

Early Detection of Mild Cognitive Impairment using MOCA Basic in Illiterate Elderly

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ABSTRACT

Introduction: Few studies have examined the performance of cognitive assessment tools in elderly with limited education particularly Mild cognitive impairment which is a clinical transitional state between normal cognitive aging and the initial pathological features of dementia.

Objective: To detect the psychometric properties of Arabic MOCA- B in screening for mild cognitive impairment among illiterate and low educated community dwelling elderly.

Methods: A cross sectional study was conducted among 310 elderly, 60 years and older, illiterate and low educated community dwelling elderly. All subjects were assessed using the Montreal cognitive assessment basic (MoCA-B), Mini-Mental State Examination (MMSE), and the Clinical Dementia Rating Scale (CDR).

Results: The recommended cut off values of MOCA B test to detect MCI among illiterates was 20 out of 30 points with 100% sensitivity and 97.46 % specificity and 21 points with 100% sensitivity and 95.71% specificity among low educated elderly.

Conclusion: The Arabic MoCA-B is an accurate cognitive assessment tool in diagnosing MCI among illiterates and low educated elderly.

Keywords: Dementia, MCI, MOCA- B.

INTRODUCTION

Understanding late-life cognitive changes is critical to supporting these growing numbers of older people and detecting those with cognitive problems in order to maintain their welfare, independence, and quality of life. Furthermore, reliable estimations of age-related cognitive change will allow early-stage neurodegenerative disease to be distinguished from normal ageing. ⁽¹⁾.

Because different research have employed different criteria of MCI, determining the prevalence of MCI in the community is

problematic. MCI prevalence in community-dwelling persons over 65 years old has been reported as ranging from 3% to 25%, with variations due to factors such as the sample's mean age and therefore the screening tests used ⁽²⁾. According to a study conducted in Egypt, the prevalence of MCI is between 34.2 and 44.3% of elderly men and women respectively ⁽³⁾. A systemic review conducted by Odejimi and colleagues in 2020 found the prevalence of cognitive impairment in Egypt could reach 51.4% ⁽⁴⁾.

MCI can be stable, reverse to normal, or transform into different dementia subtypes. Annual conversion rate occurs in approximately 10–15 percent of MCI patients, compared to 1–4% in the general healthy aged population ⁽⁵⁾.

Direct cognitive testing is difficult in North Africa and the Middle East due to high illiteracy rates. For the illiterate population, there are no validated screening measures for cognitive impairment in Arabic ⁽⁶⁾.

The majority of current neuropsychological tests were created without taking illiteracy into account. As a result, when these tests are administered to illiterate older persons, the degree of difficulty and unfamiliarity with the test content may cause these older adults to appear to have low-level cognition, leading to misleading MCI and dementia diagnoses ⁽⁷⁾.

Few research have looked at how well cognitive assessment instruments perform in persons with low education levels. Also, among Arabic-speaking illiterates, cutoff values for psychometric features of cognitive tests are not well established ⁽⁸⁾.

Few tests including MMSE, MOCA, and Addenbrooke's cognitive examination are available in Arabic; however, MMSE does not assess executive function and other tests are not suitable for illiterates except for Montreal cognitive assessment basic (MOCA –B) ⁽⁹⁾.

MOCA-B is a modified version of the MOCA test that was created for those who are illiterate or have fewer than 5 years of schooling ⁽¹⁰⁾. Saleh and colleagues validated the Arabic version in Egyptian poorly educated persons in 2019

⁽¹¹⁾.; however, to our knowledge, no research in Egyptian illiterate people have been conducted .

AIM OF THE STUDY

Our aim was screening for MCI using Arabic MOCA-B, evaluation of this test and defining cutoff points for MCI in illiterate and low educated community dwelling Egyptian elderly.

MATERIALS AND METHODS

Study design and participants

A cross sectional included 310 elderly 60 years and older, illiterate, and low educated community dwelling elderly recruited from community and outpatient clinic in Ain Shams University Geriatrics hospital during the period between october 2019 and February 2021. The study was conducted after taking permission from MoCA organization for using the test and the test is available online on <https://www.mocatest.org/paper-tests/moca-test-basic/> ⁽¹²⁾.

The study was approved from ethical committee of Ain Shams University, and approved from each participant (explanation was done for each participant).

The sample size was calculated using Pass program, setting the type-1 error (α) at 0.05 with a confidence interval width of 0.15 (margin of error 7.5%). Result from previous studies ⁽¹³⁾ showed that the 34.1% of older adults had MCI. Calculation according to these values produced a minimal sample size of 154 participants.

Exclusion criteria included patients with acute neurological condition e.g. (delirium, disturbed level of conscious or

recent stroke), patients with a mental disorder (eg, major depressive disorder, schizophrenia) hindering accurate diagnosis after history taking and examination.

Methods

1- Data from each patient (participant) was collected (after accepting to participate in the study) including demographic data and history.

2- Psychometric assessment:

A- Diagnosis of MCI was obtained according to revised Peterson's criteria which requires the following for diagnosis: 1) Change in cognition recognized by the affected individual or observers; 2) Objective impairment in one or more of cognitive domains; 3) Preservation of independence in functional activities; and 4) Absence of dementia ⁽¹⁴⁾ and by clinical dementia rating scales (CDR) which when administered in a standardized fashion, has excellent reliability ⁽¹⁵⁾.

CDR is a scale used to assess six domains of cognitive and functional performance applicable to MCI, Alzheimer disease and other dementia subtypes as follows: Memory, Orientation, Judgment & Problem Solving, Community Affairs, Home & Hobbies, and Personal Care. The necessary information for each rating was obtained through an interview of the patient and a reliable informant. In addition to ratings for each domain, an overall Global CDR® Score was calculated through the use of an CDR® Scoring Algorithm available online (<https://naccddata.org/data-collection/tools-calculators/cdr>) ⁽¹⁶⁾. This score is **beneficial for** characterizing and tracking a patient's level of impairment. An overall

CDR global score was obtained based on a standard algorithm that weights memory as the primary category and weights the remaining categories as secondary ⁽¹⁵⁾, an Arabic version was used ⁽¹⁷⁾:

O = Normal , 0.5 = Very Mild Dementia; 1 = Mild Dementia 2 = Moderate Dementia 3 = Severe Dementia. The score of 0.5 was used to diagnose MCI.

B- The following cognitive assessment tests were then performed with comparison between them:

MMSE: comprises of 30 questions assessing orientation, registration, attention, and calculation, three items recall, language and construction skills ⁽¹⁸⁾, Arabic version ⁽¹⁹⁾.

MOCA-B: It is a pen-and-paper cognitive screening test including 10 subsets and assessing multiple cognitive domains (e.g., executive functions, memory, fluency, and attention). The sub-tests were optimized to check illiterate individuals and people with a limited level of education. and complex problem-solving tasks are designed to explain scenarios that pertain to everyday life. A subject can earn a maximum of 30 points, Several features were considered in designing the MoCA-B to optimize its ability to detect MCI in individuals with limited education ⁽²⁰⁾. Arabic version ⁽¹¹⁾.

Before the start of the study, **a pilot** was performed on 30 of our normal participants to detect if the test is suitable for illiterates or needs some modifications as during practice in our memory clinic, we found trail making test, some pictures in naming (peacock and zebra) and an item of abstract thinking (similarities between north and south) were difficult to many patients. After application, we found the

total score still within the normal range even if there was difficulty in some test items, so no modifications were needed.

3- Assessing other geriatric domains

A- Screening for Depression was performed using the Patient Health Questionnaire 2 (PHQ-2) ultra-short screening instrument for depression: The PHQ-2 inquired about the frequency of depressed mood and anhedonia over the past two weeks ⁽²¹⁾ and patients with depression were excluded.

B- Functional assessment by using the Instrumental Activities of Daily Living (IADL); ⁽²²⁾ and the Activities of Daily Living (ADL) ⁽²³⁾ to detect impairment in activities of daily living.

Statistical analysis:

Quantitative variables were presented as mean and standard deviation. Qualitative data were presented as frequency and proportion and the chi-square test was used to compare the two groups. The level of significance was taken at P-value < 0.05, otherwise is non-significant. Data entry and statistical analysis were done using a statistical package for social science (SPSS) version 20.0.

RESULTS

Pilot study: The **MOCA -B** test was applied, in combination with MMSE and CDR on 30 normal participants, to see if there is difference between illiterates and low educated and to know the normative scores of the MOCA B test and the most difficult questions in the test.

We found small difference between illiterate and low educated using the

MOCA B test, 85% of them got no scores in executive function (trail making), only 10% can abstract (north and south), 10% only can identify peacock in naming, 10% only got 5 scores in delayed recall.

Then we completed the study to get the optimal cut off scores for diagnosis of MCI by **MOCA -B** test among elderly with minimum literacy.

The population under the study were 310, the mean age is 65.24 ± 5.36 years. Among the studied population, 57.7% of the participants were females and 69.4% of them were illiterate.

Regarding functional status, (92%) were independent in **ADL** and (6%) were assisted, Regarding nutritional status, (2%) of them were malnourished, (6.8%) were at risk of malnutrition, and (91.3%) were well nourished. Regarding mood state 92.3% of studied participants were not depressed.

AS regarding cognition as assessed by CDR, **60.6%** had normal cognitive function, **(28.7%) mild cognitively impaired participants**, **10.7%** demented participants, So, the prevalence of Mild Cognitive Impairment by **CDR** is 28.7 %. Also we found that the recommended cut off values 20 with 100% sensitivity and 97.46 % specificity to detect MCI by **MOCA -B** among illiterates group **table (1)**, and 21 with 100% sensitivity and 95.71% specificity among low educated group **table (2)**, using (ROC MOCA B curve) analysis.

At the end we found that there was highly significant difference between MMSE and MOCA basic regarding their performance in MCI diagnosis as accuracy of **MOCA -B** 97.83%% in comparison to MMSE 94.95%% **table (3)**

DISCUSSION

MCI and dementia are becoming more common in both developed and developing countries. Rapid population ageing in both low- and middle-income nations makes it critical to identify people at risk of developing dementia at early stages so that targeted preventative measures can be implemented⁽²⁴⁾.

Illiteracy could be a major issue in Egypt and the Arab world as a whole. It impacts cognitive performance during psychometric testing and may lead to MCI and dementia overdiagnosis. This incorrect diagnosis may lead to stigmatisation of cognitively intact people or those with minor cognitive issues, leading to social disengagement and depression, as well as increased healthcare expenditures, community hardship, and healthcare personnel strain⁽²⁵⁾.

Many cognitive assessment tests, including the MMSE with various cut-off values for MCI and dementia, were tried in illiterates and low-educated adults, but none of them showed to have high sensitivity or specificity. The MoCA-B is the first cognitive screening test to show adequate validity in diagnosing MCI in illiterate and low-educated individuals⁽²⁰⁾.

In our study the recommended cut off values were 20 points with 100% sensitivity and 97.46 % specificity to detect MCI among illiterate group and 21 points with 100% sensitivity and 95.71% specificity among low educated.

The study of **Saleh and colleagues in 2019** showed that the recommended cut-off was 21/22 with sensitivity of 92.5% and specificity of 98.2% for detecting Mild NCD in low educated elderly⁽¹¹⁾.

The study of **Amatneeks and Hamdan, 2020** that showed that cutoff point of ≤ 21 points provides the best sensitivity and specificity for detection of cognitive impairment by MOCA-B with less impact of education on the total MOCA-B score than on the total MMSE score⁽²⁶⁾.

As regard diagnosis of MCI, MOCA B is more accurate than MMSE, this result go hand in hand with other studies^(11,20) revealing that MOCA B test is better than MMSE in the diagnosis of MCI with superior sensitivity and specificity when compared to MMSE.

CONCLUSION

The Arabic MoCA-B is an accurate cognitive assessment tool in diagnosis of MCI among illiterates and low educated elderly.

Ethical Considerations: Our study is approved by the ethical committee of the faculty of medicine at Ain Shams University. The objective of the study was conducted to the patient. Confidentiality of data was assured, and no one had the right to read the patient's medical information except the main researcher.

Conflict of interest: On behalf of all authors, the corresponding author states that there is no conflict of interest.

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Table (1): ROC MOCA basic to detect MCI by CDR among illiterate group.

Area under the curve	95% CI	Sig.
0.996	0.976 to 1.000	<0.0001

Criterion	Sensitivity	Specificity	+LR	-LR	+PV	-PV
< 11	0	100		1		55
<=11	6.19	100		0.9	100	57
<=12	12.37	100		0.9	100	58
<=14	15.46	100		0.9	100	59
<=16	21.65	100		0.8	100	61
<=17	30.93	100		0.7	100	64
<=19	71.13	100		0.3	100	81
<=20 *	100	97.46	39.33	0	97	100
<=22	100	78.81	4.72	0	79.5	100
<=23	100	48.31	1.93	0	61.4	100
<=24	100	22.88	1.3	0	51.6	100
<=25	100	0	1		45.1	

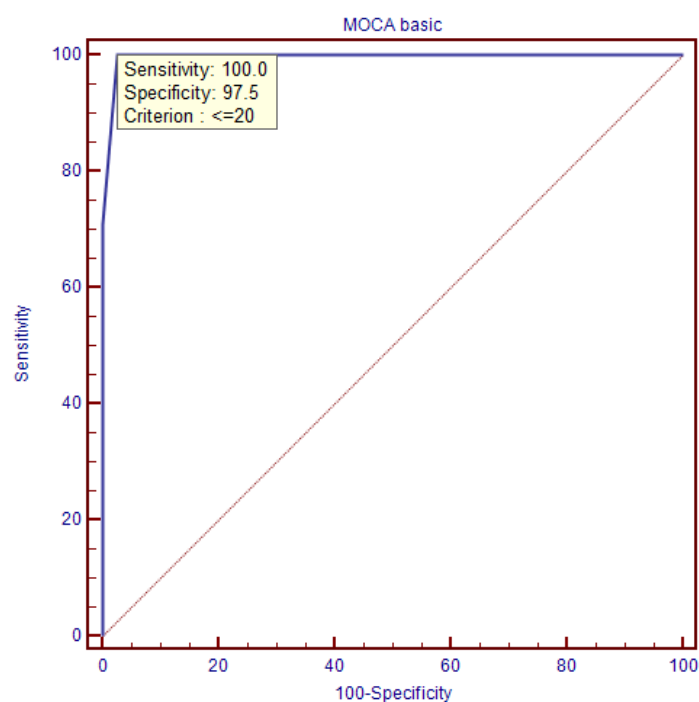


Table (2): ROC MOCA basic to detect MCI by CDR among ≤ 4 years education group

AUC	95% CI	Sig.
0.997	0.955 to 1.000	<0.0001

Criterion	Sensitivity	Specificity	+LR	-LR	+PV	-PV
< 11	0	100		1		74
≤ 11	12	100		0.9	100	76
≤ 19	24	100		0.8	100	79
≤ 20	84	100		0.2	100	95
≤ 21 *	100	95.71	23.3	0	89.3	100
≤ 22	100	78.57	4.67	0	62.5	100
≤ 23	100	57.14	2.33	0	45.5	100
≤ 24	100	44.29	1.79	0	39.1	100
≤ 25	100	11.43	1.13	0	28.7	100
≤ 26	100	8.57	1.09	0	28.1	100
≤ 28	100	0	1		26.3	

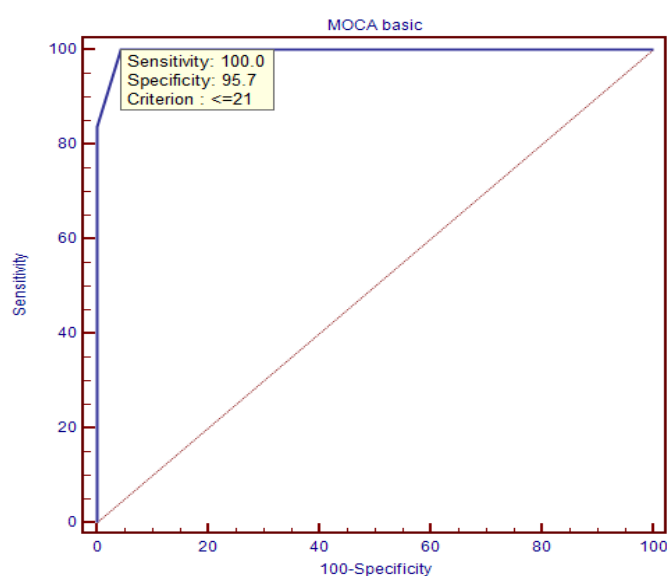


Table (3): Comparison between MMSE and MOCA B regarding their Diagnostic performance in MCI.

	Sensitivity	Specificity	PPV	NPV	Accuracy	Log rank test		
						z	p value	sig.
MOCA B	100.00%	96.81%	93.68%	100.00%	97.83%	2.9	0.003	S
MMSE	88.76%	97.87%	95.18%	94.85%	94.95%			

* P-value <0.05: Significant (S); **P-value< 0.01: highly significant (HS)

MOCA –B Montreal Cognitive Assessment basic - **MMSE**: Mini Mental State Examination