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Psychometric Adaptation and Validation of the Bangla Six-Item Cognitive Impairment Test (6-CIT) Among Bangladeshi Older Adults

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Abstract

Cognitive impairment (CI) is an age-related illness involving declines in memory, attention, and executive functioning, adversely affecting well-being and increasing the chances of dementia. An accurate assessment of CI in Bangladesh needs culturally suitable screening tools, as many existing tools were developed in Western contexts. So, valid, reliable, and culturally appropriate screening tools are urgently needed to detect CI early. The study aimed to adapt and validate the 6-item Cognitive Impairment Test (6-CIT) in Bangla for use among older adults. Using a cross-sectional design, data were collected via convenience sampling from 681 older adults aged 60 to 79 years in Bangladesh. Psychometric assessment showed strong item quality, as indicated by item-total and inter-item correlations. Internal consistency and test-retest reliability were excellent, as indicated by McDonald's omega (ω), Cronbach's alpha (α), and Guttman lambda (λ2). Expected differences across age, gender, smoking habit, and sleeping pill use confirmed known-group validity. Correlations with stress and well-being showed evidence of convergent and divergent validity. Velicer's MAP test showed a unidimensional structure for the scale, while EFA confirmed the adequacy of the data (KMO =.77; Bartlett's X^2 =1628.59, p <.001). The initial two-component solution explained 72.68% of the variance. The receiver operating characteristic analysis showed good to excellent item accuracy. Overall, the Bangla 6-CIT is a reliable, valid, and feasible screening tool for primary care and community-based settings to support early detection and intervention for CI of older adults in Bangladesh.

Keywords: cognitive impairment, older adults, 6-item cognitive impairment test, psychometric validation

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Introduction

Cognitive impairment (CI) is a significant global public health issue that dramatically raises the worldwide impact on the concentration, memory, orientation, and executive functioning of older adults. It is also a major risk factor for death and disability. CI interferes with activities of daily living, leading to reduced functional independence and poorer quality of life among older adults.

With advancements in the health sector, controlling disease and improving living standards have significantly increased global life expectancy (Hay et al., 2017). As a result, the global population of older adults is increasing rapidly. Older adults accounted for 5.9% of the global population in 1960, rising to 8.2% in 2000, and reached 13.5% in 2022, reaching approximately 567.8 million people. In 2030, older adults will make up 1 in 6 people globally, and by 2050, it is projected to reach approximately 2.1 billion. The number of oldest-old or those aged above 80 years is expected to grow at the fastest rate, with their numbers expected to triple between 2023 and 2060 to reach 545 million (World Population Prospect, 2024)

Afrin et al. (2025) stated that the prevalence of elderly adults in Bangladesh is predicted to increase from 8% in 2020 to 22% in 2050. Bangladesh Bureau of Statistics (2022) concluded that in 1974, the number of people aged 60 to 64 years was 1682629; in 2011, it was 3218974; and in 2022, the number of people aged 60 years was approximately 15 million. This rapid growth of older adults highlighted the rising incidence of age-related disorders, including cognitive impairment (CI). The prevalence of CI is increasing worldwide. As CI in older adults is a significant well-being issue, it is characterized by deterioration in attention, memory, cognitive, and learning capabilities (ICD-10, 2013). It greatly influences the well-being and risk of mortality and dementia. The average incidence of CI reported by Campos et al. (2024) varies by region worldwide, with rates of 35.2% in Brazil, 20.5% in Australia, 19.4% in Asia, 20.1% in North America, and 25.7% in Africa.

CI of older adults is especially concerning in Bangladesh. Imran et al. (2024) reported significant rates of severe (53%) and mild (38.7%) CI, and that older people living in cities and males are more vulnerable. Due to cultural differentiation, social stigma, apathy, and limited access to mental health care, CI frequently goes undetected. These factors increase the difficulties of cognitive assessments and indicate the need for culturally appropriate screening tools.

Cognitive functions change due to neurological, biological, and environmental factors as people age, according to the Cognitive Aging theory. As a result, there is a gradual deterioration in memory, attention, and information processing, which is the normal part of aging (Salthouse, 1996). CI describes a cognitive problem when thinking, memory, or attention skills deteriorate more quickly than is typical with aging. Early detection of individuals at risk for cognitive issues is crucial, according to the theory of neuropsychological screening. Screening tests help determine who is likely to have issues and who requires more thorough testing, but they cannot directly diagnose the disease (Lezak et al., 2012).

Brooke and Bullock (1999) developed the Six-Item Cognitive Impairment Test (6-CIT), a brief cognitive screening instrument intended to identify cognitive impairment among senior citizens. It can be used in both clinical settings and the community. They found strong psychometric properties, with good convergent validity (r = .91). 6-CIT showed good sensitivity (78.57%) and specificity (100%), with an area under the curve (AUC) of .91 at a cutoff of 7/8. Tuijl et al. (2012) also found good convergent validity (r = -.82) and a good AUC value (.95) in receiver operating characteristic (ROC) analysis after using a cutoff value of 10/11 among older adults in the Netherlands. O'Caoimh and Molloy (2023) found good convergent validity (r = -.86) and an AUC value (.88) in Ireland. O'Sullivan et al. (2016) reported that 6-CIT demonstrated good accuracy and validity in Ireland. Aree-Ue et al. (2020) translated and validated the 6-CIT scale in the Tai version and found excellent content (S-CVI and I-CVI = 1.00), convergent (r = .47) divergent (r = -.91), and validity and excellent reliability (α = .80). Apóstolo et al. (2018) also assessed the convergent validity of CIT-6 in the Portuguese version with good test-retest (r = .95), Cronbach's alpha reliability (α = .88), corrected item-total correlations (r = .32 to .90), and excellent AUC (.91) score by ROC analysis. Salis et al. (2023) found convergent validity (r = .84) and a good AUC score (.95) using a cutoff of 7/8 in Italy. Despite the rising body of evidence and validation across various countries, no validated Bangla version of the 6-CIT is currently available for older adults in Bangladesh. To fill this gap, the current research investigates the psychometric qualities of the Bangla-adapted 6-CIT among older adults in Bangladesh.

Rationale of the Study

In community settings and primary health care, cognitive screening plays a significant role in the early identification of older adults at risk of CI. Although extensive neuropsychological evaluations provide detailed information, they are time-consuming and impractical for routine screening or large-scale population studies, especially in low-resource settings (Brodaty et al., 2006). In this situation, brief screening tools such as the 6-CIT are helpful due to their simplicity, quick administration, and suitability for older adults with low literacy. It measures major cognitive domains, such as memory, orientation, and attention, within a few minutes. International research confirms the 6-CIT's psychometric validity, but without appropriate adaptation, cognitive assessment instruments created in other languages might not be culturally relevant (Beaton et al., 2000). Moreover, comprehensive psychometric evaluation is rare, with most prior research concentrating on basic validity indicators and diagnostic accuracy (Brooke & Bullock, 1999; Tuijl et al., 2012; O'Sullivan et al., 2016; O'Caoimh & Molloy, 2023). However, no research has adapted and validated the 6-CIT for use among Bangladeshi older adults using EFA factor structure and ROC curve Analysis. Therefore, the current study aims to adapt and validate the Bangla version of the 6-CIT among older adults in Bangladesh with robust psychometric properties. Culturally suitable screening tools are expected to facilitate early detection of cognitive impairment and promote rapid intervention in both clinical and community settings in

Bangladesh.

Objectives of the Study

The current study aimed to assess the psychometric properties of the 6-CIT using statistical methods appropriate for its items, which are scored with heterogeneous weights across different cognitive domains, among Bangladeshi older adults. The specific goals were: OB1: The Map test was used to ascertain the proper number of factors, and Exploratory Factor Analysis (EFA) was used to investigate the scale's factor structure; OB2: To examine the reliability (Cronbach's alpha, McDonald omega and Gutman λ2) of 6-CIT; OB3: to determine the validity (content, known-group, convergent, and divergent) of 6-CIT; and OB4: to measure cognitive impairment screening classification accuracy using ROC analysis.

Method

Participants

Using convenience sampling, several Bangladeshi areas, including Chittagong, Dhaka, Khulna, Satkhira, Bogura, Comilla, Sylhet, and Rangpur, were selected to recruit 752 participants. To ensure the samples' geographical diversity, these districts included a mix of rural, suburban, and urban areas. Participants were then divided into groups according to where they lived within these districts. Mahalanobis distance test, a chi-square test was used to evaluate them. As possible outliers, cases with $p < .001$ were considered for elimination (Tabachnick & Fidell, 2019). Based on this test, 681 older adults aged 60-79 years (M = 67.55, SD = 5.67) were retained in the final scale. Using Raosoft sample size calculation (Raosoft, 2004), a 50% response distribution, a 99% confidence interval level, and a 5% margin of error, a population size of approximately 15 million older adults (aged 60 years and above) in Bangladesh was considered based on recent national demographic estimates, reflecting the country's rapidly aging population (Bangladesh Bureau of Statistics, 2022). Based on the estimated sample size, 664 participants were recommended as the minimum required sample. The final sample of 681 older adults, therefore, exceeded the required sample size. Participants were classified as male (457, 64.73%) and female (249, 36.26%) (see Table 1). To assess the test-retest reliability at two-week intervals, 106 of these participants were also used. Participants were selected based on predefined exclusion and inclusion criteria. The inclusion criteria were to be aged 60-79 years and to be physically and mentally well. Participants were excluded if they showed signs of cognitive impairment or were physically and mentally unfit to provide a reliable response.

Table 1
Sociodemographic Characteristics of the Older Adults in Bangladesh (N=681)

Variables	*N* (%)	Variables	*N* (%)
Gender		Smoking Behavior	
Female	431 (63.3%)	Yes	314 (46.1%)
Male	250 (36.7%)	No	367 (53.9%)
Age		Residence	
Young Old (60-69 Years)	455 (66.8%)	Rural	432 (63.4%)
Old-old (70-79 Years)	226 (33.2%)	Sub-urban	95 (14.0%
Sleeping Pill User		Urban	154 (22.6%)
Yes	284 (41.7%)		
No	397 (58.3%)		

Measures

The English Version of Cognitive Impairment Test (6-CIT)

CIT was originally developed in English by Brooke and Bullock (1999)**.** A brief cognitive screening test, the 6-Item Cognitive Impairment Test (6-CIT), is used to identify cognitive impairment (CI) in older persons. Orientation (year, month, and time), memory (five-component address recall), attention (counting backward from 20 and reciting months in reverse), and concentration/calculation (serial 7s) are the six cognitive domains that are evaluated. A total score range of 0–28 is obtained by scoring each item for errors; higher scores indicate poorer cognitive ability. The following cut-points have been verified for clinical interpretation: 0-7 denotes normal cognition, 8-9 implies mild cognitive impairment, and ≥10 indicates dementia or likely CI (Brooke & Bullock, 1999). Excellent psychometric qualities of the 6-CIT include near-perfect inter-rater reliability (κ =.93-.99), good test-retest reliability (r = .91), and moderate internal consistency (α = .61-.74). It demonstrates robust diagnostic accuracy (AUC = .90–.97; sensitivity = 82–94%; specificity = 85–97%), strong convergent validity with established cognitive measures (r = -.70 to -.88 with MMSE-mini mental state examination), and large known-group effect sizes (d = 1.20–2.40) between dementia and healthy control groups (Brooke & Bullock, 1999; Tuijl et al., 2012). Applying the 6-CIT scale takes 2 or 4 minutes. This scale can be used in hospitals, general care, and the community. The low-educated people can also be applied to this scale.

The Bangla Version of Cognitive Impairment Test (6-CIT)

The Standard Scale Translation procedure, as provided by the International Test Commission, was used to translate the 6-CIT from its original English version into Bangla

(ITC, 2017). The forward and back translation processes were carried out for cross-cultural adaptation in compliance with the Beaton et al. (2000).

For focused group discussion (FGD), eight older people participated to verify the item's cultural and linguistic appropriateness. The seven-member expert panel included a linguist, a professor, two psychologists, two professors from the English department, and a current researcher. Based on the detailed information obtained from the focus group discussion, the expert panel evaluated the cultural and linguistic differences between the scale's original language (English) and target language (Bangla).

Two bilingual experts, proficient in both psychological assessment and English, completed the forward translation of the scale (from English to Bangla). After finishing, they evaluated the cultural compatibility of the scale items. To ensure the translated version correctly reflected the original English version's meaning, the expert panel reviewed every item in the scale.

Then, a linguist and two English department professors back-translated the scale from Bengali to English. The expert panel then assessed the translated items to ensure they were accurate and consistent with the English original. Semantic clarity, conceptual equivalence, and idiomatic language were all simultaneously assessed for each item.

Then the expert group formulated an initial version of the Bangla 6-CIT scale and investigated it on 48 older adults. This test assessed the items' simplicity and understanding as well as the results of both backward and forward translation. The pilot study showed that the sample could easily answer all the questions, so no modifications to the scale were needed.

Given that Cronbach's alpha was adequate (α =.81) and the item-total correlations were positive (≥ .20; Clark & Watson, 2016), the scale items seemed reasonable. Additionally, every item in the pilot test showed a substantial positive connection. The final version of the scale for the primary study, which was later carried out with a larger sample (N = 752), retained all items.

Additionally, participants' personal information was gathered using a Personal Information Form (PIF).

The WHO Five Well-Being Index (WHO-5)

Well-being is measured by the Bangla version of the WHO-5 well-being index (Faruk et al., 2021). It has 5 items and functions as a dependable instrument. The scale has a 6-point Likert-type structure (0 = *at no time*, 5 = *all of the time*). Zero is the lowest possible score, and 25 is the highest. A higher score indicates better psychological health. A score of 13 is considered the threshold, meaning that any score below 13 indicates poor well-being. The Bangla version of the WHO-5's convergent validity was evaluated against the Warwick-Edinburgh Mental Well-being Scale, another well-being measure .52. The perceived stress scale and the current scale had divergent validity .44. It was found that the test-retest reliability was .71.

The Perceived Stress Scale (PSS-10)

It was developed by Cohen et al. (1983) and translated into Bangla by Islam (2020) to assess an individual's stress levels over the preceding month. The 5-point Likert scale for the 10-item self-reported scale is as follows: 0 = *never*, 1 = *rarely*, 2= *sometimes*, 3 =*fairly frequently*, and 4 = *very often*. The PSS score ranges from 0 to 40. A lower score indicates reduced perceived stress. Low scores were 0-3, moderate scores were 4-13, and high scores were 14-40 for perceived stress. The scales' reliability was .84.

Procedure

The present research used an in-person survey method to ensure the accuracy and reliability of the data collection. With the help of a trained research assistant in psychology, all data from aged people were collected. All samples received a printed questionnaire with detailed instructions and an informed consent form (ICF). Before taking part, older adults had to sign the consent form and carefully read the ICF and any associated instructions. They completed the questionnaire after verifying the signed consent. To ensure complete anonymity and preserve the validity of the responses, they were also told that no personal identifiers, including their name, address, or contact details, were required. Completing the questionnaire usually took five to ten minutes. When a participant was done, the research assistant thanked them for their time and cooperation.

Ethical Aspect

The University of Chittagong's Institutional Review Board in Chittagong, Bangladesh, examined and approved this study (Approval Number: AERB-FBSCU-20250126-(1)). The Kingshill Research Center in Swindon, UK, owns the rights to the 6-Item Cognitive Impairment Test (6-CIT). Healthcare professionals can utilize it for free. For academic, non-commercial research objectives, an adapted Bangla version was employed in this study.

Data Analysis and Processing

The data were analyzed using two statistical software programs, IBM SPSS version 22 and JASP version .95.3.0. Descriptive statistics, including means and standard deviations, were used to assess the sample characteristics and data distribution. Skewness and kurtosis were used to assess normality. Principal Axis factoring with direct oblimin rotation was used to perform Exploratory Factor Analysis (EFA). KMO ($\geq$.60) and Bartlett's test ($p < .05$) were used to evaluate the appropriateness of the data (Tabachnick & Fidell, 2019). Based on the Minimum Average Partial (MAP) test, factor loadings$\geq$ .40, and eigenvalues > 1, factors were retained (Velicer, 1976). Reliability analysis, criterion, and known-groups validity, and receiver operating characteristic (ROC) curve analysis were used for psychometric evaluation instead of exploratory or confirmatory factor analysis, in accordance with the original study and later international validations (Brooke & Bullock, 1999; Tuijl et al., 2012;

Apóstolo et al., 2018; DeVellis, 2017), and also its items are scored using heterogeneous weights and evaluate different cognitive domains.

Results

Data were checked for outliers and missing values before final analysis, and none were found. The standardized residuals were normally distributed and fell within ±3.29. Descriptive statistics and item-total associations were investigated for each of the (6-CIT) (see Table 2). The item means indicated moderate levels of acceptance, ranging from .53 to 5.78. The skewness and kurtosis values for the 6-CIT items range from .03 to 1.70 and from .30 to -1.98, respectively, indicating a normal distribution. When the skewness and kurtosis values are less than 2 and 7, respectively, a sample of 300 or more will have a normal distribution (Kim, 2013).

Because the data satisfied the requirements of normality and linearity and had skewness and kurtosis values within acceptable bounds, Pearson's product-moment correlation was performed. Item analysis of the corrected item-total correlation and the item-total correlation revealed correlations ranging from $r = .46$ to $r = .71$ and from $r = .56$ to $r = .85$, all significant at $p < .01$, indicating strong item quality and internal consistency (see Table 2; Ebel & Frisbie, 1991). All elements were therefore retained for additional analysis. Every corrected, updated item-total correlation within the current scale exceeded the .20 cutoff (Clark & Watson, 2016). These results suggested that each item contributed significantly to the overall scale, consistent with accepted psychometric criteria (Ebel & Frisbie, 1991).

Table 2

Descriptive Statistics, Inter-item Correlation and Item-Total Statistics (r) for Each Item of the Bangla Version of Cognitive Impairment Test (6-CIT) of Older Adults (N = 681)

Descriptives Statistics					Inter-item correlation						Item Total Statistics		
Items	*M*	*SD*	Skewness	Kurtosis	CIT 1	CIT 2	CIT 3	CIT 4	CIT 5	CIT 6	Corrected Item-total correlation	Item-Total correlation (Pearson)	Cronbach's Alpha if Item Deleted
CIT 1	1.33	1.88	.72	-1.49	1						.59	.72	.74
CIT 2	.53	1.14	1.70	.90	.46	1					.46	.56	.78
CIT 3	.68	1.26	1.30	-.30	.41	.68	1				.51	.61	.77
CIT 4	2.03	1.98	-.03	-1.98	.56	.35	.41	1			.71	.82	.71
CIT 5	2.94	1.72	-1.06	-.80	.36	.22	.29	.60	1		.62	.73	.74
CIT 6	5.78	3.57	-.57	-1.03	.46	.27	.34	.59	.61	1	.67	.85	.78

Note: All correlations are significant at $p < .01$.

Bartlett's test of sphericity and the Kaiser-Meyer-Olkin (KMO) measure were used to assess if the data were suitable for Exploratory Factor Analysis (EFA). Adequate sampling was indicated by the observed KMO value (.77), which was higher than the suggested cutoff value of .60 (Tabachnick & Fidell, 2013). The factorability of the correlation matrix was confirmed by the significant result of Bartlett's test of sphericity (X^2 = 1628.59, *df* = 15, p <.001).

Table 3

Confirmation of CIT Factor Number using Minimum Average Partial (MAP) Test and Exploratory Factor Analysis (EFA) (N = 681)

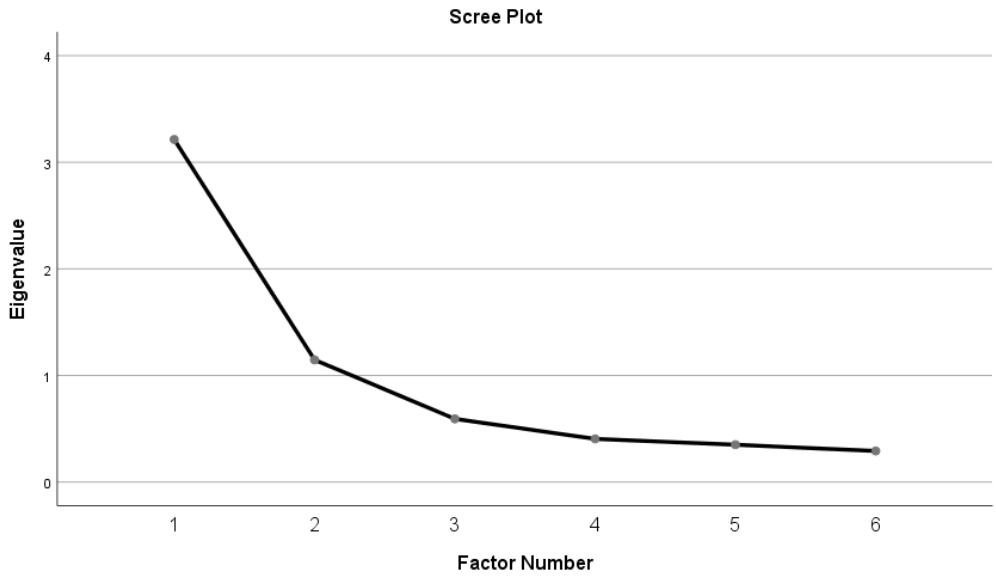
Confirmation of Factor by the MAP test						
Item	*h2*	F1	F2	Factor	Average Squared Partial Correlation	Average 4th Power Partial Correlation
Item 5	.46	.79		.0000	.2123	.0602
Item 6	.47	.78		1.0000	.1021[a]	.0165[b]
Item 4	.54	.76		2.0000	.1102	.0251
Item 1	.41	.44	.32	3. 0000	.2063	.1270
Item 2	.50		.97	4.0000	.4421	.3694
Item 3	.50	.12	.68	5.0000	1.0000	1.0000
Eigenvalues (>1)		3.21	1.15			
Variance by factor (%)		53.57	19.11			
Total variance (%)		72.68				
KMO		.77				
Bartlett's sphericity test		X^2 = 1628.59, *df* = 15, p < .001				

Note. KMO = Kaiser-Meyer-Olkin; h^2 = Communality.

Extraction method: Principal Axis Factoring; Rotation method: Direct oblimin with Kaiser Normalization

a & b = both the smallest average squared partial correlation and the smallest power partial correlation indicated a single factor of the scale

Figure 1
A Scree Plot Using Eigenvalues Showing the CIT Factors



Principal axis factoring with direct oblimin rotation was used to perform an EFA on the total sample (N = 681). The CIT showed a two-factor structure based on eigenvalues. A scree plot showed the CIT's distinct two-factor structure (Figure 1). With factors 1 and 2 explaining 53.57% and 19.11% of the variation, respectively, the CIT's two-factor structure accounted for 72.68% of the total variance (Table 3). Six items were extracted by the CIT into two factors that resembled the original scale's factor structure. Four items (item 1, 4, 5, and 6) loaded on factor 1, and two (item 2 and 3) loaded on factor 2, according to the CIT's two-factor structure. This scale has a one-factor structure in most studies across different countries (e.g., Italy, the Netherlands, Ireland, Thailand), despite having once been a two-factor scale.

To ascertain if CIT was unidimensional or bidimensional, the Minimum Average Partial (MAP) test was performed. The MAP test showed that one factor best fit our society. The average squared partial correlation and average fourth power partial correlation for a one-factor structure were the lowest, according to the MAP test results (see Table 3). This reveals unequivocally that our CIT scale is more appropriate for one factor of our society than two.

Internal consistency reliability for the 6-CIT was good, ranging from .71 to .78 (see Table 2). The Bangla 6-item cognitive impairment test (6-CIT) had a good Cronbach's alpha (α =.78) (George & Mallery, 2024). The 6-CIT was administered to 106 older people in the sample twice, separated by 2 weeks, to assess the test-retest reliability and temporal stability. Strong consistency and uniform responses from participants over time

were indicated by the test-retest reliability coefficient of $r = .75$ ($p < .001$) (Christiansen, 1991) (see Table 4). Additionally, Gutman λ2 ($\lambda 2 = .82$) and McDonald omega ($\omega = .83$) values, which are higher than the recommended cutoff score (.70), demonstrate the scale's good internal consistency (Hair et al., 2019) (see Table 4). These results suggested that the Bangla 6-CIT scale is a reliable instrument for measuring cognitive impairment in older adults.

Table 4
The Reliability of the Bangla Cognitive Impairment Test (6-CIT) (N=681, Test-retest, n=106)

Reliability index	Coefficient
Cronbach's α	.78
Guttman's λ2	.81
MacDonald's ω	.83
Test-retest Reliability (2-week interval)	.75

To assess content validity, eight experts in developmental and clinical psychology, along with the geriatric mental health expert, rated each item on the 6-CIT using a 4-point Likert scale (1 = *irrelevant*, 4 = *very relevant*) (Aree-Ue et al., 2020). While all item-level CVI (I-CVI) scores were 1, scale-level CVI (S-CVI) values were 1. This result, which was higher than the minimum of .83 recommended for assessing with six to eight experts, demonstrates substantial agreement among the experts regarding the presentiveness and relevance of the items (Beaton et al., 2020).

For measuring known-group validity, CIT scores between groups that were thought to differ according to gender, age, income, sleeping pill usage, smoking behavior, and present living status (see Table 5). In the group of gender, males ($n = 250$) had higher CIT ($M = 16.01$, $SD = 8.40$) than women ($n = 431$; $M = 11.71$, $SD = 8.47$), with a slight but significant difference (t (679) = -6.41, $p < .001$, Cohen's $d = .51$). For age groups, compared to old-old adults (70–79 years, $n = 226$; $M = 15.40$, $SD = 7.95$), young-old participants (60–69 years, $n = 455$) had lower CI scores ($M = 12.24$, $SD = 8.85$), t (679) = -4.54, $p < .001$, Cohen's $d = .37$). For users of sleeping pills, those who reported using sleeping pills scored significantly higher on the CI ($n = 284$, $M = 18.40$, $SD = 7.12$) than those who did not ($n = 397$; $M = 9.62$, $SD = 7.82$), with a large effect (t (679) = 15.06, $p < .001$, Cohen's $d = 1.17$). For smoking behavior, compared to smokers ($n = 362$; $M = 16.89$, $SD = 8.45$), non-smokers showed less CI scores ($n = 319$, $M = 9.20$, $SD = 6.99$), t (679) = 12.83, $p < .001$, Cohen's $d = .99$. These results validate the construct validity of the Bangla 6-CIT because it effectively distinguishes between groups that are anticipated to differ in CI according to previous studies and theoretical justification (Brooke & Bullock, 1999).

Table 5

Known-group Validity of Bangla Cognitive Impairment Test (6-CIT) Across Gender, Age, Sleeping Pill User, and Income Status (N = 681)

Group	*N*	*M*	*SD*	*t*	*df*	*p*	Mean differences	Cohen's *d*
Gender								
Female	431	11.71	8.47	-6.41	679	.001*	4.30	.51
Male	250	16.01	8.40					
Age								
Young Old (60-69 Years)	455	12.23	8.85	-4.54	679	.001*	3.17	.37
Old-old (70-79 Years)	226	15.40	7.95					
Sleeping Pill User								
Yes	284	18.40	7.12	15.06	679	.001*	8.78	1.17
No	397	9.62	7.82					
Smoking Behavior								
Yes	362	16.89	8.45	12.83	679	.001*	7.69	.99
No	319	9.20	6.99					

Note. *p <.05.

Pearson product-moment correlations with related constructs were used to assess the Bangla Cognitive Impairment Test (6-CIT) 's convergent and divergent validity (see Table 5). CI showed a good negative correlation with well-being (r = -.67, p < .001) and a good positive correlation with perceived stress (r = .53, p < .001) (see Table 6). These correlations support the categorical screening adaptation strategy by confirming that the tool reflects expected divergent patterns from protective well-being states and convergent patterns with distress constructs (O'Caoimh & Molloy, 2023; Brooke & Bullock, 1999). This is conceptually consistent with standards of psychometric theory (Campbell & Fiske, 1959).

Table 6

Convergent and Divergent Validity of the Bangla Cognitive Impairment Test (6-CIT) (N = 681)

Variables	1	2	3
1. Cognitive Impairment Test (6-CIT)	1		
2. Perceived Stress (PSS)	.53**	1	
3. Psychological Well-being	-.67**	.-.51**	1

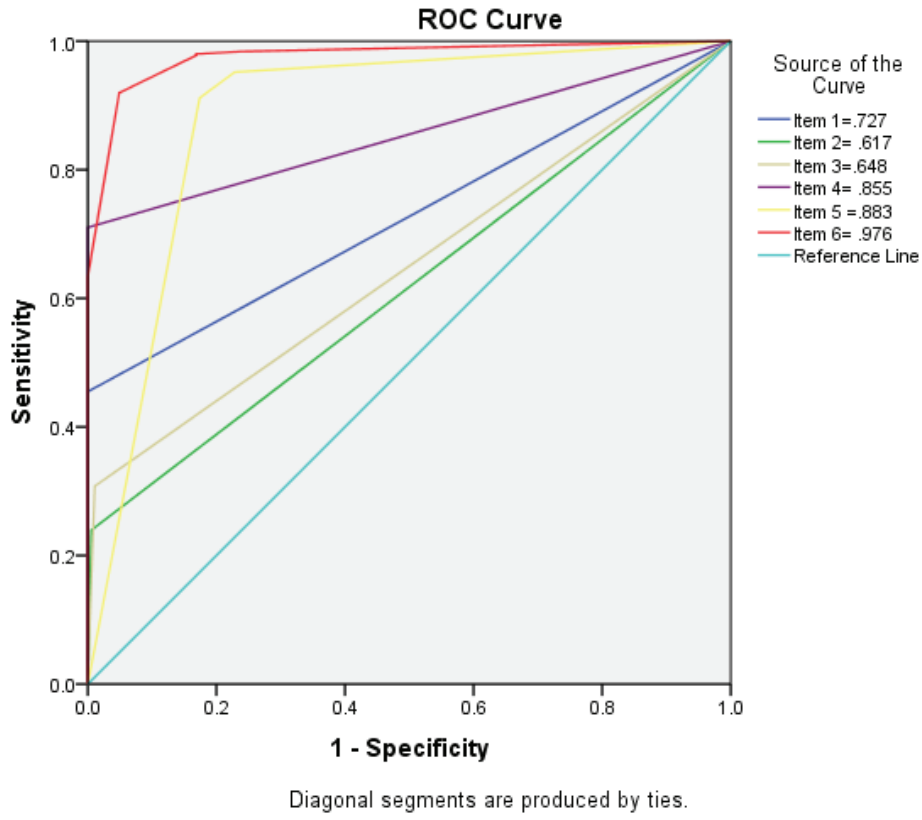
Note. **p<.01 (2-tailed).

The diagnostic accuracy of the CIT in differentiating between people with and without CI was assessed by using ROC analysis. The indicator of test performance is the area under the curve (AUC), where an AUC of 1 shows perfect discrimination and an AUC of .5 showed no discriminative capability. This technique is frequently used in epidemiological and clinical studies to validate diagnostic instruments.

The discriminatory accuracy of the six-item CIT was measured using receiver operating characteristic (ROC) analysis (see Figure 2) using a cut-off of 7/8. The AUC data were interpreted as follows using accepted ROC curve interpretation guidelines: item 4 (AUC = .855 and item 5 (AUC = .883) were good, item 6 (AUC = .976) was excellent, items 2 (AUC = .617) and item 3 (AUC = .648) were decent, and item 1 (AUC = .727) was acceptable (Hosmer et al., 2013). According to earlier screening studies (Brooke & Bullock, 1999), every item showed statistically significant discrimination (AUCs > .50, p <.001).

Figure 2

ROC Curve for the Bangla Cognitive Impairment Test (6-CIT) Items in Detecting Cognitive Impairment (N = 681) of Older Adults



Discussion

The main aim of the present study was to measure the psychometric properties of the Bangla Cognitive Impairment Test (6-CIT) scale. For this, several statistical methods were used, including item analysis, reliability and validity analyses, and ROC curve analysis. The scale items were scored across a variety of cognitive domains, weighted, and tested among older people in Bangladesh. The research indicated that the 6-CIT is a valuable instrument for assessing cognitive problems, declines, or impairment among Bangladesh's older people and has strong psychometric properties.

The first aim of the study was to use the Map test to determine the optimal number of factors, and to use Exploratory Factor Analysis (EFA) to investigate the scale's factor structure. A two-factor structure, which explained 72.68% of the total variation, was first proposed using EFA. The appropriate KMO value (.77) and significant Bartlett's test of sphericity ($X^2 = 1628.59$, $df = 15$, $p < .001$), which revealed adequate inter-item correlations for factor extraction, confirmed the suitability of the data for factor analysis (Tabachnick & Fidell, 2013). However, as only one factor was kept in both the original and modified MAP procedures, Velicer's MAP test supported a unidimensional structure (Velicer, 1976). The MAP results show that the construct may operate as a single integrated factor in the Bangladeshi cultural setting, despite the EFA indicating two related dimensions. Cross-cultural validation studies that viewed psychological constructs more broadly, rather than as discrete subdimensions, have yielded similar results (Brooke & Brooke, 1999; Tuijl et al., 2012; O'Sullivan et al., 2016; O'Caoimh & Molloy, 2023; Apóstolo et al., 2018).

The second objective of the study was to measure different forms of reliability, including Gutman's lambda, McDonald's omega, test-retest, and Cronbach's alpha. Item analysis revealed that the six CIT-6 items had sufficient psychometric properties, and each item's item-total correlation coefficient was higher than the recommended value (.20) (Clark & Watson, 2016). This revealed that each item contributes significantly to the overall score and is reasonably consistent with the scale's basic concept. According to Classical test theory, items with item-total correlations greater than .20 are usually considered suitable for scale inclusion due to their adequate validity and internal consistency (Nunnally & Bernstein, 1994; DeVellis, 2017).

The third objective of the study was to determine the validity (content, known-group, convergent, and divergent) of the Cognitive Impairment Test (6-CIT). Both convergent and discriminant validity evidence supported the 6-CIT's appropriate construct validity. Given that stress is both theoretically and empirically linked to cognitive impairment (CI), the 6-CIT scale's convergent validity is supported by its moderately positive correlation with the Bangla Perceived Stress Scale (Jurgens et al., 2025). It indicates the higher level of CI associated with perceived stress. The expectation that 6-CIT and stress are related but separate constructs is supported by the magnitude of this correlation. The correlation between 6-CIT and the WHO-5 well-being index showed divergent validity. The findings suggested that 6-CIT measures a construct distinct from positive psychological functioning, as shown by a relatively weaker or negative relationship between CI and well-being. The

WHO-5 scales, used as a divergent measure, further showed that the CITS measures a particular aspect of CI rather than reflecting overall well-being (O'Caoimh & Molloy, 2023; Brooke & Bullock, 1999).

Significant difference among theoretically relevant groups validated the cognitive impairment test scale's (CIT) known-group validity. Higher levels of CI were observed in female people, old-old people, smokers, and sleeping pill users than in male participants, young old, non-smokers, and non-sleeping pill users. These findings support by Nunnally and Bernstein, (1994), Brooke and Bullock, (1999) the discriminative capacities of cognitive assessment tools since they are in line with previous findings that cognitive impairment differs by gender (National Institute on Aging, 2010), age (Livingston et al., 2020), and health-related activities like smoking habit (Zhong et al., 2015), and sleeping pill user (Sabia et al., 2021).

To confirm content validity, eight judges' assessments were performed. The excellent item-level (ICVI = 1) and Scale-level (S-CVI = 1) indicated that every item was deemed pertinent and understandable. These findings showed that the scale accurately reflects the concepts of CI and is consistent with theoretical presumptions (Lynn, 1986). In general, the study's findings suggested that the scale has strong content validity, providing a strong platform for future, more comprehensive psychological testing.

The fourth aim of the study was to use Receiver Operating Characteristics (ROC) analysis to assess the accuracy of CI screening classification. The ROC curve using a cut point of 7/8. The 6-CIT's items have varying discriminative strength, according to the curves (ROC) analysis. These results are consistent with other findings by Brooke and Bullock (1999), Hosmer et al. (2013), O'Sullivan et al. (2016), and Salis et al. (2023). The ROC analysis revealed different levels of discriminatory capacity across the items. Fair discriminatory ability was shown by items 2 and 3, acceptable discriminatory ability by item 1, strong discriminatory ability by items 4 and 5, and great discriminatory ability by item 6. The predictive validity of all items was supported by all AUCs being statistically significant ($p < .001$). The scale effectively discriminates cognitive function, as indicated by the overall pattern, with higher AUC scores indicating better diagnostic performance.

The Bangla 6-CIT demonstrated one-dimensionality with high validity and reliability among older adults in Bangladesh. Its clear design, easy to use, and strong psychometric properties make it a valuable tool for community-level screening, early identification, and intervention. This test can help broaden the foundation for cross-cultural cognitive assessment in Bangladesh and be useful for evaluating cognitive impairment in the general population in clinical and research settings. Policymakers, clinicians, and counselors will be able to assess older people's cognitive impairment and develop interventions to improve it using the validated Bangla 6-CIT.

The first culturally appropriate and psychometrically verified Bangla version of the Cognitive Impairment Test (CIT) for older adults in Bangladesh is a noteworthy contribution of the current study. There are still a few proven Bangla-language screening tools, even though cognitive impairment is becoming more widely acknowledged as a

significant public health concern among the aging population. By providing the CIT's construct validity, language equivalency, and dependability, the current study expands its applicability to a Bangladeshi setting. In addition to facilitating future research, screening, and intervention efforts in geriatric mental health in Bangladesh, this validation provides researchers and practitioners working with older adults who speak Bangla.

Limitations and Future Directions

Causal inferences about CI and related factors are limited by the study's cross-sectional design. Additionally, differences in reading and education levels may have impacted performance, and response bias may have been introduced by relying on self-reported health behaviors. The recommendations of the present study are to assist in the early detection of cognitive impairment in older adults; the Bangla 6-CIT can be used regularly in primary care and community settings. Future research should use longitudinal designs and more varied nationally representative populations to investigate the predictive validity and temporal stability of the Bangla version of the 6-CIT.

Finally, 6-CIT is a valid and reliable scale for assessing cognitive impairment of older adults in Bangladesh. It might be very important for the development of therapeutic programs, mental health assessments, and future research. Researchers from all over the world will be able to compare the original 6-CIT with the current Bangla version of cognitive impairment measures, in addition to learning about its psychometric properties and validation process.

Conclusion

The results indicate that the Cognitive Impairment Test (CIT) in Bangla is a valid and reliable tool for evaluating cognitive impairment among Bangladeshi older adults. Early screening, research, and clinical evaluation of cognitive performance in Bangla-speaking populations may be made easier by the availability of a culturally appropriate measure.

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Appendix

Six Items Cognitive Impairment Test (6-CIT)

ক্রমিক নং	প্রশ্ন	উত্তর
১	এখন কোন সাল?	
২	এখন কোন মাস?	
এখানে অংশগ্রহণকারীকে ৫ টি উপাদানযুক্ত একটি ঠিকানা প্রদান করা হবে। আপনি ভালোভাবে লক্ষ্য করুন। **মো: মামুন হোসেন, শাহ মঞ্জিল, রোড নং-২২, এ কে খান রোড, চট্টগ্রাম।**		
৩	এখন সময় কত (এক ঘন্টার মধ্যে)?	
৪	উল্টোভাবে ২০ থেকে ১ পর্যন্ত গননা করুন।	
৫	বছরের মাসগুলোকে উল্টোভাবে বলুন।	
৬	৩নং উক্তিতে আপনাকে যে ঠিকানা দেওয়া হয়েছিল তা পুনরায় বলুন।	