ISSN 0973-2063 (online) 0973-8894 (print)

Bioinformation 22(8): 4617-4621 (2026)

BIOINFORMATION
Discovery at the interface of physical and biological sciences

BIOMEDICAL INFORMATICS

www.bioinformation.net

Volume 22(8)

Research Article

Received August 1, 2026; Revised August 31, 2026; Accepted August 31, 2026, Published August 31, 2026

DOI: 10.6026/973206300224617

SJIF 2026 (Scientific Journal Impact Factor for 2026) = 8.478
2022 Impact Factor (2023 Clarivate Inc. release) is 1.9

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Citation: Gupta & Gupta, Bioinformation 22(8): 4617-4621 (2026)

ADAS-Cog performance in urban Indian Alzheimer's patients: Implications for culturally appropriate assessment

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ISSN 0973-2063 (online) 0973-8894 (print)
Bioinformation 22(8): 4617-4621 (2026)

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Abstract:
Assessment tools developed for Western populations may not accurately evaluate cognitive impairment in multilingual Indian patients with Alzheimer's disease. Therefore, it is of interest to assess the domain-based performance using the Alzheimer's Disease Assessment Scale-Cognitive Subscale (ADAS-Cog) among 12 urban Indian patients aged 70–83 years. Memory domains showed the greatest impairment, with the highest scores for Word Recall (4.75±2.96) and Word Recognition (3.75±2.38), whereas language domains such as Comprehension (1.25±0.45) and Word Finding (1.08±0.90) remained relatively preserved. Age showed a significant positive correlation with total ADAS-Cog score (Spearman r=0.65, p=0.022), while education showed no significant association with cognitive impairment. Thus, data shows the cognitive profile of Alzheimer's disease we further emphasize the need for culturally and linguistically adapted cognitive assessment tools for Indian clinical practice.

Keywords: Alzheimer's Disease Assessment Scale-Cognitive Subscale (ADAS-Cog), Alzheimer's disease (AD), cognitive assessment, cultural adaptation, multilingual population, neuropsychological testing, memory impairment, word recall, cognitive domains, Indian clinical settings

Background:
Dementia is a public health crisis in India and is projected to create an additional burden on healthcare resources over the next twenty years **[1]**. Cognitive assessment tools used to assess dementia and provide care to individuals with dementia have primarily been developed for Western cultures and populations and are used in clinical practice in India despite significant cultural and linguistic differences; therefore, they are not necessarily appropriate **[2]**. The ADAS-Cog is considered to be one of the most widely used cognitive evaluation tools for assessing cognitive impairment in Alzheimer's Disease. The ADAS-Cog assesses memory, language, praxis and orientation **[3]**. As the severity of cognitive impairment increases, so do ADAS-Cog scores and it is viewed as the gold standard for assessing Alzheimer's Disease **[4]**. Linguistically, India is an exceedingly diverse nation with multiple regional languages and dialects, which pose very real challenges for administering English-language neuropsychological cognitive assessments **[5]**. For bilingual and multilingual individuals, proficiency in each of the tested languages may influence performance on cognitive tests, independent of cognitive decline due to many factors **[6]**. A significant challenge for bilingual and multilingual individuals in task performance will be with episodic memory tasks (*e.g.*, Word Recall and Word Recognition) due to their reliance on linguistic encoding and retrieval of language-based stimuli **[7]**. Therefore, it is of interest to evaluate the ADAS-Cog domain-level performance and cultural-linguistic influences among urban Indian Alzheimer's disease patients.

Materials and Methods:
The research used a cross-sectional observational approach that was conducted at one time point and focused on identifying patterns of cognitive domain performance for patients with cognitive impairment or with Alzheimer's Disease (AD) who lived in urban India. The Neurology Clinic at the Marengo Asia Hospital, Gurugram, was the site of this research under Dr Praveen Gupta's supervision. The study included 12 participants, of whom complete ADAS-Cog domain score data were available and English-speaking ability was required to participate. The classification of participants as MCI, Mild AD, Moderate AD, or Severe AD was made through documentation provided by the clinic. The age range of the participants was 70–83 years (75.83 ± 3.49 years, Mean ± Standard Deviation) and the educational background of participants ranged from 15–18 years (16.58 ± 1.24 years, Mean ± Standard Deviation). The sample included an equal number of males (6) and females (6). Seven participants were classified as MCI, two as Mild AD, two as Moderate AD and one as Severe AD. The cognitive assessment used the standardised neuropsychological measure, the Alzheimer's Disease Assessment Scale - Cognitive Subscale (ADAS-Cog), which measures 11 cognitive domains: Memory, Language, Praxis and Orientation. The total ADAS scores ranged from 0 to 70, with higher scores indicating increased cognitive impairment. Assessments were performed in English by trained clinical staff according to established clinical practice guidelines, taking approximately 30-45 minutes to complete. Scores for Domain-Specific and Total were documented separately for analytical purposes. Descriptive Statistics (*e.g.* mean, S.D., median and range) for demographic and cognitive variables were calculated. Due to the small size of the sample and the possible non-normal distribution of scores, Spearman's Rank Correlation Coefficient was calculated to assess relationships between Age, Education and Total ADAS-Cog scores. Two-tailed testing at an alpha level of 0.05 was used to evaluate the scientific validity of the results. Pearson correlation coefficients were also reported for descriptive purposes. All procedures followed were in accordance with the ethical standards outlined in the Declaration of Helsinki and consent (informed or via proxy) was obtained from all participants or their caregivers prior to the cognitive assessment.

Results:
Twelve urban-dwelling elderly Indians (aged 70–83; mean = 75.83 ± 3.49), with 16 years and a half of education (+/- 1.24 years), were recruited for this study. The total ADAS-Cog scores (11-65) averaged 26.58 ± 18.23 for the participants. By diagnosis,

58.3% were categorised as MCI, 16.7% as mild AD, 16.7% as moderate AD and 8.3% as severe AD. The domain analysis indicated the most significant impairment in the memory domains, particularly in Word Recall (mean = 4.75, SD = 2.96) and Word Recognition (mean = 3.75, SD = 2.38); whereas the language domains, Word Finding (mean = 1.75, SD = 1.19) and Comprehension (mean = 1.25, SD = 0.45), have preserved functioning. The correlation analysis of age and ADAS-Cog showed a strong positive correlation (Spearman r = 0.65, p = 0.022) and education was weakly correlated with the severity of Cognitive Impairments (Spearman r = 0.25, p = 0.440). These results support the traditional cognitive profiles associated with Alzheimer's disease and emphasise the need for culturally adapted assessments in multilingual clinical settings in India. **Table 1** shows the demographic and clinical characteristics of all 12 participants, including age, sex, education, severity classification and total ADAS-Cog scores. **Table 2** shows the statistical summary of participant demographics and disease severity categories within the sample population. **Table 3** provides detailed domain-level performance statistics across the 11 ADAS-Cog cognitive domains and highlights greater impairment in memory-related domains. **Table 4** compares the relationship between age and total ADAS-Cog scores and demonstrates a moderate-to-strong positive correlation between increasing age and cognitive impairment severity. **Table 5** shows the association between education and total ADAS-Cog score, revealing no statistically significant protective effect of education on impairment severity in this sample. **Table 6** shows that the majority of participants were in the MCI category, indicating early-stage presentation in most patients. **Table 7** shows an equal sex distribution among male and female participants. **Table 8** compares the highest and lowest impaired ADAS-Cog domains and shows that memory-related domains were most affected, whereas language-related domains remained relatively preserved. **Table 9** provides culturally adapted Indian word substitutions proposed for the ADAS-Cog Word Recall task to minimise linguistic and cultural confounding during cognitive assessment.

Table 1: Demographic and clinical characteristics of participants

Patient ID	Severity	Age (years)	Sex	Education (years)	ADAS-Cog Score
P001	Mild AD	70	Male	17	27
P002	Moderate AD	78	Male	18	45
P003	Severe AD	83	Male	15	65
P004	MCI	77	Male	17	12
P005	MCI	73	Male	17	11
P006	MCI	76	Female	15	15
P007	MCI	75	Male	17	17
P008	Moderate AD	78	Female	18	52
P009	MCI	74	Female	17	11
P010	MCI	72	Female	15	13
P011	Mild AD	79	Female	18	32
P012	MCI	75	Female	15	19

Table 2: Statistical summary of participant characteristics

Variable	Mean (SD) / n (%)	Median	Range
Age (years)	75.83 (3.49)	75.5	70–83
Education (years)	16.58 (1.24)	17	15–18
Total ADAS-Cog Score	26.58 (18.23)	18	11–65
Sex: Male / Female	6 (50.0%) / 6 (50.0%)	—	—
Severity: MCI / Mild / Moderate / Severe AD	7 (58.3%) / 2 (16.7%) / 2 (16.7%) / 1 (8.3%)	—	—

Table 3: Domain-level performance statistics of ADAS-Cog

Domain	Mean	SD	Median	Min	Max
Word Recall Task	4.75	2.96	3.5	2	10
Naming	2.42	1.73	2	1	6
Commands	1.58	1.62	1	0	5
Constructional Praxis	3.00	2.30	2	1	8
Ideational Praxis	2.17	1.90	1	0	6
Orientation	3.00	2.04	2	1	7
Word Recognition	3.75	2.38	2.5	2	9
Test Instructions	1.83	1.27	1	1	5
Spoken Language	1.75	1.06	1	1	4
Word Finding	1.08	0.90	1	0	3
Comprehension	1.25	0.45	1	1	2

Table 4: Correlation between age and total ADAS-Cog score

Variable Comparison	Correlation Test	Correlation Coefficient (r)	p-value	Interpretation
Age vs Total ADAS-Cog Score	Spearman Correlation	0.65	0.022	Moderate-strong positive correlation
Age vs Total ADAS-Cog Score	Pearson Correlation	0.72	0.008	Strong positive correlation

Table 5: Correlation between education and total ADAS-Cog score

Variable Comparison	Correlation Test	Correlation Coefficient (r)	p-value	Interpretation
Education vs Total ADAS-Cog Score	Spearman Correlation	0.25	0.440	Small insignificant relationship

Education vs Total ADAS-Cog Score	Pearson Correlation	0.15	0.636	Weak insignificant relationship

Table 6: Severity distribution among participants

Severity Category	Number of Participants	Percentage (%)
MCI	7	58.3
Mild AD	2	16.7
Moderate AD	2	16.7
Severe AD	1	8.3

Table 7: Sex distribution of participants

Sex	Number of Participants	Percentage (%)
Male	6	50.0
Female	6	50.0

Table 8: Highest and lowest performing ADAS-Cog domains

Domain Category	Domain	Mean Score	Interpretation
Most Impaired	Word Recall Task	4.75	Highest impairment
Most Impaired	Word Recognition	3.75	Significant memory impairment
Least Impaired	Word Finding	1.08	Relatively preserved language function
Least Impaired	Comprehension	1.25	Minimal impairment

Table 9: Proposed Indian word list for culturally adapted ADAS-Cog

Original ADAS-Cog Word	Proposed Indian Equivalent	Cultural Rationale
Cactus	Tulsi (Holy Basil)	Familiar in Indian households
Seashore	Ganga (River bank)	Culturally recognised river association
Gloves	Dupatta (Scarf)	Common daily garment
Trumpet	Tabla (Drum)	Familiar Indian musical instrument
Canoe	Rickshaw	Common transport mode
Cottage	Chawl / Haveli	Familiar residential structures
Daisy	Marigold (Genda)	Commonly recognised flower
Cabin	Dhabha	Familiar roadside establishment
Steeple	Minaret / Temple Shikhara	Familiar religious structures
Hammock	Charpoy (Rope bed)	Traditional Indian resting furniture

Discussion:

Findings from this pilot study indicate that ADAS-Cog scores for urban Indian patients evaluated with English versions of ADAS-Cog are similar. The most significant areas of impairment on the ADAS-Cog were memory-related domains, while the language-related domains were relatively preserved. This is consistent with the "classical" neuropsychological profile of patients with Alzheimer's disease (AD), in which episodic memory is often the earliest and most prominent area of dysfunction **[8]**. The highest degree of impairment was observed in the Word Recall task, followed by Word Recognition, underscoring what is already known about the impact of hippocampal and medial temporal lobe dysfunction on the encoding, consolidation and retrieval of new memories during the early phases of Alzheimer's disease **[9]**. In addition, similar studies have found that the memory-related domains on the ADAS-Cog continue to be among the most significant predictors of the severity of Alzheimer's disease as it progresses along the continuum of diagnosis and treatment **[10]**. Of particular note in the current study was the variability in participants' memory-domain scores, especially on the Word Recall task. The wide variety of scores reflects considerable heterogeneity in disease severity among study participants, with some participants being diagnosed with Mild Cognitive Impairment (MCI) and others being diagnosed with Severe Alzheimer's Disease. Furthermore, the association noted between total ADAS-Cog score and advancing age is consistent with the previously established relationship of increased age and the severity of cognitive impairment associated with Alzheimer's Disease **[11]**. Advancing age remains one of the strongest predictive factors in progression and clinical decline in Alzheimer's Disease **[12]**. Language-related domains, including Word Finding and Comprehension, showed relatively intact performance among study participants. These findings are consistent with previous studies, which suggest that in highly educated individuals, mild stages of Alzheimer's disease (AD) may still have language difficulties; this is particularly true in the beginning stages of the disease **[13]**. Because the majority of participants had a high level of education, there was limited variability in comprehension scores, which may also indicate a ceiling effect. Studies to date have showed that adapting innate testing methods will increase accuracy when testing divergent linguistic and educational populations **[14]**. The study identified several important linguistic and cultural factors to consider when assessing the neuropsychological status of multilingual individuals living in India. Although it is common practice to use English-language assessment instruments when assessing patients in urban settings, familiarity with English may also independently affect performance on tests of cognitive functioning, regardless of cognitive decline **[15]**. These observations are consistent with the findings of Lakshminarayanan *et al.* who demonstrated that the culturally adapted Indian version of the ADAS-Cog is a valid and reliable instrument for assessing cognitive impairment, emphasizing that linguistic and cultural adaptation improves the accuracy and clinical applicability of Alzheimer's disease assessment in Indian populations **[21]**. Previous studies have shown that language

proficiency directly influences neuropsychological test scores, regardless of individuals' baseline cognitive status **[16]**. In this study, individuals who had the most difficulty performing on the Word Recall task, which relied heavily on participants' English vocabulary, likely had difficulty encoding English words. In addition to memory problems, this is a strong hypothesis for the observed high number of low scores on the Word Recall task. The predominance of MCI (Mild Cognitive Impairment) among study participants highlights the need for early identification and intervention in the treatment of Alzheimer's disease (AD). Early identification allows for the introduction of supportive management strategies, caregiver education, reduction of risk factors associated with MCI and cognitive intervention prior to excessive functional decline **[17]**. Misinterpretation of test materials unfamiliar to the individual's culture may lead to over- or underestimation of the individual's impairment severity. To achieve equivalence in cognitive assessment tests across various cultural groups, testing procedures need to be adjusted to account for the multilingual nature of the healthcare environment **[18]**. Another significant finding of this study was the lack of a statistically significant effect of educational level on total ADAS-Cog severity (Cognitive Disorder Severity). The cognitive reserve model of AD states that the higher an individual's educational level is, the longer it may take for the individual's symptoms to present themselves; however, education alone will not prevent an individual from developing impairment once the associated neurodegenerative process has surpassed the individual's compensatory threshold **[19]**. Thus, the proposed Indian Word List described in this study provides a feasible method for minimising cultural and linguistic bias during ADAS-Cog Word Recall testing. Substituting culturally unfamiliar Western words with equivalent vernacular Indian words may improve the reliability of individual diagnoses in multicultural settings **[20]**.

Conclusion

We show that urban Indian Alzheimer's patients assessed using the ADAS-Cog show predominant impairment in memory-related domains with relative preservation of language functions, consistent with the classical Alzheimer's disease profile. The findings further emphasise that culturally adapted cognitive tools, including Indianized word lists, are essential to ensure that neuropsychological assessments evaluate true memory impairment rather than linguistic unfamiliarity in multilingual clinical populations.

References:

[1] Ravindranath V & Sundarakumar JS. *Nat Rev Neurol.* 2021 **17**:747. [PMID: 34663985]
[2] Chakravarty K & Ray S. *Ann Indian Acad Neurol.* 2023 **26**:347. [PMID: 37970313]
[3] Morkovina O *et al. Front Psychol.* 2024 **15**:1332391. [DOI: 10.3389/fpsyg.2024.1332391]
[4] Shiekh S *et al. J Alzheimers Dis.* 2021 **80**:337. [PMID: 33554910]
[5] Bajpai S *et al. Dement Geriatr Cogn Disord Extra.* 2022 **12**:51. [PMID: 35611146]
[6] Farron MR *et al. J Int Med Res.* 2022 **50**:03000605211068720. [DOI: 10.1177/03000605211068720]
[7] García-Chanes RE *et al. Behav Neurol.* 2022 **2022**:9045290. [PMID: 35795033]
[8] Zhao W *et al. J Gerontol A Biol Sci Med Sci.* 2023 **78**:743. [PMID: 36782352]
[9] Briceño EM *et al. Neuropsychology.* 2023 **37**:247. [PMID: 35482625]
[10] Lee J *et al. Alzheimers Dement.* 2023 **19**:2898. [PMID: 36637034]
[11] Ren H *et al. Front Psychiatry.* 2024 **15**:1429934. [PMID: 39465050]
[12] Kalaria R *et al. Alzheimers Dement.* 2024 **20**:4290. [PMID: 38696263]
[13] Gu Z *et al. JMIR Aging.* 2025 **8**:e64148. [PMID: 40009844]
[14] Harrison JE *et al. Alzheimers Dement.* 2025 **21**:e100004. [DOI: 10.1002/Alz70859_100004]
[15] Safiri S *et al. Front Med (Lausanne).* 2024 **11**:1474043. [PMID: 39736972]
[16] Mi J *et al. Front Aging Neurosci.* 2024 **16**:1363458. [PMID: 38566826]
[17] Xue C *et al. medRxiv.* 2024 **2024**.02.08.24302531. [PMID: 38585870]
[18] AlAnazi FH *et al. Cell Mol Neurobiol.* 2023 **43**:3405. [PMID: 37540395]
[19] Livingston G *et al. Lancet.* 2020 **396**:413. [PMID: 32738937]
[20] Czerwinski-Alley NC *et al. J Alzheimers Dis Rep.* 2024 **8**:659. [DOI: PMID: 38746627]
[21] Lakshminarayanan M *et al. Aging Ment Health.* 2022 **26**:423. [PMID: 33491464]