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RESEARCH ARTICLE

Cross-cultural adaption of the computerized assessment of information processing battery (COGNITO) for an Indian longitudinal study on rural elderly

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Abstract

Introduction: Testing cognitive functions in Indians with low literacy and linguistic diversity is challenging. We describe the adaptation process of a comprehensive neurocognitive test battery to suit both literate and illiterate aging rural Indians.

Methods: Following the International Test Commission (ITC) guidelines for cross-cultural adaptation, we adapted the COGNITO battery. This involved translating instructions, linguistic elements, and stimuli of each test from the original English version with the help of bilingual experts. Five stimuli across eight subtests were adapted to maintain construct equivalence and cultural relevance.

Results: The Kannada version of COGNITO, a digitally administered tool, was feasible and effective measure for assessing cognitive functions in Kannada-speaking aging individuals from a rural Indian population.

Discussion: We emphasize the importance of maintaining semantic and theoretical construct equivalence with the source tool, and ensuring cultural and socioeconomic congruence for the cross-cultural adaptation of computerized cognitive batteries.

KEYWORDS

aging, cognition, cross-cultural adaptation, dementia, developing country, India, literacy

HIGHLIGHTS

- Assessed cognitive functions in rural elderly with low literacy and high linguistic diversity.
- Followed International Test Commission (ITC) guidelines for cross-cultural adaptation to suit literate and illiterate aging rural Indians.

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- Maintained semantic and theoretical construct equivalence with the source tool, ensuring cultural and socioeconomic congruence for cross-cultural adaptation of cognitive batteries.

1 | INTRODUCTION

The longitudinal trajectory framework with emphasis on the preclinical stages of Alzheimer's disease (AD) has recently garnered scientific attention.[1] Sensitive cognitive assessments that explore this cognitive trajectory in addition to differentiating AD patients from healthy individuals are hence gaining importance.[2] Approximately c aging cohort studies[2,3] have been conducted globally to identify risk factors for dementia. Considering that cognitive change is a critical outcome measure in these studies, the use of comparable cognitive assessments is essential for pooling data for comparison across studies.

Although basic cognitive processes are common, the culture and sociodemographics of the target community (urban or rural residence, high or low literacy) could influence the identification and definitions of relevant cognitive constructs, development or adaptation of tests, process of test administrations, and interpretation of performance.[4–6] In addition, the administration of such neuropsychological tests in a low-income country like India has to face additional obstacles like sociocultural barriers, traditional and religious beliefs, and mental health stigma.[6] For example, the misconception that cognitive decline is an inevitable part of normal aging reduces motivation levels, manifesting as defensive behavior or poor cooperation during testing.[7] Extensive explanations are frequently required leading to midway interruptions in testing.[8] Mistrust regarding research and general lack of awareness about cognitive assessment procedures, examinees' concept of competitiveness, and their approach to speed tests and task completion may lead to performance impairments unrelated to the underlying pathology.[9,10] Additionally, many of the rural elderly have little formal schooling, and are involved in occupations that do not require reading, writing, or drawing skills, which affects their functional illiteracy as these skills are not used in their daily life.[8,11] The gender-biased social role of women in rural India restricts their exposure to economic and cognitive challenges such as handling money and decision making.[11] Uncorrected, age-related physical conditions, such as sensory (vision and hearing) and motor impairments (tremors) are commonly seen in rural India, for which the extent of supplementary assistance warranted and the grading of subsequent test performance in such situations are not clear.[7] Also, interpersonal factors, such as communication style including physical proximity, background, authority, and the age of the examiner can also affect test performance.[9] Given the challenges associated with cognitive testing, there is a dearth of articles which have elucidated the methodology of cross-cultural adaptation of cognitive tests to a non-Western scenario. Cognitive literature from developing countries, and comparisons of West versus non-Western settings also highlight the need for adaptations.[7,12–15]

The International Test Commission (ITC) has provided clear guidelines for the cross-cultural adaptation and translation of testing procedures.[16] Apart from establishing the theoretical equivalence (ensuring semantic, idiomatic, experiential, and conceptual equivalence) with the original battery, it is necessary to ensure that the translated content is culturally appropriate, relevant, and meaningful to the target population.[17] The current article describes the process of cross-cultural adaptation of the COGNITO battery,[18] a computerized neuro-cognitive tool that addresses barriers of assessments for the Srinivaspura Aging, Neuro Senescence, and COGnition (SANSCOG) study from the English language (source) to the Kannada language (target). The process comprises three aspects: (1) the application of ITC guidelines as the general framework; (2) assurance of adhesion to the underlying theoretical target of each testing procedure; and (3) tailoring to the cultural and sociodemographic characteristics of the target community. As most of the published literature on the adaptation process has focused on establishing psychometric properties, we aim to elucidate the systematic methodology of the test adaptation process, as the psychometric properties are published elsewhere.[19]

2 | METHODS

2.1 | Target population

SANSCOG is a longitudinal, prospective community-based cohort study in Srinivaspura, Kolar district, Karnataka, India, undertaken by the Centre for Brain Research (CBR), Indian Institute of Science. The aim is to assess factors affecting cognitive changes in normal and pathological aging in a cohort of adults aged 45+. They mostly belong to the low-income group, with a literacy rate of approximately 60%. The primary language in the region is Kannada, and most individuals in the cohort are bilingual.[20] Details of the study methodology and assessments done have been published elsewhere.[21] The study was approved by the institutional ethics committees of the participating institutes.

2.2 | Measures

COGNITO is the core cognitive battery (Table S1) used in the Prevent Study of TRIBEKA Consortium.[22,23] The subtests and detailed description of the construction of the COGNITO tests including references to floor and ceiling effects as well as reliability estimates are detailed elsewhere.[18,24] The psychometric properties,[18,24] discriminatory abilities,[25] and normative data[26] have been evaluated. COGNITO is capable of identifying preclinical cognitive changes decades prior to the clinical diagnosis of dementia.[27] A touch screen records participant response after auditory administration of instructions and stimulus (except in Stroop, implicit memory, vocabulary, and drawing tests). This enables its use with illiterate and lesser-educated individuals as well.

2.3 | Adaptation process

The adaptation process had two parts: translation and stimulus adaptation. We adhered to ITC guidelines (Table S2) for cross-cultural adaptation of the COGNITO battery, covering Pre-Condition (PC), Test Development (TD), Confirmation, Administration, Score Scales, and Documentation. We acquired intellectual property rights and the author's input (phase PC-1). Feedback was gathered by administering the original version to mental health professionals and researchers (PC-2). We held five consensus meetings and incorporated suggestions from experts and clinical neuroscientists. Expert teams handled forward and backward linguistic translation, followed by pretesting and revisions in Kannada. Stimulus adaptation involves modifying culture-specific elements while preserving the tested construct. The process included item selection, expert review, and finalization.

We conducted pre-pilot testing on 135 participants and received positive feedback. We made changes to the administration process, such as using a touch screen monitor, introducing a familiarization task, providing additional explanations, implementing practice trials, and introducing a discontinuation rule. We also made modifications for illiterate participants, such as excluding reading-based subtests.

3 | RESULTS

3.1 | Translation of instructions and linguistic elements

Both the ITC and World Health Organization (WHO) translation guidelines[28] were utilized. The ITC phase TD-2 advises that using a judgmental design involving forward and backward translation along with cognitive interviewing is optimal, while the WHO guidelines describe these steps. For linguistic adaptation, respective expert teams (in phase TD-1; Table S3) were constituted for forward and blinded back translation. To ensure that the test instructions and item content of source language (SL) and target language (TL) have similar meanings, the consensus translated version in Kannada was administered to five research staff who were bilingual. In this pretesting phase, the tests were first administered in the SL and then the TL. The staff members' suggestions were recorded, and if they deemed any item as significantly deviant in the TL from the SL, the previous step was repeated. We followed a reiterative design and administered the edited TL version to 13 participants who were part of various community projects to ensure the ease of comprehension of the translated content (TD-3). The steps employed in the translation are detailed in Table 1.

RESEARCH IN CONTEXT

1. **Systematic review**: We reviewed relevant literature using PubMed and found that computerized cognitive batteries measuring accuracy and latency over a wide cognitive spectrum would enable large-scale epidemiological research, providing a broader perspective on subtle age-related cognitive changes and preclinical stages of dementia. However, such comprehensive batteries that are indigenously developed or culturally as well as scientifically adapted are scarce in India.
2. **Interpretation**: We described the systematic steps undertaken in adapting the COGNITO battery to the Indian culture and sociocultural context, while retaining the theoretical test construct, improving ecological validity, and avoiding the confound of formal education.
3. **Future directions**: This could facilitate cultural and regional adaptation of cognitive batteries for use in other similar studies in non-Western settings. In addition, normative and longitudinal cognitive data generated from this adapted battery could provide evidence on the differential rates of cognitive decline across educational levels.

3.2 | Stimulus adaptation

Stimulus adaptation involved culture-specific modification of items with retention of the construct being tested. Objects, images, faces, names, and words used in the original battery may be culturally or linguistically inappropriate to the target population.[29] Stimulus adaptation, unlike translation, requires customization according to test specifics and stimulus nature, involving review by language experts, psychologists, and community feedback, as detailed in Table 2 for original version principles. The adaptation process based on these principles is detailed below.

3.2.1 | Name list

Participants recall nine names immediately and after delay, identify them among eighteen names with distracters, and reconstruct ten names, noting recognition points. In the implicit memory test, participants reconstruct a set of ten names (five shown, five new), recording the point of identification. The Kannada name list was formulated as follows.

Step 1: Item selection

a. Identification of the opening phoneme

The Kolar district telephone directory, SANSCOG survey database, and social networking groups specific to the target region were

TABLE 1 Steps followed for translation as per ITC and WHO guidelines.

Step	WHO description of the step	ITC description	Process employed
1. Forward translation: Translating from source language (SL = English) to target language (TL = Kannada).	a. Avoid colloquialisms and jargon b. Aim for conceptual equivalence	a. Language appropriateness is more important than syntax structure. b. Complexity of the instructions must be maintained.	P1 and P2 independently performed the translation. P2 was kept naïve to the test administration to avoid bias and influence of test structure on translation.
1. Expert panel	a. Identify and resolve inadequate expressions/concepts of the translation. b. Suggestions for alternatives and resolution of discrepancies.	Multiple judgmental designs must be considered to avoid or correct any errors	A consensus of the forward translations was attained through P3. A consortium of LE, P1, and NP reviewed both the translations and the consensus. Colloquial jargon and confusing terms were eliminated. For example: the usage of identical versus similar can alter the meaning of the test significantly and prove critical in tests involving comprehension.
1. Backward translation: TL to SL	Back translation by an independent translator, whose mother tongue is the SL and has no knowledge of the test.	–	PT and P4 were blind to the tests and did not have information relating to the rationale for the test. They independently back translated the battery.
1. Back translation review	Emphasis in back translation should be on conceptual and cultural equivalence and not linguistic equivalence	Use the back translation design to compare the complexity of items, and to see if the test captures what is intended.	P5 was not involved in the translations and formulated the consensus. NP proofread, reviewed, and compared the back translated English version and the original English version. Significant discrepancies that could alter the meaning or intention of the tests were flagged and checked. For example, change in instructions such as "…touch the identical shape" to "…touch similar shape" resulted in different meanings. Such issues were flagged and the previous steps were repeated in these instances. Simple linguistic equivalence without alteration in meaning was ignored.
1. Pretesting and cognitive interviewing	Pretesting: Pretest respondents should include individuals who would otherwise not be eligible for the main study. Cognitive interviewing: What they thought the question meant? Any word they did not understand well or found unacceptable?	Cognitive interviewing is a promising design for better pretest validation	a. COGNITO was administered to five research staff who were bilingual, initially in SL and then in TL. Any deviance reported was flagged and the previous steps were repeated for the item. Thirteen project staff who underwent debriefing with the final modified version found the instructions easy to follow.
1. Final version	The final version of the tests in the TL should be the result of all the iterations described above. It is important that a serial number (eg, 1.0) be given to each version.	Nil	The translated instructions obtained following the steps were finalized in its sixth version.
1. Documentation	1. Initial forward version 2. A summary of recommendations by the expert panel 3. The back translation 4. A summary of problems found during pretesting and the modifications proposed 5. The final version.		All the steps were documented. Reports and scripts were maintained at each stage.

Note: LE is a language expert. NP is a neuropsychology postdoctoral fellow. P1, P2, P3, P4, and P5 are psychologists. PT is a professional translator.
Abbreviations: ITC, International Test Commission; WHO, World Health Organization.

TABLE 2 Stimulus selection principles followed in the original version.

Stimulus	Subtest utilizing the stimulus	Principle in original version
Names	1. Articulation test 2. Immediate and delayed recall and recognition 3. Implicit memory test	1. Selection of the first letter of the names (C, M, or J) was based on its frequency in the target community. These letters were used for cued recall. 2. All names were disyllabic. 3. Names had similar length. 4. Names were proportioned across each phono-articulatory group (occlusive, constrictive, and nasal).
Faces	1. Face recall 2. Face–name association test	1. Pleasant face without any obvious emotional expression. 2. Three-quarter view of the facial photograph providing a three-dimensional view aiding spatial recall. 3. Jewelry or clothing kept to a minimum as they could verbally aid recall.
Phonemes	Phoneme comprehension	1. Phonemes and distracters were commonly seen or used in the target community. 2. Five distracters and one target object were provided in each set: (a) one phonetic distracter; a phoneme that sounds similar to the target phoneme but having a different meaning (phonetic distracter for "button" is "mouton"); (b) one morphological distracter; an object that looks similar to the target object (traffic light for wind mill); (c) one semantic distracter; an object belonging to the same category as the target object (broom for rake); and (d) two neutral distracters; objects that cannot be categorized as similar in phonetic/morphological/semantic characteristics.
Object names	Naming and association test	Objects for naming and association and distracters were commonly encountered in the target community.
Synonyms	Vocabulary test	1. Synonym and distracter were of equal length. 2. Distracters were semantically unrelated; one was a phonetic distracter for the synonym. 3. The word, target synonym, and the five distracters formed one set with difficulty progressing over sets.

screened to short-list the most common opening phonemic letters of names ([Ma], [Ra], [Sa], [Na], and [Va]) in the target community.

b. Assessing syllable count and name length

Latin languages divide words into syllables, which consist of a single vowel sound with or without surrounding consonants. However, in Kannada, each consonant is paired with a vowel to form a letter, and the concept of syllables is replaced with the native concept *matragana*. *Matragana* represents the total time required to pronounce all the letters in a word (with *matre* representing the time for one letter). To ensure consistency, the names were kept at uniform lengths. The Supplementary material provides further details. The opening phonemes chosen were [Sa], [Va], and [Ma], as they allowed for names with an equal number of letters (2.5 to 3) and prosodic instants (3 to 4 *matres*). The list avoids homonyms (eg, *Nagendra; Narendra*), rhyming names (eg, *Savita; Vanita*), names with repeated phonemes (eg, *Na-Vi-Na*), acquired derivatives that denote respect to elderly by adding a suffix to root names (eg, *Muniyappa*, *Muniyamma*), and names starting with derivatives of the chosen phonemes (eg, *Meenakshi*, *Muniraju*).

Step 2: Item screening

There were 18 names (10 male and 8 female) in the English version. The Kannada names were categorized according to different age-bands, and names that were common in each age-band were short-listed. For the final list, 18 names (10 male and 8 female) which conformed across age-bands were selected. As names with occlusive phono articulation are uncommon in Kannada, only names with constructive and nasal articulation were included.

Step 3: Expert review

The finalized list was reviewed by the language expert in comparison with the original list and its background principles. No significant changes were suggested at this stage.

3.2.2 | Faces

In the face recall task, participants are shown faces corresponding to the names from the Name Recall task. During the name-face association test, they are presented with a series of 18 faces (nine from face recall and nine distracter faces) and asked to determine if the face was shown before and recall the associated name if applicable. From a pool of 30 face photographs, 18 were selected based on age and gender, avoiding earrings, visible make-up, and spectacles. Females were allowed to wear neck chains and a bindi (a vermillion dot) due to

FIGURE 1 A sample of stimuli adapted for the face recall task. French faces are displayed in the left panel and South-Indian faces are displayed in the right panel.

cultural significance. The images were captured from a distance of 1 meter, at 562 × 762 pixels and 72 × 72 dpi resolution in JPG format, featuring a plain backdrop. A three-point lighting system and a 45° angled face improved picture quality while minimizing shadows. Adobe Photoshop was used for final editing to ensure uniformity in brightness, size, orientation, and background (Figure 1).

3.2.3 | Phoneme comprehension

The phoneme comprehension test evaluates participants' understanding of phonemes using phonemes, corresponding images, and distracter images (semantic, phonetic, and morphological). Participants select the object matching the target phoneme from a frame of six objects following a written target word. Each frame includes five distracter images (one for each type: phonetic, morphological, semantic, and two neutral).

Step 1: Item selection—target object

Four principles were followed to achieve uniformity during item selection/replacement; namely that the items (1) should be commonly used or seen in the community, as familiarity alone did not qualify; (2) should not be abstract/contextual in nature; (3) should not have multiple names and the name of the target object should not have alternate meanings in different contexts; and (4) should belong to the same category. The database developed by George and Mathurnath[30] for the Indian Picture Naming Test was used to search for equivalent objects (refer to the Supplementary material for item-wise modification).

Step 2: Item selection—distracters

Distracters were selected based on the following guidelines: (1) Phonetic distracters should not have multiple commonly used names (eg, "blouse" has multiple names like *ravike*, *jaakitu*, etc., in Kannada); and (2) morphological distracters should resemble the phoneme but not have semantic or categorical connections (eg, "lighthouse" cannot be a morphological distracter for the phoneme "traffic light" due to its semantic component). Abstract, unfamiliar, or uncommon distracters were excluded. The Indian Picture Naming Test database alone could not fulfill all these criteria, so a psychologist and language expert identified additional items that met the requirements (see the Supplementary material for item modifications) (Figure 2).

Step 3: Expert review

The finalized phonemes and distracters were reviewed by the language expert and psychologist to ensure adherence to principles and appropriateness for the target population. No significant changes were suggested at this stage.

3.2.4 | Object names

The phoneme comprehension test assesses understanding through phonemes and related images, requiring the selection of the correct object from six, including five distracters (phonetic, morphological, semantic, and two neutral) based on a written word. Ten sets of associations are presented, of which five are functional, and five are semantic.

Step 1: Item selection—target words and associations

All target objects belonged to one of the categories listed in the Indian Picture Naming Test[30] except one ("sculpture" was retained to maintain item difficulty). Unfamiliar objects like "piano" and "jeans" were replaced by equivalent objects belonging to the same category (*tabla* and "trousers" respectively). A few associations which were uncommon in the target population despite familiarity, like "car and garage," were also replaced (to "train and railway track") along similar lines.

Step 2: Selection of distracters

Each set has three distracters and one associated object. As many of the original distracters were unfamiliar to the target population, they were replaced with known items from the same category (Figure 3).

3.2.5 | Synonyms

The vocabulary test assesses verbal crystallized intelligence, that is, the application of intellect to tasks drawing on prior knowledge acquired through experience, education, and acculturation.[31] Participants are asked to select the correct synonym for a word, which appears on the left side, from the six options given on the right.

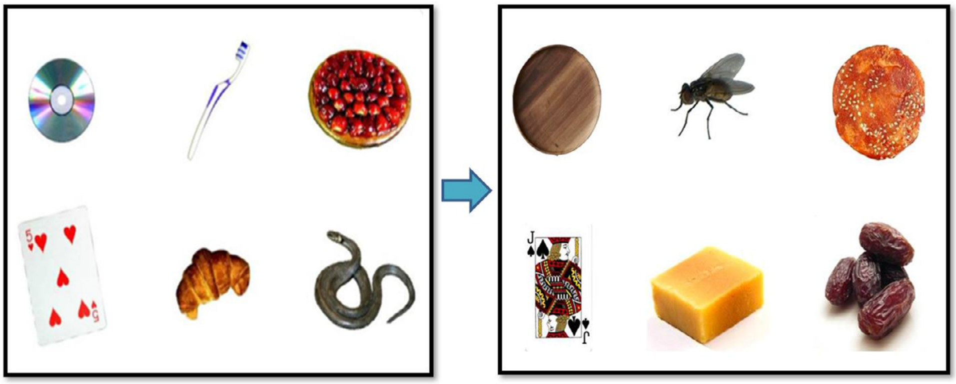

FIGURE 2 A sample of stimuli adapted for the phoneme comprehension test. The upper panel shows the source language (English) version with *tart* as the target, a tooth brush as a phonetic distracter, a croissant as a semantic distracter, and a CD as the morphological distracter. The lower panel is the translated language (Kannada) version with *Kajjaya* as the target, *Karjura* as the phonetic distracter, *Mysore pak* as the semantic distracter, and a brown plate as the morphological distracter.

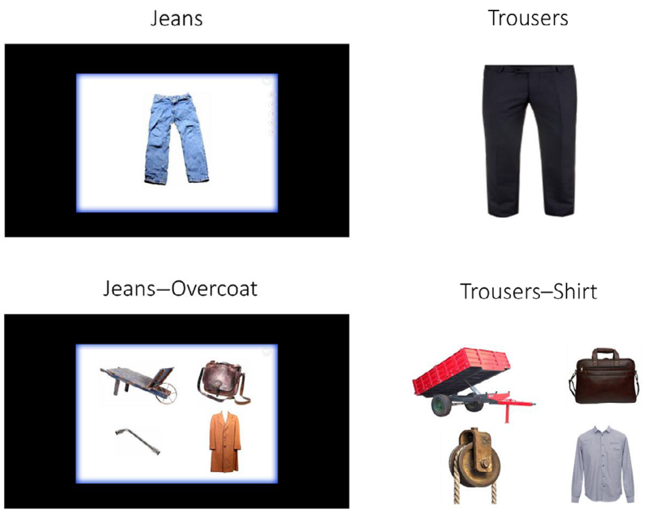

FIGURE 3 A sample of the stimulus adaptation for the naming and association test. The left panels show the original set (jeans and overcoat), while the right panels show the adapted set (trousers and shirt), each with culturally appropriate distracters.

Step 1: Item selection—target words

The language expert and psychologist reviewed whether (1) the word is culturally appropriate (eg, "posy," the concept of floral bouquet, is not culturally familiar); (2) an equivalent form of the word is available (eg, "opprobrious" is an adjective which does not have an equivalent in the TL); and (3) the word is used in a regular communicative purpose or limited only to literary use. Post-translation, appropriate items were retained, and flagged items were replaced with others from the same category (eg, "indemnity" was replaced by "tax").

Step 2: Item selection—synonym and distracter words

Synonyms which did not have multiple meanings and were commonly used were selected. Phonetic distracters were equal in length to the synonym; other distracters also of the same length were chosen randomly. A phonetic distracter was operationally defined as any word that has structural (*R-A-H-A-S-Y-A* and *A-S-A-H-Y-A*) and/or phono articulation similarities (*A-A-G-J-N-Y-E* and *P-R-A-G-J-N-Y-E*) and/or sound similar (*Jaradi* and *Charandi*) to the synonym; and did not have any direct categorical or semantic association to the target word or other distracters.

Step 3: Expert review

The final list was sent to 12 qualified mental health professionals (one social worker, two psychiatrists, and nine psychologists) for face validation (refer to the Supplementary material for details).

3.3 | Pre-pilot testing and changes to administration

The test was administered to 135 participants (mean age 57.4 years; 10 males; 51.1% literates). The instructions and test process were perceived to be understandable and there were no changes suggested in the instructions by the participants. The test administrators (researchers) kept observation notes on the administration process of the tests (ITC phase TD-4). As the target population was more familiar with television than laptop screens, we used a touch screen monitor of 24 inches to improve visual familiarity. We further noticed difficulties in touch screen usage. Hence, a simple task using an agriculture scene was introduced to familiarize them with the same, prior to testing. Additionally, the examiner's seating was changed from facing the participant to sitting in a perpendicular orientation, which eased testing apprehension based on nonverbal observations. Various types of stimuli (audio, visual, tactile) and colored pictures were used to increase motivation and ecological validity and additional explanations were given for the Matrices test assessing nonverbal reasoning, as the cohort was unfamiliar with the concept of puzzles. To maintain standardized administration and to ensure comprehension of test instructions, based on pre-pilot testing experience, we fixed three sets of practice trials or the all-successful practice trial (whichever is earlier) before starting the test trials as the administration process (COGNITO has no such practice trial rule). We also introduced a discontinuation rule based on the Weschler's Adult Intelligence Scale, 4th edition (WAIS-IV) to the Matrices test to reduce cognitive fatigue (COGNITO has a no-discontinuation rule). The subtests Vocabulary, Stroop, and Implicit memory involve reading, and were therefore dropped for illiterate participants. The normative scores for illiterates were calculated without these subtests.

4 | DISCUSSION

Available cognitive batteries developed and standardized for elderly Indians are in the paper-and-pencil format.[32–37] These are validated for diagnosed dementia and not for preclinical cases.[38–40] Computer administered cognitive assessment for early detection of pathological aging has various advantages.[41] It ensures standardization of administration, minimizes cultural and literacy confounds, avoids interviewer bias, and expedites data collection and management. Precise recording of reaction time provides data on information processing time which may be an important age-independent marker for cognitive decline.[42–45] COGNITO stands out among other batteries as it includes a comprehensive range of tests that go beyond detecting differences in established dementia cases. It covers cortical and subcortical functioning, estimates information-processing time, and focuses on visuospatial functioning. This battery is designed to capture early changes in the prodromal stage and has shown promise in detecting emerging changes in younger preclinical stages of dementia.[23]

In India, studies on aging-related cognition have largely used global cognitive screening tools[46] or literal translations of Western tests,[34] which involve purchasable, copyrighted cognitive batteries such as the Weschler Memory Scale.[47] Our methodology for cross-cultural adaptation of COGNITO can support aging research in low-income countries. We followed international guidelines, ensuring linguistic, semantic, and sociocultural equivalence with the assistance of a language expert and judgmental methods. The involvement of a language expert throughout the adaptation process played a crucial role in identifying unique characteristics and norms of the target population, which were effectively incorporated into the adapted stimuli. For instance, in the target community, names are often derived from a common root name, such as *MUNI*, with variations like *Muni-raju* and *Muni-swamy*. Gender is indicated by adding specific suffixes, for example, *Muni-amma* for females and *Muni-appa* for males. These derivatives are typically acquired and not official names, with the suffixes denoting respect for elderly individuals. Therefore, in addition to considering familiarity and linguistic characteristics, adapting to communication norms was an important sociocultural aspect of the process. While the general steps of stimulus adaptation were followed, each stimulus was treated differently. Face photographs were selected to ensure construct equivalence, while a 12-expert review rating was used for vocabulary-related tests. The finalization of items after item selection was based on the nature of the construct, original author requirements, and recommendations from the scientific advisory committee.

Elderly individuals from a lower/middle income setting are often not familiar with cognitive testing, posing difficulties in maintaining attention. Varied types of stimuli (audio, visual, tactile) in the current computerized battery could hence improve motivation.[48] Auditory instructions and task examples aid comprehension in both functional and true illiterates. Interpersonal confounders such as authority and physical distance are thus reduced. The use of colored pictures for object recognition and naming-related tests has better ecological validity[49] and is better suited to persons with lower education compared to line drawing-based stimuli.[30] From the pre-piloting experience, we also made changes to the testing scenario. Unlike the traditional testing condition, where the examiner sits across from the respondent, computer administration permitted them to sit side by side, thus creating a more informal and less judgmental posture.

Cross-cultural adaptation of cognitive tests for children from India have used judgmental evidence to assess the cultural suitability of translations and adaptations of instruments.[50] Our adaptation process employed a combination of theory-driven, exposure-fair, and culture-driven approaches. While many cross-cultural adaptations focus on statistical analysis or technical details like back translation, we recognized the need for detailed item-wise descriptions in a diverse cultural setting for replication purposes. Adapting the phoneme comprehension task required considering theory, familiarity, culture, and language principles due to the lack of semantically equivalent words across languages. Choosing equivalent items based on a single criterion could impact the test dynamics and construct, which might not be evident when examining overall performance scores in large samples. Ensuring genuine equivalence between the adapted and source versions of the vocabulary test was challenging due to a limited number of true bilinguals. Therefore, we conducted item-wise comparisons using a combination of theory and language-driven approaches at multiple levels of expert review. Our aim was to retain the theoretical test construct and feasibility while enhancing ecological validity and avoiding the confounding factor of formal education in a diverse non-Western population. The follow-up pilot study would provide statistical data to further validate the adaptation process.[19] The COGNITO adaptation for SANSCOG demonstrates a concise approach to culturally tailoring cognitive tests, highlighting interdisciplinary collaboration, back translation, and targeted community adjustments.

Our cross-cultural adaptation employs criteria derived from two previous adaptation studies carried out in India[46,51] and provides qualitative comparisons. COGNITO has been used previously within longitudinal population studies[25] to describe temporal trajectories of cognitive performance. Adaptation to an Indian sample would help extend such work cross-culturally and provide larger low-literacy cohorts to improve current hypotheses pertaining to education, neurodegeneration, and mechanisms of cognitive reserve.

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CONFLICT OF INTEREST STATEMENT

The authors declare no conflicts of interest. Author disclosures are available in the Supporting information.

CONSENT STATEMENT

Consent from participants was not necessary for this adaptation process described in this manuscript.

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Additional supporting information can be found online in the Supporting Information section at the end of this article.

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