


Validity of the Georgian Montreal Cognitive Assessment for the Screening of Mild Cognitive Impairment and Dementia

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Abstract

Montreal Cognitive Assessment (MoCA) test has been shown to be a reliable tool to detect mild cognitive impairment (MCI), however, no Georgian language version exists. The goal of this study is to determine the validity, reliability, and accuracy of Georgian version of MoCA in the evaluation of amnesic MCI (aMCI) and Alzheimer's disease (AD). Montreal Cognitive Assessment was translated into Georgian language and was administered to healthy participants (HP) and patients with aMCI and AD. We studied 46 HS, 20 patients with aMCI, and 20 patients with AD. There was significant difference in MoCA scores between HP, patients with aMCI, and patients with AD ($P = 0.04$). The area under the receiver operating characteristic curve for the aMCI and AD groups by MoCA was 0.88 and 0.95, respectively, compared to 0.43 and 0.67 by Mini-Mental State Examination (MMSE). The Georgian version of MoCA is a valid, reliable, and sensitive screening tool to detect aMCI and AD in Georgian-speaking population and is superior to MMSE.

Keywords

MoCA, mild cognitive impairment, Alzheimer's disease, Georgian language

Introduction

The prevalence of dementia is increasing in both developing and developed countries.¹ Over the past 2 decades, development of screening tools for the identification of early stages of cognitive impairment became an important goal for health-care providers as timely initiation of preventive interventions may potentially delay the development of clinically overt degenerative dementia.² Several definitions have been used to determine a threshold and differences between normal age-associated minor cognitive changes and dementia. The term "mild cognitive impairment" (MCI) was introduced to define this state and has been extensively studied in the last 2 decades.^{2,3}

Neuropsychological testing may be helpful to distinguish MCI from normal aging, but thus far there is no single test to diagnose this condition.³ Mini-Mental State Examination (MMSE) has been used worldwide including Georgia as a brief screening test that quantitatively assesses the severity of cognitive impairment and documents cognitive changes occurring over time.⁴⁻⁶ However, MMSE is often insensitive to detect MCI.^{2,3} Montreal Cognitive Assessment (MoCA) test was introduced about 20 years ago and showed higher specificity

and sensitivity to detect MCI compared to MMSE.⁷⁻⁹ In addition, MoCA compared to MMSE is more sensitive to detect executive dysfunction.⁹ Although MoCA is translated and adapted into 55 languages and dialects, no Georgian version exists.⁷

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language. In the Georgian version of the test, only 2 minor changes were made: (1) In the first sentence of the first item of verbal fluency domain, the English name John was replaced by the common Georgian name Vano, which is Georgian version of Ivan or Johan or John. (2) In the second point of verbal fluency domain, where a study subject has to name as many words beginning with “F” as he/she can during 1 minute, we changed “F” into “K.” We chose this letter because the number of words beginning with “K” in Georgian is equivalent to the number of words beginning with “F” in English.

Subjects

The patients and healthy participants (HP) were recruited from the outpatient clinic of Department of Neurology, Khechinashvili University Hospital, Tbilisi, Georgia, from March 1, 2014, to March 1, 2015. Local ethics committee of the Khechinashvili University Hospital approved the study protocol and informed consent form. All study participants or caregivers (in case of dementia) signed approved consent form.

Interview, neurological examination, and neuropsychological testing were conducted by board-certified neurologists. Amnesic MCI (aMCI) was diagnosed based on Petersen diagnostic criteria,¹¹ and *Diagnostic and Statistical Manual of Mental Disorders* (Fourth Edition) criteria was used for the diagnosis of Alzheimer's disease (AD).¹²

Healthy participants were recruited from the random sample of the family members accompanied by patients visiting the aforementioned outpatient clinic who agreed to participate and signed informed consent. No attempt was made to match for age, except recruiting subjects who were older than 50 years. All HP were interviewed for medical history, and those with a known history of cardiovascular disease (hypertension, coronary artery disease, and atrial fibrillation), diabetes mellitus, and neurological and psychiatric disorders were excluded. No medical assessment of HP was performed.

As per original MoCA description, 1 point was added to MoCA's total score for the persons with education ≤ 12 years.⁷ To establish retesting reliability, $n = 30$ subjects ($n = 10$ from each group including HP, aMCI, and AD) were repeatedly tested after 3 weeks from the first investigation using MoCA and MMSE. Sensitivity and specificity were calculated to assess the diagnostic accuracy of the MoCA based on the recommended cutoff score of <26 points for MCI and <24 for dementia.⁷

Statistical Analysis

Values were reported as mean (\pm standard deviation [SD]), percentage, or median with interquartile range (25-75 percentile), and nonparametric tests (Mann-Whitney U or χ^2) were performed to compare the distributions or classifications of variables as appropriate. Cronbach α was computed to measure internal consistency of MoCA test. Receiver operating characteristic (ROC) analysis was used to assess the ability of the Georgian MoCA to compare with the MMSE. Larger area under

Table 1. Demographical and Neuropsychological Characteristics of Study Cohort.

Variables	Controls (n = 46)	aMCI (n = 20)	AD (n = 20)	P
Age, years	57.7 \pm 10.8	62.8 \pm 11.5	70.5 \pm 6.5	.04
Female, % (n)	67.4 (31)	25.0 (5)	45 (9)	.9
Education, years	11.5 \pm 0.5	11.6 \pm 0.5	11.7 \pm 0.5	.5
MoCA	26.3 \pm 2.5	19.2 \pm 1.8	11.7 \pm 3.9	.04
MMSE	29.6 \pm 0.8	26.8 \pm 1.9	18.4 \pm 6.3	.04

Abbreviations: AD, Alzheimer's disease; aMCI, amnesic mild cognitive impairment; MMSE, Mini-Mental State Examination; MoCA, Montreal Cognitive Assessment.

curves indicated better diagnostic performance. Sensitivities, specificities, positive predictive values, and negative predictive values were measured at cutoff scores. $P < .05$ was considered statistically significant throughout the analysis. SPSS version 22 was used for statistical analysis.

Results

We studied 86 subjects: 46 HP without cognitive impairment, 20 patients with aMCI, and 20 patients with AD. Table 1 shows demographic and neuropsychological characteristics of these 3 groups. Healthy participants were significantly younger compared to patients with aMCI and AD ($P = .04$). Although there was female predominance in the control group, this difference was not statistically significant ($P = .9$). There was no difference in years of education between the 3 groups ($P = .5$).

There was statistically significant ($P = .04$) difference in MoCA scores between HP (26.3 \pm 2.5), patients with aMCI (19.2 \pm 1.8), and patients with AD (11.7 \pm 3.9). Observed difference remained significant after adjustment for age ($P = .043$), as well as after adjustment for age, gender, and level of education ($P = .045$).

Mini-Mental State Examination scores were significantly ($P = .041$) different between the groups, showing the same trend with highest scores documented in HP (29.6 \pm 0.8) followed by aMCI (26.8 \pm 1.9) and AD groups (18.4 \pm 6.3). This difference remained significant after adjustment for age ($P = .041$), as well as after adjustment for age, gender, and level of education ($P = .041$).

Test-retest reliability data were collected from a subsample of HP ($n = 10$) and patients with aMCI and AD ($n = 10$). Statistical analysis revealed good internal consistency of repeated MoCA testing in all 3 groups including HP (Cronbach α 0.86), patients with aMCI (Cronbach α 0.92), and patients with AD (Cronbach α 0.89).

Area under the ROC curve for the aMCI and AD groups by MoCA was 0.88 and 0.95 (Figures 2 and 3), while corresponding values by MMSE were 0.43 and 0.67, respectively (Figures 2 and 3). Table 2 shows the sensitivities, specificities, positive predictive values, and negative predictive values of the Georgian MoCA at different cutoff values. The recommended MoCA cutoff value of 26 points showed excellent sensitivity

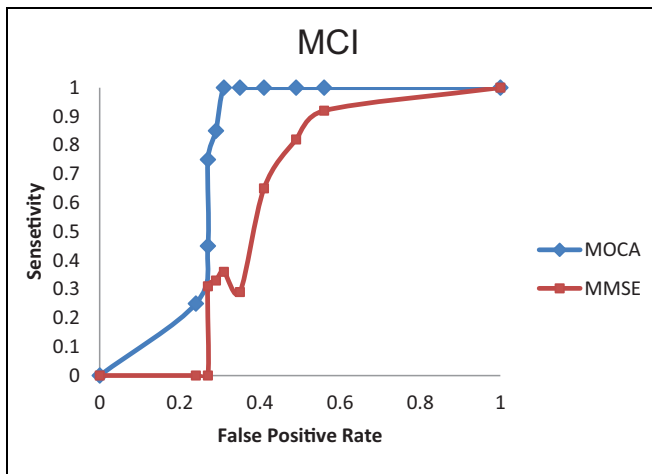


Figure 2. Receiver operating characteristic (ROC) curve analysis of the Mini-Mental State Examination (MMSE) and the Georgian version of the Montreal Cognitive Assessment (MoCA) to detect mild cognitive impairment (MCI).

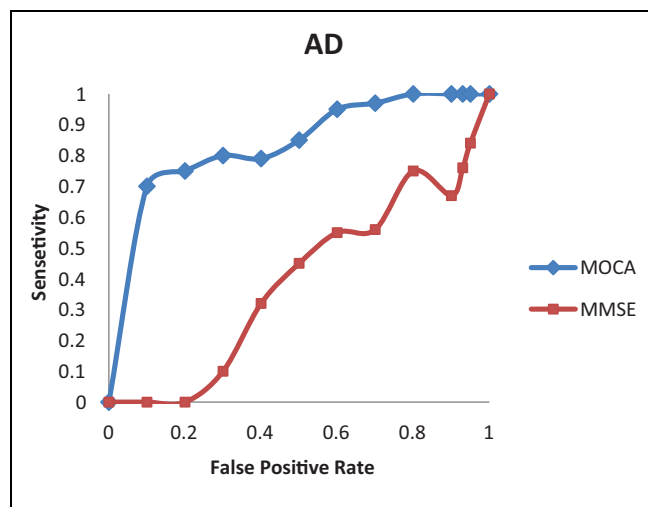


Figure 3. Receiver operating characteristic (ROC) curve analysis of the Mini-Mental State Examination (MMSE) and the Georgian version of the Montreal Cognitive Assessment (MoCA) to detect Alzheimer’s disease (AD).

(100%) to detect aMCI, however, specificity of this cutoff was low (44%). The optimal cutoff value for the Georgian MoCA appears to be 22, as the sensitivity of the Georgian MoCA for aMCI screening is 100% and specificity 69%.

Discussion

In this study, we have shown validity of MoCA as a screening tool to detect aMCI and AD in Georgian-speaking population. Translated Georgian version of MoCA will be 56th language adopting this test.

Our data show statistically significant difference in MoCA and MMSE scores between healthy individuals, patients with aMCI, and patients with AD, which is not unexpected finding and is compatible with previous reports.^{7,13} Mini-Mental State

Table 2. Sensitivity, Specificity, Positive Predictive Value, and Negative Predictive Value of the Georgian Version of the Montreal Cognitive Assessment for Detection of Amnesic Mild Cognitive Impairment.

Cutoff	Sens	Spec	PPV	NPV
18	0.25	0.76	0.27	0.74
19	0.45	0.73	0.37	0.78
20	0.75	0.73	0.50	0.89
21	0.85	0.71	0.51	0.93
22	1.00	0.69	0.54	1.00
23	1.00	0.65	0.48	1.00
24	1.00	0.59	0.46	1.00
25	1.00	0.51	0.42	1.00
26	1.00	0.44	0.39	1.00

Abbreviations: NPV, negative predictive value; PPV, positive predictive value; Sens, sensitivity; Spec, specificity.

Examination scores in Georgian population including healthy individuals and patients with aMCI were compatible to Trzepacz et al¹³; however, patients with AD in our cohort had lower MMSE, probably reflecting more advance disease.¹³ Although Georgian-speaking healthy individuals’ MoCA scores were similar to those reported by Trzepacz et al,¹³ patients in the current study with aMCI showed about 3-point and those with AD about 5-point lower scores.^{7,13} One possible explanation for this discrepancy is education, which was on average 5 years less in our patients with aMCI and AD.¹³ Alternatively, lower MMSE scores in our patients with AD may indicate probably more advanced disease.

Georgian version of MoCA revealed good internal consistency (Cronbach α range 0.8-0.9) of repeated MoCA testing in all 3 groups including healthy persons, patients with aMCI, and patients with AD.

This study shows better performance of Georgian MoCA compared to MMSE to detect aMCI and AD. An area under the curve for the MCI and AD groups by MoCA was 0.88 and 0.95 compared to 0.43 and 0.67 by MMSE, respectively. This is in agreement with previous studies of English- and non-English-speaking populations confirming the advantage of MoCA for the screening of aMCI and dementia of different etiologies.^{9,13,14,15}

In this study, recommended MoCA cutoff score <26 to detect aMCI showed excellent sensitivity of 100%, which is similar to 90% originally reported by Nasreddine et al.⁷ However, specificity was around 44%, which is much lower compared to originally reported 87%.⁷ It is possible that this cutoff score <26 is not perfect as the data from the subsequent studies showed that Nasreddine et al’s original paper did not reflect a typical MCI population.¹⁶⁻¹⁹ We found that lower cutoff score of 22 was optimal to detect aMCI as it showed 100% sensitivity and 69% specificity. This is similar to reported MoCA results in Korean and US African American populations.^{14,15} In addition to cultural differences, one possible explanation of this finding is the fact that in the current study, an average number of years in full-time education was 2 years lower compared to the cohort of Nasreddine et al.⁷

One possible limitation of this study is relatively small sample size. However, even with this small sample size, we were able to show validity and reliability of Georgian MoCA for the screening of aMCI and AD in Georgian-speaking population in addition to its superiority compared to MMSE. Although these results are generalizable to Georgian-speaking patients with aMCI and AD, it may not be generalizable to the patients with vascular cognitive impairment or other types of degenerative dementias. Population-based study is in progress and we will have more normative data, which will allow better determination of cutoff values for the screening of MCI and dementia.

In conclusion, Georgian MoCA is a valid and reliable test, which can be used in general practice for evaluation of aMCI and AD.

Authors' Note

All authors made substantial contributions to the conception and design of the study and analysis and interpretation of data. Marina Janelidze contributed to study concept and design, drafting of the paper, and revising it critically for intellectual content. Nino Mikeladze contributed to data acquisition, analysis and interpretation of data, drafting of the paper, and revising it critically for intellectual content. N. Bochorishvili contributed to data acquisition, drafting of the paper, and revising it critically for intellectual content. A. Dzagidze contributed to data acquisition, drafting of the paper, and revising it critically for intellectual content. M. Kapanidze contributed to data acquisition, drafting of the paper, and revising it critically for intellectual content. N. Mikava contributed to data acquisition, drafting of the paper, and revising it critically for intellectual content. I. Khatiashvili contributed to data acquisition, drafting of the paper, and revising it critically for intellectual content. D. Kakhiani contributed to data acquisition, drafting the paper, and revising it critically for intellectual content. E. Mirvelashvili contributed to study design and statistical analysis of the data. N. Shiukashvili contributed to statistical analysis of the data. Zurab Nadareishvili as a senior author contributed to study concept and design, analysis and interpretation of data, drafting of the paper and revising it critically for intellectual content, preparation of the manuscript, and final approval.

Declaration of Conflicting Interests

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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