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Comparison of the Quick Mild Cognitive Impairment (Q*mci*) Screen to the Montreal Cognitive Assessment (MoCA) in an Australian Geriatrics Clinic.

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Abstract

Introduction

The Montreal Cognitive Assessment (MoCA) accurately differentiates mild cognitive impairment (MCI) from mild dementia and normal controls (NC). While the MoCA is validated in multiple clinical settings, few studies compare it to similar tests also designed to detect MCI. We sought to investigate how the shorter Quick Mild Cognitive Impairment (Q*mci*) screen compares to the MoCA.

Methods

Consecutive referrals presenting with cognitive complaints to a teaching hospital geriatric clinic (Fremantle, Western Australia), underwent a comprehensive assessment and were classified as MCI (n=72) or dementia (n=109). NC (n=41) were a sample of convenience. The Q*mci* and MoCA were scored by trained geriatricians, in random order, blind to the diagnosis.

Results

Median Q*mci* scores for NC, MCI and dementia were 69 (+/-19), 52.5 (+/-12) and 36 (+/-14) respectively, compared to 27 (+/-5), 22 (+/-4) and 15 (+/-7) for the MoCA. The Q*mci* more accurately identified cognitive impairment (MCI or dementia), area under the curve 0.97, than the MoCA (AUC 0.92), p=0.04. The Qmci was non-significantly more accurate in distinguishing MCI from controls (AUC 0.91 versus 0.84 respectively=0.16). Both instruments had similar accuracy for differentiating MCI from dementia, (AUC of 0.91 versus 0.88,p=0.35). At the optimal cut-offs, calculated from receiver operating characteristic curves, the Q*mci* (≤57) had a sensitivity of 91% and specificity of 93% for

cognitive impairment, compared to 87% sensitivity and 80% specificity for the MoCA (≤23).

Conclusion

While both instruments are accurate in detecting MCI, the Q*mci* is shorter and arguably easier to complete, suggesting that it is useful instrument in an Australian geriatric outpatient population.

Keywords: (cognition, memory, dementia, screening, assessment)

Key points:

1. Few studies are available comparing short screens specifically designed to identify mild cognitive impairment (MCI).
2. This study provides the first external validation of the Quick Mild Cognitive Impairment (Q*mci*) screen against the well-established Montreal Cognitive Assessment in an older sample of patients attending a geriatric clinic in Western Australia.
3. After correcting for the effects of age and education the Q*mci* was statistically significantly more accurate than the MoCA at differentiating cognitive impairment (MCI and dementia) from normal controls. There was no difference in distinguishing MCI from normal controls.
4. Given the small sample size and select population, further study is required to confirm these findings.

Introduction

The prevalence of mild cognitive impairment (MCI) is expected to increase worldwide, as populations age (1). MCI is a heterogeneous disorder, characterised by subtle cognitive deficits, without loss of function with variable progression to dementia (2). MCI leads to four outcomes, namely; progression to dementia due to Alzheimer's disease (AD), progression to dementia due to another disease, stability or recovery (3). It has been proposed that MCI often represents an earlier stage of AD and criteria based on biomarkers have been developed to operationalise this paradigm (4, 5). There is still skepticism about the use of biomarkers in this way, particularly as single diagnostic tests (6). Nevertheless, as prognosis and treatment options for MCI and dementia differ (7, 8), an increasing emphasis is placed on early identification and management (9, 10) of MCI. Identification in clinical practice is however, limited by a lack of suitable sensitive and specific instruments. Indeed, criteria for this syndrome are numerous and not all capture change associated with disease (11). Access to gold standard assessment, with neuropsychological testing is curtailed by a lack of resources necessitating the use of short cognitive instruments that often double as both short screens and cognitive tests in busy clinics. The most widely used instrument is the Mini-Mental State Examination (MMSE) (12) and its standardised version (SMMSE) (13, 14) but these are limited by ceiling effects and low sensitivity to mild dementia and MCI. To overcome these problems, the Montreal Cognitive Assessment (MoCA) was developed. The MoCA has high sensitivity for MCI and is widely translated and validated, in different clinical settings (15). The MoCA takes approximately 10 minutes to complete (15) but the utility of its original cut-off score (<26) has been questioned (16). The specificity of the MoCA at this cut-off score is low (17) with studies demonstrating specificities as low as 35% (16). To adjust for this, lower cut-off scores for MCI (17, 18, 19, 20) are proposed.

However, uncertainty remains as to which cut-off is most appropriate and in which setting.

The Quick Mild Cognitive Impairment screen (Q*mci*) is a new, shorter cognitive screen with high sensitivity and specificity for MCI (19). Derived from an earlier version, the AB Cognitive Screen 135 (ABCS 135) (21, 22), it was designed to improve sensitivity and specificity, yet retain a short administration time. The Q*mci* is validated in Canada against the SMMSE and ABCS 135 (23, 24), in Dutch against the SMMSE (25) and in Ireland against the 6-item Cognitive Impairment Test (26) but has not otherwise been externally validated. Given that few studies have compared short cognitive instruments designed specifically to identify MCI, we externally validated the Q*mci* in an Australian sample by comparing its accuracy to the MoCA. Investigating the performance of short cognitive screening instruments is important, as there is much heterogeneity between study populations with psychometric properties including the accuracy, cut-off points selected and the positive and negative predictive value of instruments varying between studies, particularly where sample sizes differ (27). Given this, we chose to validate the Q*mci* in a geriatric clinic, a setting in which it is yet to be validated and one that is rarely considered for the validation of short cognitive screening instruments despite their frequent use in this setting.

Methods

Data Collection

Consecutive referrals of patients with cognitive complaints to a geriatric outpatient clinic at Fremantle Hospital and Health Service, Western Australia, were invited to participate and underwent a comprehensive assessment between December 2013 and June 2015. This was not a specialised memory clinic but referrals of patients with

cognitive symptoms sent to the department were cohorted together. Controls were a sample of convenience. The Q*mci* and MoCA were administered in clinic, in random order, by trained geriatricians, blind to the final diagnosis. This project was part of a quality improvement project to determine which cognitive assessment tool is optimal for use in a hospital based geriatric medicine clinic and was approved by the Director of Safety, Quality and Risk and the Director of Clinical Services at Fremantle Hospital and Health Service as a quality assurance project. This allowed consecutive patients, presenting with cognitive symptoms, to be included without the requirement for written consent, although participants were informed that additional cognitive testing was being conducted as part of the project.

Participants

All participants were diagnosed clinically by a consultant geriatrician after multi-disciplinary team assessment and a full work-up for alternative causes. Participants were classified using the Clinical Dementia Rating (CDR) scale (28, 29). Dementia was based upon DSM-IV (30) and NINCDS criteria (31). Dementia severity was determined according to the CDR-SB rating and found that most patients had a mild impairment. MCI was diagnosed using Petersen's criteria (2, 32) in conjunction with MDT assessment in those staged with a score of 0.5 on the CDR. Older caregivers attending with patients (n=2) and older patients attending this general geriatric clinic (n=39), without memory loss, were invited to participate as normal controls (n=41). Controls were asked regarding memory loss and underwent a similar MDT assessment as patients. All participants resided in their own homes and none lived in residential facilities. Participants were excluded if they were aged <45 years, if they presented with depressive (active) symptoms, if they presented to clinic with subjective memory

complaints and were found to have normal cognition, or if they were not fluent English speakers. Depression was excluded clinically, supported by the Geriatric Depression Scale short-from (33) using a cut-off score of ≥7, targeting high specificity (34).

Outcomes

The Q*mci* has six subtests (orientation, five word registration, a clock drawing test, five word recall, verbal fluency and logical memory, a test of immediate verbal recall of a short story) and is scored out of 100 points (test available as an online supplement at: http://ageing.oxfordjournals.org/content/early/2012/05/18/ageing.afs059/suppl/DC1). The logical memory subtest contributes most to the sensitivity and specificity of the instrument (24). Median administration time is 4.2 minutes. The Q*mci* correlates with the CDR, the standardised ADAS-cog and the Lawton-Brody activities of daily living scale (35). The optimal cut-off for the Q*mci*, for cognitive impairment (MCI or dementia) in a sample of patients attending outpatients in Canada is ≤62 (36). The MoCA has seven subtests covering five cognitive domains; memory, language, visuospatial, attention and cognitive control, and is scored out of 30 points (15).

Analysis

Data were analysed using SPSS version 22.0. Normality was tested using the Shapiro-Wilk test and found that the majority of data were non-parametric. The Mann-Whitney U test was used to compare non-parametric variables. Where more than one group was compared data were analyzed using the Kruskal–Wallis test. The Chi-squared test compared frequencies. Accuracy was determined from the Area under the Curve (AUC) using Receiver Operating Characteristics (ROC) curves. AUC results were classed as excellent if between 1-0.9, good between 0.9-0.8, fair between 0.8-0.7, poor between 0.7-0.6 and failed for those between 0.6-0.5 (37). Sensitivity, specificity, positive predictive values (PPV) and negative predictive values (NPV) were calculated for a

range of cut-off scores. Optimal cut-off scores were calculated from the ROC curves and were defined as those that maximised the AUC value (27). Binary logistic regression was used to control ROC curves for the effects of age and education.

Results

In all, 230 participants were assessed. Of these, eight were excluded: five with subjective memory complaints and normal cognition, one with active depression and two with an uncertain diagnosis. The characteristics of the 222 included are presented in Table 1. The median age of the sample was 76, interquartile range (IQR) ±13 years. In all, 115 (52%) were female. No significant differences were found in the gender composition between MCI, dementia and control groups ($p = 0.06$). There was a high prevalence of cognitive impairment (82%). Of those included, 72 had MCI, 109 had dementia and 41 were normal controls. Subjects with MCI ($p < 0.01$) and dementia ($p < 0.001$) were significantly older than controls. Patients with dementia had significantly less years of education than control ($p = 0.03$), but no significant difference was found between MCI and control groups ($p = 0.75$). The median Q*mci* score for MCI was 52.5 ±12 compared to 69 ±9 for controls ($p < 0.001$). The median MoCA scores for MCI and normal were 22 ±3.75 and 27 ±5, respectively ($p < 0.001$). Figure 1 presents ROC curves comparing the ability of the Q*mci* and MoCA to distinguish controls from MCI and dementia. The Q*mci* and MoCA both had good to excellent accuracy in separating cognitive impairment (either MCI or dementia), from normal controls. The Q*mci* had a similar AUC in differentiating MCI from normal controls (AUC of 0.91) compared with the MoCA (AUC of 0.84), z=-1.40, p=0.16. Likewise, there was no significant difference between either instruments accuracy to differentiate MCI from dementia: AUC of 0.91 for the Q*mci* compared to 0.88 for the MoCA, z=-1.02, p=0.31. The Q*mci* and MoCA both had excellent accuracy on identifying cognitive impairment (either MCI or dementia), AUC of 0.97

versus 0.92 respectively, with *Qmci* having significantly better accuracy than MoCA, *z*=-2.01, p=0.04. After correcting the ROC curve analysis for the effects of age and education the Q*mci* was still, albeit borderline, statistically significantly more accurate at differentiating cognitive impairment from normal controls (AUC of 0.97; 95% confidence interval: 0.95 - 0.99) compared with the MoCA (AUC of 0.94; 95% confidence interval: 0.90 - 0.97), z=1.67, p=0.048 (one-tailed). Based upon sensitivity and specificity analysis, calculated from ROC curves, the optimal Q*mci* cut-off for cognitive impairment was ≤57. At this cut-off, the Q*mci* had a sensitivity of 91% and specificity of 93%. The optimal MoCA cut-off in this sample was ≤23 yielding a sensitivity of 87% and specificity of 80%. Optimal cut-off points for MCI were ≤60 for the Q*mci* and ≤23 for the MoCA. Lower cut-offs were found for dementia, ≤50 and ≤22 for the Q*mci* and MoCA respectively. The sensitivity and specificity of both instruments, at these cut points, are presented in Table 2 and in Tables 3 and 4 (available as supplementary material).

Conclusion

This study presents the results of the first external validation of the Q*mci* against the MoCA in a sample of older adults presenting to a geriatric outpatient clinic in Western Australia. The results show both instruments are accurate in differentiating MCI from dementia and controls. While the Q*mci* had a larger AUC in differentiating MCI from NC, this did not reach statistical significance. The Q*mci* was however, statistically significantly better able to distinguish patients with cognitive impairment (MCI or dementia) from controls (p=0.04). The results found that the optimal Q*mci* cut-off in distinguishing normal controls from cognitive impairment is ≤50 for the Q*mci* and ≤22 for the MOCA. This is at odds with the original MoCA data that found that a score ≤26 indicates cognitive impairment (15), although this was based on a sample of 90 people.

Other studies have also found that this cut point does not reflect normal values. Rossetti and colleagues used the MoCA in a population of 2,653 individuals and found a mean score of 23.4 with 66% of subjects scoring below 26/30 (38). A Japanese study of 1,977 subjects over age 65 years revealed a mean score of 21.8 (39).

These data show features suggestive of a typical rising age distribution from normal to MCI to dementia in keeping with age as a major risk factor for cognitive decline, albeit this compromised by the highly selected normal control group. However, the distribution of scores across the three groups on the Q*mci* is consistent with previous studies using the Q*mci,* which recruited normal, asymptomatic volunteers (23). The optimal cut point for distinguishing MCI from normal is ≤60 for the Q*mci*, which is also in accord with previous studies, although the optimal cut-off for cognitive impairment was slightly lower (≤57) (20, 36). The optimal cut point for the MoCA in this respect is ≤23, which is similar to that reported in a recent paper by Freitas and colleagues (18). While the Q*mci* had a larger AUC than the MoCA in differentiating patients with MCI from controls, these differences did not reach statistical significance. Although both tests had high scores for sensitivity, specificity, PPV and NPV, the Q*mci* had a higher sensitivity and specificity than the MoCA in differentiating normal from MCI at their optimal cut-offs (selected using the maximal accuracy approach). This suggests that the Q*mci* may be the better test to use in a geriatric clinic setting where both high sensitivity and specificity are desirable.

There are several limitations in this study. The sample size was small, particularly with respect to the number of people with normal cognition, and while representative of a geriatric clinic, could potentially under-power the study to show superiority of one instrument over the other in a general practice setting. The controls were obtained by testing patients who presented to the clinic with non-cognitive

problems and also from family members of patients. Future studies should include patients presenting with subjective memory complaints. However, the numbers of these patients attending a general geriatric clinic is expected to be small. We excluded obvious clinical states and participants were reviewed by MDT assessment, but we cannot be certain that these controls were truly normal. Further, there is over representation in the sample by the dementia group. However, it is arguable that in a sample presenting to a geriatric outpatient clinic with cognitive symptoms, where the pre-test probability of cognitive impairment is high that such a high prevalence of MCI and dementia is expected, comparable with a case-finding exercise to rule in the condition. In this setting that normal controls were younger and less in number doesn't take from the comparison of the accuracy of the instruments. Indeed, adjusting for age and education did not affect the ROC curve analysis. Another limitation is that we cannot assume that the population is representative of all geriatric medicine clinics in Australia, particularly as patients with memory complaints are cohorted in our geriatric department. However, there is a general uniformity of geriatric medicine practice in Australia to allow one to consider this patient population to be not inconsistent with those seen in other clinics Australia wide. Prevalence data for cognitive disorders is not available for Australian states but we estimate that there are approximately 3000 individuals with dementia living in the catchment area of our hospital (40). The size of our sample is reflective of the community prevalence of cognitive disorders. Furthermore, external validation in other samples, particularly community samples e.g. in general practice with a lower prevalence or dedicated memory clinics with a higher prevalence of cognitive impairment, and using other study approaches including prospective designs are required to evaluate the psychometric properties including appropriate cut-off scores in these settings. Another limitation is that formal neuropsychological testing was not

performed on all subjects but the use of the CDR provided a robust basis for the syndromal diagnoses of MCI and dementia. Many patients had a disease diagnosis based on imaging findings and MDT. The commonest diagnosis was Alzheimer's disease. The NINCDS criteria were used for the latter and DSM-IV used for identifying dementia supported by the CDR. Finally, the method of producing the optimal cut-off scores used in this study (the maximal accuracy approach) is not a gold standard and assumes that false positives and negatives are equally desirable. It also depends on the prevalence of cognitive impairment, which in this case was high, rendering the cut-offs appropriate for use in a memory clinic, where prevalence is expected to be high, but potentially inappropriate for screening in general practice (27, 41).

In summary, this study presents the first external validation of a new short cognitive screening instrument designed to separate MCI from mild dementia and normal cognition, the Q*mci* screen. In this sample, of those attending a geriatric medicine clinic at Fremantle Hospital, both the MoCA and Q*mci* were accurate in identifying MCI and differentiating it from normal controls and dementia although the Q*mci* had a higher sensitivity and specificity at their optimal cut-off. These results also reaffirm that the original cut-off for the MoCA, ≤26, is inappropriate in older adults and suggests that if a cut-off is to be considered then ≤23 for MCI and ≤22 for dementia may be optimal. Given the shorter administration time and excellent accuracy shown in this study, we suggest that the Q*mci* is at worst non-inferior to the MoCA in distinguishing between normal cognition, MCI and dementia, and may be a better choice for a short cognitive instrument to use in a geriatric outpatients clinic.

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Graphics

Table 1. Characteristics of participants including age, gender, education, Quick Mild Cognitive Impairment (Q*mci*) screen and Montreal Cognitive Assessment (MoCA) score, according to diagnosis: normal controls, mild cognitive impairment (MCI) or dementia.

Group		**Total**	**Normal Controls**	**MCI**	**Dementia**
Number		222	41	72	109
Sex (% female)		52%	56%	40%	58%
Age					
(years)	Median	76	69	75	79
	IQR	82-69 = ±13	73.75-64.5 = ±9	79.75-70 = ±10	84-73 = ±11
	range	50-95	50-95	53-90	52-93
Education					
(years)	Median	11	12	12	10
	IQR	12.25-9 = ±3	15-9 = ±6	14-10 = ±4	12-9 = ±3
	range	4-21	7-21	8-18	4-18
Q*mci* (Median score with IQR)		45 57-36 = ±21	69 81-62 = ±19	52.5 57-45 = ±12	36 42-28 = ±14
MoCA (Median score with IQR)		21 24-15.75 = ±8	27 29-24 = ±5	22 24-20.25 = ±4	15 19-12 = ±7

Table 2. Sensitivity, Specificity, Positive Predictive Value (PPV), and Negative Predictive Value (NPV), with 95% confidence intervals (CI), for different Quick Mild Cognitive Impairment (Q*mci*) screen and Montreal Cognitive Assessment (MoCA) cut-off scores for cognitive impairment (mild cognitive impairment and dementia), without adjustment for age or education, compared with normal controls.

Cut-off score	**Sensitivity (95% CI)**	**Specificity (95% CI)**	**PPV (95% CI)**	**NPV (95% CI)**	**False Positive (95% CI)**	**False Negative (95% CI)**
≤63	97% (94-99%)	66% (60-72%)	93% (89-96%)	82% (69-95%)	34% (20-49%)	3% (1-6%)
≤62	96% (93-98%)	71% (65-77%)	94% (90-97%)	78% (65-92%)	29% (15-43%)	4% (1-7%)
≤61	94% (91-97%)	78% (73-83%)	95% (92-98%)	76% (63-89%)	22% (9-35%)	6% (2-9%)
≤60	93% (90-97%)	80% (75-86%)	95% (92-99%)	73% (60-86%)	20% (7-32%)	7% (3-10%)
≤59	93% (89-96%)	88% (84-92%)	97% (95-100%)	73% (61-86%)	12% (2-22%)	7% (3-11%)
≤58	93% (89-96%)	88% (84-92%)	97% (95-100%)	73% (61-86%)	12% (2-22%)	7% (3-11%)
≤57 (optimal cut-off)	91% (87-94%)	93% (89-96%)	98% (96-100%)	69% (57-81%)	7% (0-15%)	9% (5-14%)
≤56	89% (85-93%)	93% (89-96%)	98% (96-100%)	66% (53-78%)	7% (0-15%)	11% (6-16%)
≤55	85% (80-90%)	93% (89-96%)	98% (96-100%)	58% (46-70%	7% (0-15%)	15% (10-20%)
≤54	83% (79-88%)	93% (89-96%)	98% (96-100%)	56% (44-68%)	7% (0-15%)	17% (11-22%)
MoCA						
≤26	96% (94-99%)	54% (47-60%)	90% (86-94%)	76% (60-91%)	46% (31-62%)	4% (1-7%)
≤25	94% (91-97%)	59% (52-65%)	91% (87-95%)	71% (55-86%)	41% (26-57%)	6% (2-9%)
≤24	91% (87-95%)	68% (62-74%)	93% (89-97%)	64% (49-78%)	32% (17-46%)	9% (5-13%)
≤23 (optimal cut-off)	87% (82-91%)	80% (75-86%)	95% (92-98%)	58% (45-71%)	20% (7-32%)	13% (8-18%)
≤22	78% (73-84%)	85% (81%-90%)	96% (93-99%)	47% (36-59%)	15% (4-25%)	22% (16-28%)
≤21	68% (62-74%)	98% (96-100%)	99% (98-100%)	41% (31-51%)	2% (0-7%)	32% (25-39%)
≤20	61% (54-67%)	100%	100%	37% (28-46%)	0%	39% (32-46%)

Appendix 1

Table 3. Sensitivity, Specificity, Positive Predictive Value (PPV), and Negative Predictive Value (NPV), with 95% confidence intervals (CI), for different Quick Mild Cognitive Impairment (Qmci) screen and Montreal Cognitive Assessment (MoCA) cut-off scores for mild cognitive impairment, without adjustment for age or education, compared with normal controls.

Cognitive Screen Cut-off score	Sensitivity (95% CI)	Specificity (95% CI)	PPV (95% CI)	NPV (95% CI)	False Positive (95% CI)	False Negative (95% CI)
Q*mci*						
≤63	92% (87-97%)	66% (57-75%)	83% (74-91%)	82% (69-95%)	34% (20-49%)	8% (2-15%)
≤62	89% (83-95%)	71% (62-79%)	84% (76-92%)	78% (65-92%)	29% (15-43%)	11% (4-18%)
≤61	86% (80-92%)	78% (70-86%)	87% (80-95%)	76% (63-89%)	22% (9-35%)	14% (6-22%)
≤60 (optimal cut-off)	83% (76-90%)	80% (73-88%)	88% (81-96%)	73% (60-86%)	20% (7-32%)	17% (8%-25%)
≤59	82% (75-89%)	88% (82-94%)	92% (86-99%)	73% (61-86%)	12% (2-22%)	18% (9-27%)
≤58	82% (75-89%)	88% (82-94%)	92% (86-99%)	73% (61-86%)	12% (2-22%)	18% (9%-27%)
≤57	76% (69-84%)	93% (88-97%)	95% (89-100)	69% (57-81%)	7% (0-15%)	24% (14-33%)
MoCA						
≤26	90% (85-96%)	54% (44-63%)	77% (68-86%)	76% (60-91%)	46% (31-62%)	10% (3-17%)
≤25	86% (80-92%)	59% (49-68%)	78% (69-88%)	71% (55-86%)	41% (26-57%)	14% (6-22%)
≤24	81% (73-88%)	68% (60-77%)	82% (73-91%)	67% (52-81%)	32% (17-46%)	19% (10-29%)
≤23 (optimal cut-off)	72% (64-80%)	80% (73-88%)	87% (78-95%)	62% (49-75%)	20% (7-32%)	28% (17-38%)
≤22	56% (46-65%)	85% (79-92%)	87% (77-97%)	52% (40-64%)	15% (4-25%)	44% (33-56%)
≤21	38% (29-46%)	98% (95-100%)	96% (90-100)	47% (36-58%)	2% (0-7%)	63% (51-74%)
≤20	25% (17-33%)	100%	100%	43% (33-53%)	0%	75% (65-85%)

Table 4. Sensitivity, Specificity, Positive Predictive Value (PPV), and Negative Predictive Value (NPV), with 95% confidence intervals (CI), for different Quick Mild Cognitive Impairment (Qmci) screen and Montreal Cognitive Assessment (MoCA) cut-off scores for dementia, without adjustment for age or education, compared with normal controls.

Cognitive Screen Cut-off score	Sensitivity (95% CI)	Specificity (95% CI)	PPV (95% CI)	NPV (95% CI)	False Positive (95% CI)	False Negative (95% CI)
Q*mci*						
≤53	100%	95% (92-99%)	98% (96-100)	100%	5% (0-11%)	0%
≤52	100%	95% (92-99%)	98% (96-100)	100%	5% (0-11%)	0%
≤51	100%	95% (92-99%)	98% (96-100)	100%	5% (0-11%)	0%
≤50 (optimal cut-off)	95% (92-99%)	100%	100%	89% (80-98%)	0%	5% (1-9%)
≤49	95% (92-99%)	100%	100%	89% (80-98%)	0%	5% (1-9%)
≤48	94% (91-98%)	100%	100%	87% (78-97%)	0%	6% (1-10%)
≤47	92% (87-96%)	100%	100%	82% (71-93%)	0%	8% (3-13%)
MoCA						
≤25	100%	59% (51-66%)	87% (81-92%)	100%	41% (26-57%)	0%
≤24	98% (96-100%)	68% (61-76%)	89% (84-95%)	93% (84-100)	32% (17-46%)	2% (0-4%)
≤23	96% (93-99%)	80% (74-87%)	93% (88-98%)	89% (79-99%)	20% (7-32%)	4% (0%-7%)
≤22 (optimal cut-off)	94% (90-98%)	85% (80-91%)	94% (90-99%)	83% (72-95%)	15% (4-25%)	6% (2-11%)
≤21	88% (83-93%)	98% (95-100%)	99% (97-100)	75% (64-87%)	2% (0-7%)	12% (6-18%)
≤20	84% (79-90%)	100%	100%	71% (59-82%)	0%	16% (9-22%)
≤19	76% (69-83%)	100%	100%	61% (50-73%)	0%	24% (16-32%)