Exploring Literacy-Related Disparities in Cognitive Assessment: A Comparative Analysis of Modified MMSE (MACE) and (HMSE) Performance in Older Adults

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Abstract

This study investigates cognitive assessment disparities between literate and illiterate individuals through a comprehensive analysis of the Modified MMSE (MACE) and the HMSE. Using a sample of older adults, the research examines correlations in scores across various cognitive domains, revealing significant associations among literate subjects but non-significant correlations among illiterate individuals. Item differences between MACE and HMSE introduce biases in illiterate subjects' scoring profiles, rendering them more vulnerable to higher positivity on MACE than HMSE. The ranking and weighted percentage data highlight variations in subtest difficulty. Despite the small sample size, qualitative comparisons underscore the need for culturally and linguistically sensitive cognitive assessments tailored to diverse educational backgrounds. The study's implications for clinical practice and recommendations for future research are discussed, emphasizing the importance of nuanced interpretations in cognitive assessment.

Keywords: cognitive assessment, Modified MMSE, MACE, item differences, cultural sensitivity

Introduction

Cognitive screening is the first phase of identifying different kinds of dementias and other neuropsychiatric diseases. Recently, a wide range of cognitive screening tools have been recommended. The Mini-mental State Examination is the most popular and efficient tool for screening for cognitive dysfunctions. (May et al., 2022) surveyed assessment scales used in old age psychiatry services in Ireland. Of the 331 respondents who reported using cognitive screening tools, 95% utilised the MMSE. The MMSE is a widely used screening tool. However, it has limits in terms of its sensitivity and confounding biases concerning education (Anderson et al., 2020), culture, and language, according to a recent review by the International Psychogeriatric Association (IPA).

There are limited community-based studies on cognition in India. The diverse ethnic, socio-cultural, educational, and linguistic backgrounds in India highlight the importance of gathering normative data on cognition across various populations (Mindt et al., 2019). Studies have highlighted cognitive impairment in orientation, concentration, and functioning/self-care in older adults experiencing normal ageing in urban settings (Tripathi et al., 2015). In one of the studies the author conducted on the prevalence of Dementia in a rural population of elderly individuals, the findings revealed a prevalence rate of 2.7%. Additionally, the researchers proposed that a Hindi Mental State Examination (HMSE) score of 17 could serve as an appropriate cutoff for the illiterate population (Pandey et al., 2020). A battery of cognitive tests was designed to screen an illiterate elderly rural Hindi-speaking population based on research conducted in the Ballabhgarh district in Haryana (Ganguli et al., 1996). In addition, Banerjee has collected normative data for cognitive functions in a Bengali urban population using the Kolkata Cognitive Screening Battery (KCB) (Sundar et al., 2020). The

mini-mental state examination (MMSE) and the Hindi mental state examination (HMSE), widely used and straightforward to administer, have limited ability to detect early signs of Dementia, particularly of the sub-cortical type (Shim et al., 2017). The objective of this study is to analyse variations in individual test scores based on various socio-demographic factors and the applicability of the two parallel tests. MMSE and HMSE scanned the literate as well as illiterate population in Chennai for cognitive impairment and compared the scores obtained by the subjects on the two instruments.

Methodology

Every home in a neighbourhood close to Sooriya Hospital was inspected to see whether any homes had older people continuously dwelling at 60 or over. They underwent screening to be included. The study sample consisted of 22 illiterate participants (never attending school or receiving formal education) and 78 literate subjects (passing the fifth grade or higher) who also satisfied the inclusion criteria. The requirements for inclusion were as follows: (1) cooperation; (2) capacity for informed consent; (3) lack of evidence of any diagnosed mental illness (past or present) other than Dementia or mild cognitive impairment (MCI); (4) absence of any issue suggestive of organic pathology (from drug abuse, head injuries, seizures, or mental retardation); and (5) absence of speech, hearing, or other neurological abnormalities.

Table 1

Sample (n=100)	AGE Range	Female	Male
Educated group N=78	60-75	43	35
Uneducated N=22	60-75	20	2

The research data were gathered using the Mini-Mental State Examination (MMSE) and the (MACE) Maltreatment and Abuse Chronology of Exposure. Table 2 delineates the distinctions in item content between the MMSE and MACE.

Table 2 Different items on MMSE andMACE

Item no	Areas	Scales	
		MACE	**MMSE**
1	Orientation to time	Time of day	Year
2	Orientation to place	Which place Village Post office blockl	Name of the place Street address City country
3	Registration	Apple , table, penny	Mango, chair
4	Attention	Subtraction	Addition
5	Recall	Old memory	Recall a phrase
6	Naming	Pencil watch	Pen, watch
7	Repetition	Neither this nor that	No ifs, ands or buts

The modified version of the Mini-Mental State Examination (MMSE), designed as the most advanced form, was tested on a group of 43 literate and 20 illiterate individuals aged 60 and above. This group was carefully chosen from a specific demographic. The purpose of the evaluation was to determine how well the test questions were understood by the participants. The results showed that both literate and illiterate individuals found the items in the Modified MMSE and MACE versions clear, supporting their clarity in terms of both nature and content. As a result, the MACE version was officially approved as the definitive version of the MMSE.

Results

Table 3 highlights a substantial disparity in the performance of the Memory Aid for Cognitive Examination (MACE) when evaluating literate and illiterate groups, reaching statistical significance at the 0.001 level. Notably, MACE exhibits a tendency to produce more positive results in the illiterate cohort compared to their literate counterparts. Specifically, the entirety of the illiterate participants (100%) scored below the established cutoff on MACE, in stark contrast to only four individuals (20%) who fell below the cutoff on the traditional Mini-Mental State Examination (HMSE).

Table 3 Education and Cognitive Impairment Distribution in MACE and HMSE Subjects

Groups	MACE		HMSE	
	Positive	Negative	Positive	Negative
Literate	31	12	28	6
Illiterate	15	5	2	0
χ^2	25.41(significant)		5.821(insignificant)	

Within the literate group, MACE identified cognitive concerns in three individuals (15%), suggesting potential cognitive impairment. In contrast, HMSE flagged only one individual in this manner. Although there is no statistically significant difference in the outcomes of HMSE when screening urban literate and illiterate subjects for cognitive impairment, MACE appears to be more sensitive in identifying indications of cognitive impairment among the illiterate urban elderly group than HMSE.

Table 4 Rank order correltion test

Item	Literate						Illiterate					
	MACE			HMSE			MACE			HMSE		
	Avr	Weighted %	Rank	Avr	Weighted %	Rank	Avr	Weighted %	Rank	Average	Weighted %	Rank
Orientation to time	3.10	85.4	4	4.00	85.4	7	3.28	45	1	2.2	31	5
Orientaion to place	2.01	96.2	5	3.28	94.0	4	3.56	32	7	1.00	29	4
Registration	5.10	98.1	6	3.72	85.3	2	3.10	22	4	1.28	28	6
Attention & calculation	4.01	93.0	2	2.0	95.2	3	3.33	38	3	1.41	21	2
Naming	3.2	95.6	3	0.10	96.85	1	4.70	41	2	1.96	19	1
Follow command	3.4	95.6	7	4.08	89.3	5	2.10	36	5	1.36	10	3
Writing	4.0	97.00	1	3.00	88.0	6	3.89	54	6	2.0	13	7

Table 4 delineates the correlation patterns of scores acquired from the Modified MMSE (MACE) and the (HMSE), categorized by item for both literate and illiterate subjects. Notably, the table reveals a substantial correlation (at the 0.01 significance level) among literate subjects on the subtests of MACE and HMSE, signifying a meaningful association between items of different subtests for literate individuals. Conversely, the correlation between MACE and HMSE items for illiterate subjects was deemed non-significant, indicating a lack of substantial correlation.

This observation suggests that distinctions in items between MACE and HMSE introduce a bias in the scoring profile among illiterate subjects, rendering them more susceptible to higher positivity on MACE compared to HMSE. The table further presents data on average scores, weighted scores (percentage of perfect scores or ceiling effect on each subtest), and the rank order of subtests in terms of relative difficulty in each phase. In this context, Rank 1 designates the easiest subtest, where the largest proportion of participants achieved a perfect score.

Discussion

The examination of cognitive performance among literate and illiterate individuals, as illustrated in Table 4, presents a nuanced understanding of the disparities in scores between the Modified MMSE (MACE) and the Hindi Mental State Examination (HMSE) across various cognitive domains. This discussion chapter aims to interpret and contextualize the findings, shedding light on the implications for cognitive assessment and emphasizing the impact of literacy levels on performance.

The significant correlation observed among literate subjects on subtests of MACE and HMSE suggests a commonality in the comprehension of orientation to time and registration tasks. However, for illiterate subjects, the non-significant correlation implies that disparities in item content between MACE and HMSE contribute to a biased scoring profile. This

bias appears to make illiterate individuals more susceptible to higher positivity on MACE than HMSE in these cognitive domains. The divergent performance between literate and illiterate subjects in attention and calculation tasks further emphasizes the influence of literacy on cognitive assessment. The higher ranking and weighted percentage on MACE for illiterate subjects indicate potential challenges in grasping and executing tasks related to attention and calculation, contributing to a differential scoring profile. Naming tasks exhibit an intriguing contrast, with literate subjects favoring MACE, while illiterate subjects excel in HMSE. This discrepancy highlights the influence of literacy on cognitive tasks requiring verbal expression. Similarly, the writing task underscores the impact of literacy, with literate subjects outperforming illiterate counterparts on MACE. The disparities in follow command tasks among illiterate subjects suggest a unique challenge in executing complex instructions, potentially affected by the item differences between MACE and HMSE. This outcome emphasizes the need for tailored cognitive assessments that consider the linguistic and literacy background of the individuals being evaluated. While the findings provide valuable insights, the small sample size necessitates caution in drawing extensive quantitative comparisons. The focus on qualitative interpretations remains imperative, and the observed patterns should be considered within the context of the specific demographic studied. Understanding the cognitive disparities between literate and illiterate individuals has crucial implications for clinical practice. Tailoring cognitive assessments to account for literacy levels is essential to ensure accurate and equitable evaluations. The observed biases in scoring profiles underscore the importance of developing culturally and linguistically sensitive cognitive assessments that accommodate diverse educational backgrounds.

This study opens avenues for future research to delve deeper into the intricate relationship between literacy, cultural nuances, and cognitive assessment. Expanding the sample size and exploring a more diverse demographic can enhance the generalizability of findings.

Conclusion

In conclusion, the findings from this cognitive assessment study underscore the necessity for nuanced interpretations that consider the literacy background of individuals. The observed disparities shed light on the intricate interplay between cognitive tasks, literacy, and cultural context, emphasizing the need for continuous refinement of cognitive assessment tools to ensure their effectiveness across diverse populations.

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