive use of participant characteristics and employed cognitive interview techniques along with multi-stage sampling. The locations representing Bangkok and the four regions of Thailand were randomly chosen. Based on convenience sampling method, 48, 39, 48, 45, and 45 volunteer participants were selected from Bangkok, Chiang Mai, Khon Kaen, Chon Buri, and Nakhon Si Thammarat, respectively. To circumvent potential impediments to the participants' participation, researchers identified cognitive impairments using a RUDAS cutoff value of 23-24 and symptoms of depression using a Patient Health Questionnaire-9 (PHQ-9) cutoff value of 7. Only healthy volunteers, without any diagnosis of dementia, cognitive impairment, or depression, were selected to participate in this study. In total, 225 participants (67.60% female and 32.40% male) participated in this study. The majority of them (63.20%) had graduated with a bachelor's degree or higher. Thailand's average monthly income per household is approximately 26,018.42 THB, and in the present study, the percentage of households with incomes ranging from 15,001 to 30,000 THB; 30,001 to 50,000 THB; higher than 50,000 THB; and lower than 15,000 THB was 32.60%, 19.20%, 13.4%, and 34.80%, respectively.

Procedures

Study protocols were approved by the Mahidol University Institutional Review Board Committee (MU-CIRB 2020/337.1610). Participants received an information sheet, which they reviewed independently, and were given an informed consent form to sign. The various instruments in this study were employed in gathering data in two stages. Firstly, items on the screening instruments were addressed through face-to-face interviews lasting an average of approximately 15 minutes. Secondly, the Telephone-Based Cognitive Screening Tool was administered over the phone. These interviews took about 20 minutes. The participants were recruited for this study between September 2021 and March 2022.

Measurements

Screening Instruments

The Rowland Universal Dementia Rating Scale (RUDAS)

The RUDAS is a short cognitive assessment tool that was developed and validated by Rowland et al. This screening tool tests six domains and consists of tasks relating to body orientation, cube drawing, problem solving, praxis (coordination between both hands), memory (remembering a shopping list), and semantic verbal fluency (naming animals).[16,17] The total RUDAS score is 30 points, and the initial validation study proposed a cut-off value of 23 to screen for cognitive impairment. A RUDAS-Thai cut-off value of 24 out of 30 identifies people with dementia in cases where respondents have completed at least 6 years of primary education, and otherwise, the cut-off value decreases to 23.[18] The RUDAS-Thai is easy to use, takes less than 15 minutes to complete, and has previously been evaluated for content validity and test-retest reliability. With a Pearson's value of 0.80, the instrument was shown to have 78.7% sensitivity and 61.8% specificity.[18,19] The RUDAS-Thai was administered to each participant in this study.

The Patient Health Questionnaire-9 (PHQ-9)

Depressive symptoms were initially screened using the 2 Questions for Depression Screening (2Q) tool, consisting of two questions: 'Do you feel depressed?' and 'Have you lost interest or pleasure in doing things, or felt bored?' If a participant answered 'yes' to one or both of the two questions, the PHQ-9 was administered. The PHQ-9 inquires whether any of 9 symptoms were present for more than half of the days over the 2 weeks prior to answering the questionnaire. Severity of depression according to PHQ-9 is classified as follows: scores ranging from 7-12 signify 'mild' depression; 13-17 signify 'moderate' depression; and 18 or above signify 'severe' depression. The PHQ-9 has a high degree of sensitivity and specificity,[20] and it is recommended that participants with scores of greater than 7 see a healthcare provider.

Socio-demographic variables

An abridged questionnaire was created to gather data on socio-demographic factors, such as age, gender, educational status, and family income.

The Thai version of the Telephone-Based Cognitive Screening Tool (Thai-TeBCOG)

The 13-item Thai-TeBCOG, a cognitive evaluation test with a full score of 40 points, requires an estimated 15 to 20 minutes to administer. The items in the Thai-TeBCOG and their point allocations are described as follows: 1) Orientation to time is utilized to assess mental capacity relevant to date awareness and involves the examiner asking for the current date, including the day of the month, the month, and the year (3 points, 1 for each item); 2) Orientation to phone number is assessed by requesting that the examinee recall his/her 10-digit telephone number (1 point); 3) Ability to calculate is assessed by asking the examinee to subtract 6 from 70 and to continue to subtract 6 from their previous answer until they have completed five consecutive subtractions (5 points, 1 for each item); 4) Attention is quantified by performing a reverse spelling test, such as asking the examinee to spell ต ะ ข า บ (/takhap/ 'centipede') backwards (5 points, 1 for each item); 5) Memory-recall is assessed by employing a five-item word list recall test, wherein the examinee is given a list of five words and is asked to recall those words at a later point in the assessment (5 points, 1 for each item); 6) Working memory is assessed with the backward digit span test (5 points, 1 for each item); 7) Verbal fluency is measured using a one-minute fruit name generation test in which the examinee is given one minute to produce as many fruit names as possible (4 points); 8) Repeating a sentence is an ability examined by asking the examinee to repeat กระรอกปีนขึ้นต้นไม้ตอนกลางคืน (/krarok pin khuen tonmai ton klangkhuen/ 'A squirrel climbs up a tree at night'.) (1 point); 9) Object naming refers to the examinee's ability to produce the names of objects, and the examinee is required to respond to two questions: อะไรที่คนมักเอาไว้ใช้ตัดกระดาษ (/arai thi khon mak ao wai chai tat kradat/ 'What do people generally use to cut paper?') and ผักที่มีรสเผ็ด สีเขียวและสีแดง (/phak thi mi rot phet si khiaw lae si daeng/ 'What is a naturally spicy green or red vegetable?' (2 points, 1 for each item); 10) Processing Speed is assessed by the examinee's performance reciting the months of the year in reverse order from ธันวาคม (/thanwakhom/ 'December') through มกราคม (/makarakhom/ 'January') (4 points); 11) Inductive reasoning is the process of identifying a rule or a pattern based on cases belonging to that rule, and to test this, the examinee is assigned the task of predicting the next number in a list (2 points); 12) Abstraction involves the examinee being asked to identify commonalities between certain terms and to specify their category while avoiding concrete responses to the best of their ability (2 points); and 13) Executive functions are assessed by measuring the examinee's ability to plan and to describe sequences by answering clarifying questions, and this assessment is carried out by requesting the examinee answer irrelevant questions. (2 points).

The content validity of the Thai-TeBCOG was calculated using the Content Validity Index (CVI). A panel of five experts,

selected from senior professionals and considered to have extensive knowledge and experience in the fields of Cognitive Psychology and Neuroscience, evaluated each item on the screening tool. The credentials of the five professional experts were as follows: one expert with a PhD in Cognitive Science and an MSc in Clinical Psychology; one expert with an MD/ PhD in Neuroscience and Occupational Science and in Community Mental Health; one expert with a PhD in Community Medicine; one expert with a PhD in Occupational Science; and finally, one expert with an MSc in Mental Health. Each panelist was asked to rate each item on a scale ranging from 1-4 based on its relevance and clarity, where a score of 1 indicated 'not relevant;' 2 indicated 'relevant, but needs revision;' 3 indicated 'relevant, requiring minor revisions;' and 4 indicated 'relevant'. The I-CVI was calculated by dividing the number of experts who had given scores of 3-4 ('relevant') by the total number of experts. The resulting item-level content validity index for the tool ranged from 0.8 to 1, where a value of at least 0.78 was regarded as acceptable.[21,22] The average I-CVI score of the tool was 0.98, meaning that on average each item on the tool was assessed as having an outstanding content validity with a high level of agreement among panel members.[21] To ensure that the measurement tool would accurately measure the concept it was intended to measure, items with poor agreement among panel members would need to be removed from the tool. An I-CVI score of 0.70 is considered to be the threshold, with lower scores suggesting the item should be removed from the measurement tool.[21,23]

Statistical methods

The data were analyzed using IBM's Statistical Package for the Social Sciences (SPSS) (version PASW 18). Construct validity of the tool was examined using EFA, along with the extraction method of principal component analysis (PCA) and Oblimin rotation. Kaiser-Meyer-Olkin (KMO) and Bartlett's test were used to determine the sufficiency of sample size and its suitability for factor analysis (KMO ≥ 0.6 being an acceptable value for conducting EFA). The factors were retained if they had an eigenvalue of greater than 1. Variables with a factor loading greater than 0.40 were considered to be relevant to factor interpretation.[24] CVI and impact scores were calculated using Excel.

Results

Internal consistency

Descriptive statistics are presented in Table 1, including minimum, maximum, mean, standard deviation, skewness, and kurtosis of participants' scores for each of the 13 items, as well as their overall scores. The reliability analysis of the Thai-TeBCOG showed a Cronbach's standard coefficient of 0.754. The coefficient being greater than 0.7 demonstrated a satisfactory level of internal consistency dependability.

As seen in Table 2, almost all of the items assessing cognitive abilities from the same scale demonstrated significant correlation with each other. Inductive reasoning and abstraction abilities were discovered to be linked to a variety of other items. The majority of the associations were statistically significant and positive, and the majority of the values in the correlation matrix were moderate, eliminating the likelihood that the correlation matrix was an identity matrix.

The construct validity of the Thai version of the Telephone-Based Cognitive Screening Tool

To ensure that having a small sample size had not affected the research results, tests for skewness and kurtosis were estimated for each dependent variable (Table 1). In line with the guidelines for skewness |3.00| and kurtosis |10.00| by Kline (2005), a skewness of greater than 3.00 and a kurtosis of greater than 10.0 were considered 'non-normal' in this study.[25] The variables of 'Orientation to time,' 'Orientation to phone number,' and 'Object naming' were shown to have skewness

Table 1. Descriptive statistics of cognitive measures at initial testing (n=225)

Item	Min	Max	M	SD	Skewness	Kurtosis
1. Orientation to time (OT)	1	3	2.92	0.31	-3.88	15.80[a]
2. Orientation to phone number (PHONE No.)	0	1	0.96	0.19	-5.05	23.71[a]
3. Ability to calculate (CALC)	0	5	3.94	1.44	-1.25	0.43
4. Attention (ATTN)	0	5	4.42	1.45	-2.49	4.70
5. Memory-recall (M-ReCALL)	0	5	3.90	1.34	-1.16	0.53
6. Working Memory (WM)	0	5	2.88	1.34	-0.01	-0.97
7. Verbal Fluency (VF)	0	5	2.69	0.61	-1.58	4.05
8. Repeating a sentence (RPT-S)	0	2	0.79	0.42	-1.23	0.06
9. Object Naming (OBJ-N)	0	2	1.92	0.28	-3.83	15.05[a]
10. Processing Speed (PS)	0	4	2.93	1.30	-0.94	-0.37
11. Inductive Reasoning (IR)	0	4	1.30	0.77	0.09	0.26
12. Abstraction (ABS)	0	2	1.73	0.53	-1.90	2.73
13. Executive Functions (EFs)	0	2	1.72	0.48	-1.32	0.58
Total Score	13	40	32.09	6.09	-1.074	0.435

[a]Skewness or kurtosis outside the acceptable range; Min, minimum; Max, maximum; M, mean; SD, standard deviation

Table 2. Inter-correlation between the items (n=225)

Items	1	2	3	4	5	6	7	8	9	10	11	12
1	1											
2	.103	1										
3	.149*	.292**	1									
4	.139*	.287**	.430**	1								
5	.066	.184**	.203**	.200**	1							
6	.084	.145*	.309**	.264**	.330**	1						
7	.167*	.295**	.226**	.352**	.180**	.163**	1					
8	.135*	.131*	.147*	.292**	.074	.241**	.243**	1				
9	.234**	.034	.132*	.165*	.111	.095	.226**	.127	1			
10	.174**	.267**	.435**	.397**	.204**	.295**	.348**	.259**	.242**	1		
11	.203**	.139*	.329**	.355**	.194**	.278**	.192**	.339**	.210**	.436**	1	
12	.241**	.219**	.320**	.328**	.331**	.275**	.291**	.182**	.251**	.423**	.187**	1
13	.012	.036	.200**	.196**	.185**	.233**	.107	.140*	.071	.212**	.101	.259**

Notes: 1, orientation to time; 2, orientation to phone number; 3, calculation; 4, attention; 5, memory-recall; 6, working memory; 7, verbal fluency; 8, repeating a sentence; 9, object naming; 10, processing speed; 11, inductive reasoning; 12, abstraction; and 13, executive functions

**Correlation was significant at the 0.01 level (2-tailed)

*Correlation was significant at the 0.05 level (2-tailed)

Table 3. KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy		0.839
Bartlett's Test of Sphericity	Approx. Chi-Square	522.882
	df	78
	Sig	0.000*

*Represents significance with a significance value of less than 0.001

and kurtosis scores outside of the acceptable range, demonstrating that these cognitive measures did not result in normally distributed responses.[26] Table 3 shows the results of KMO and Bartlett's Test, where the KMO value of cognitive ability was greater than 0.8 (at 0.839) and Bartlett's test Chi-Square was approximated at 522.882 (p < 0.001). The data were subsequently analyzed using Exploratory Factor Analysis (EFA).

As displayed in Table 4, factor analysis using the Oblimin rotation method identified four factorial components with eigenvalues of greater than 1, accounting for 54.48% of the total variance. All 13 items on the instrument remained in the extraction table. The pattern matrices were carefully examined. The tests, producing factor loadings for a four-factor structure, ranged from .51 to .83 for factor one (orientation to phone number, verbal fluency, attention, and ability to calculate); from .54 to .69 for factor two (executive functions, memory-recall, working memory, and abstraction); from .44 to .74 for factor three (repeating a sentence, inductive reasoning, and processing speed); and from .70 to .76 for factor four (object naming and orientation to time). The scree plot shows the number of extracted factors (Figure 1).

Table 4. Factor Analysis after Oblimin with Kaiser Normalization Rotation for the Thai-TeBCOG (n=225)

Item	Component			
	1	2	3	4
2. Orientation to phone number (PHONE No.)	.83			
7. Verbal Fluency (VF)	.58			
4. Attention (ATTN)	.52		.46	
3. Ability to calculate (CALC)	.51			
13. Executive Functions (EFs)		.69		
5. Memory-recall (M-ReCALL)		.67		
6. Working Memory (WM)		.60		
12. Abstraction (ABS)		.54		.43
8. Repeating a sentence (RPT-S)			.74	
11. Inductive Reasoning (IR)			.73	
10. Processing Speed (PS)	.43		.44	
9. Object Naming (OBJ-N)				.76
1. Orientation to time (OT)				.70
Eigenvalue	1.96	1.82	1.82	1.48
Variance explained (%)	15.09	14.03	13.98	11.38
Cumulative %	15.09	29.12	43.10	54.48

[a]Extraction methods: principal component analysis; rotation method: Oblimin with kaiser normalization; factor loadings < 0.4 removed

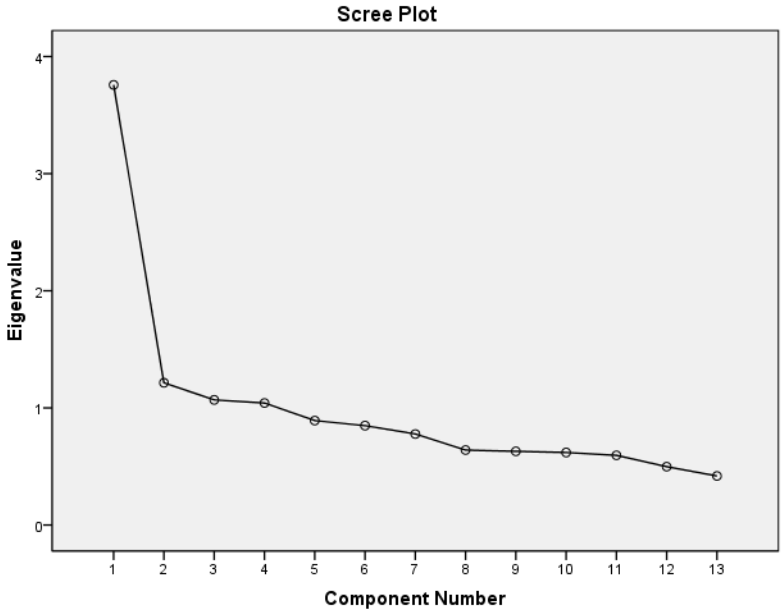

Figure 1. The scree plot, showing eigenvalues of all component numbers reflecting the EFA results for the Thai version of the Telephone-Based Cognitive Screening Tool

Discussion

The internal consistency analysis of the Thai-TeBCOG found a Cronbach's alpha value of 0.754, indicating reasonably good reliability, according to previous literature.[21,23] Previous studies on various versions of telephone-based cognitive tools have reported alpha values averaging around 0.7. For example, the Persian version of the Telephone Interview for Cognitive Status-modified (TICS-m) questionnaire had what was considered an excellent internal consistency (Cronbach's alpha = 0.712) when tested among community dwelling adults.[27] Similarly, when the telephone cognitive screen (T-CogS) was translated into a Turkish version (T-CogS-TR), the overall Cronbach's alpha coefficient was 0.763, indicating a satisfactory level of internal consistency.[28]

The results of the present study also showed that a multidimensional structure (higher order model) provided a better description of the existing relationships among the cognitive components within the Thai-TeBCOG. The results of the EFA confirmed that the four components had the following composite indicators: 1) ATTENTION (orientation to phone number, verbal fluency, attention, and ability to calculate), 2) EXECUTIVE FUNCTIONS AND MEMORY (executive functions, memory-recall, working memory, and abstractions), 3) LANGUAGE (repeating a sentence, inductive reasoning, and processing speed), and 4) NAMING AND ORIENTATION (object naming and orientation to time). This is consistent with earlier research in which factor analysis was used to identify latent dimensions in the Telephone Interview for Cognitive Status (Modified) and variables were divided into four factors: 'verbal memory', 'orientation/mental tracking', 'language/reasoning', and 'attention/working memory'.[29]

The results of the current investigation suggested that the effectiveness of the Thai-TeBCOG is in line with two widely recognized telephone screenings for cognitive impairment, the Montreal Cognitive Assessment (MoCA) and the Telephone Interview for Cognitive Status (TICS). Modeling of the Portuguese version of the Montreal Cognitive Assessment (MoCA) indicated that the tool could be split into a two factor model factorial structure, defined as MEMORY, including memory, language, and orientation sub-tests, and ATTENTION/EXECUTIVE FUNCTIONS, comprised of attention, executive functions, and visuospatial abilities tasks.[30] The Persian version of the TICS-m has been shown to have six factors consistent with the original TICS-m questionnaire: 'orientation,' 'registration/free recall,' 'attention/calculation,' 'comprehension, semantics, and recent memory,' 'language/repetition,' and 'delayed recall'.[27,31] Importantly, by using this scale, researchers have been able to assess cognitive performance in adulthood. During times of pandemic, the Thai-TeBCOG evaluation would be useful, as it would allow those who have been affected by COVID-19 for an extended period to track how their symptoms and cognitive abilities are changing over time. This study's finding of an excellent internal consistency for the Thai-TeBCOG when used in Thai contexts is a result of the tool being tailored to Thai people living in the four different regions of Thailand, as well as Bangkok (the capital city), according to their different regional dialects and local cultures. The age range of participants in this study spanned from 23 to 80 years, indicating that the Thai-TeBCOG has the potential to be utilized for assessing individuals across a wide range of ages. While this study has several important research implications, financial constraints limited the study to a preliminary and incomplete evaluation of psychometric aspects. In addition, the findings cannot be extrapolated beyond the sample used in this EFA. Therefore, future research should duplicate the findings from this investigation to explore the robustness of the Thai-TeBCOG. Norming studies with

larger and more heterogeneous samples are desperately needed. In addition, a CFA should be carried out to establish numerous psychometric features, such as cutoff point, sensitivity, and specificity.

Conclusion

Exploratory factor analysis showed a four-factor model based on prior literature and theoretical considerations to be a good fit. The thirteen items on the Thai-TeBCOG require about 20 minutes to administer via telephone. The Thai-TeBCOG is proposed as a brief, economical, valid, and reliable cognitive screening tool, beneficial for its ability to assess a broad set of cognitive domains, coupled with the advantage that it can be administered by non-professionals. Due to the increased incidence of long-term health effects attributable to Long COVID, health care practitioners may require novel approaches to evaluate cognitive impairment, especially in patients who lack convenient access to clinical settings. The results of this study show that the Thai-TeBCOG is a valid and practical tool for assessing adults in a variety of age groups, including older adults, when cognitive evaluation via in-person interviews is impractical.

Disclosure

The authors have no conflicts of interest related to this study to disclose.

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