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RESEARCH ARTICLE

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Validation of a brief Multicultural Cognitive Examination (MCE) for evaluation of dementia

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Background: The aims of this study were to present the psychometric properties of a newly designed cognitive screening instrument, the Multicultural Cognitive Examination (MCE), and to compare it with the Rowland Universal Dementia Assessment Scale (RUDAS) in a multicultural population.

Methods: The study was a Western European cross-sectional multicenter study. The MCE consists of four components evaluating separate cognitive functions and was constructed by adding measures of memory, verbal fluency, and visuospatial function to the RUDAS to create a scale with 0 to 100 points.

Results: A total of 66 patients with dementia and 123 cognitively intact participants were included across six memory clinics; 96 had minority ethnic background, and 93 had majority ethnic background. Moderate to large differences were present between patients with dementia and control participants on all MCE components. The MCE significantly improved diagnostic accuracy compared with using the RUDAS alone, with area under the curves of .918, .984, and .991 for the RUDAS, MCE composite, and demographically corrected composite scores, respectively. Diagnostic accuracy of the MCE did not significantly differ between minority and majority ethnic groups. Across MCE subcomponents, patients with Alzheimer's disease (AD) dementia performed significantly poorer on the memory component compared with those with non-AD dementia.

Conclusions: The MCE is a brief cross-cultural cognitive screening instrument that expands evaluation of the cognitive functions covered by the RUDAS, does not require any specialized training, and may be useful for classification of mild dementia or dementia subtypes.

KEYWORDS

Cognitive assessment, ethnic groups, dementia, Alzheimer's disease, diagnostic accuracy, multicultural, RUDAS

1 | INTRODUCTION

Because of demographic aging, the number of people affected by age-related cognitive decline and dementia in Europe is expected to increase significantly over the coming decades.[1] This increase is suspected to be even more pronounced in the main Western European minority ethnic populations, mainly because of their aging profile and a higher prevalence of vascular and lifestyle risk factors.[2-4] Thus, the need

for brief cognitive screening instruments that are less affected by cultural, linguistic, and educational factors is increasing.

The commonly used Mini-Mental State Examination (MMSE)[5] will often be inappropriate for cross-cultural assessments because of cultural, linguistic, and educational test bias.[6,7] Consequently, a number of cross-cultural screening instruments and cognitive test batteries have been developed for dementia during the past years, with the Rowland Universal Dementia Assessment Scale (RUDAS)[8] being the most widely used and validated instrument. The RUDAS has the advantage of being validated in both multicultural populations in high-income countries as well as across several low- and middle-income countries without need to change any of the items,[9] and it is less biased by low education compared with the MMSE.[7] However, as the RUDAS is a very brief screening instrument, it may have certain limitations when it comes to detection of the early cognitive deficits in dementia disorders and to differentiating between dementia subtypes. Although more comprehensive neuropsychological batteries, such as the European Cross-Cultural Neuropsychological Test Battery (CNTB),[10,11] do not seem to suffer from these limitations, it requires specialized test materials and trained personnel to administer and is usually beyond the scope of routine cognitive evaluations.

On the basis of these limitations, we designed a new brief screening instrument for the detection and classification of dementia in multicultural populations based on our research with the CNTB.[10-12] The Multicultural Cognitive Examination (MCE) evaluates key aspects of cognition with minimal need for specialized test materials. It is a brief instrument that incorporates the RUDAS and expands assessment of memory, verbal fluency, and visuospatial function. The components of the MCE are part of the CNTB test protocol and have been administered to patients with dementia and cognitively intact participants across minority and majority ethnic groups in five West European countries. The aims of this study were to present the psychometric properties of the MCE, compare it with the RUDAS, and explore its ability to differentiate patients with Alzheimer's disease (AD) from patients with non-AD dementia in a multicultural population.

Key points

- The Multicultural Cognitive Examination (MCE) evaluates key aspects of cognition with minimal need for specialized test materials. It is a brief instrument that incorporates the Rowland Universal Dementia Assessment Scale (RUDAS) and expands assessment of memory, verbal fluency, and visuospatial function.
- The MCE can be applied across several languages and cultures and across a broad educational range, including no formal education. The MCE components are easily administered both with and without the help of an interpreter and have been applied in more than 20 languages without need to change the content.
- By expanding the evaluation of cognitive functions covered by the RUDAS, the MCE improves the diagnostic accuracy in cross-cultural evaluations of early or mild dementia and may particularly be a resource in settings where neuropsychological support is not readily available.
- The MCE seems easily implemented in most clinical settings and may help increase diagnostic accuracy in patients from ethnic minorities. However, further validation studies are necessary to establish the clinical utility of the MCE.

2 | MATERIALS AND METHODS

2.1 | The Multicultural Cognitive Examination

The MCE consists of four components evaluating separate cognitive functions. It was constructed by adding subtests from the CNTB that had previously been found to have the best discriminative properties,[11] while being least affected by ethnicity and education,[10] to the RUDAS to create a scale with 0 to 100 points. MCE components have the following weighing: general cognitive functioning, 30 points; memory, 30 points; verbal fluency, 28 points; and visuospatial function, 12 points. The MCE score sheet and test materials are available as Supporting Information.

2.1.1 | Rowland Universal Dementia Assessment Scale

The RUDAS[8] is a brief cognitive screening test that was developed for multicultural populations. It contains six items that assess body orientation, praxis, drawing, judgment, memory, and language. Like the MMSE, it has a range of 0 to 30 points and takes about 10 minutes to complete.

2.1.2 | Recall of Pictures Test

The Recall of Pictures Test (RPT)[13] is similar to a word list learning test, but instead of learning and recalling a word list, participants are required to learn and recall 10 pictures. Immediate recall is the mean score on three learning trials rounded to the nearest whole number; delayed recall is the number of pictures recalled after an interference interval; and recognition is the number of pictures recognized among 10 distracters subtracted by the number of false positive responses with a minimum score of 0. Each RPT measure has a range of 0 to 10 points.

2.1.3 | Supermarket fluency

In supermarket fluency,[14] participants are required to generate as many different “things you can buy in a supermarket” as possible within a 1-minute interval. The score is the number of different items produced in 1 minute with a maximum score of 28 points.

2.1.4 | Clock Reading Test

In the Clock Reading Test (CRT),[15] participants are required to read the time on a series of 12 clocks showing different times. The score range is 0 to 12 points.

Scores for each of the components, including the RUDAS, can be calculated separately or as the sum of scores leading to a composite score for the MCE. The MCE, including the RUDAS, can be administered in 25 to 30 minutes.

2.2 | Participants

Patients with dementia and cognitively intact control participants were included from the validation and normative studies for the CNTB.[10,11]

Newly referred patients with a clinical diagnosis of dementia with Moroccan, Pakistani, Polish, Turkish, or former Yugoslavian immigrant background as well as from majority populations were included across six multidisciplinary hospital-based memory clinics in Berlin, Germany; Brussels, Belgium; Copenhagen, Denmark; Malmö, Sweden; Oslo, Norway; and Thessaloniki, Greece, in the period February 2013 to January 2017. Diagnoses were based on an extensive diagnostic workup[11] using the Diagnostic and Statistical Manual of Mental Disorders—Text Revision (DSM-IV-TR) diagnostic criteria for dementia[16] and diagnostic research criteria for dementia subtypes.[17-20] The consensus diagnosis reached by a multidisciplinary team of senior clinicians was used as the reference standard.

The control sample was derived from a pool of 330 cognitively intact participants from the CNTB normative study[10] conducted from September 2009 to October 2016. In addition, five participants who were excluded from the normative study because of RUDAS scores less than 23 points were included in the present study. Participants were 50 years or older, living independently and free of any comorbid conditions that could interfere with neuropsychological testing, and were recruited from local districts through population registries, relatives to patients in memory clinics, senior centers, voluntary organizations, social networks of bilingual researchers, and advertisement in local newspapers. Cognitively intact participants were matched by education and age to patients with dementia by list-wise exclusion of those with higher education and younger age until significant differences between the groups were no longer present. From the pool of 335 cognitively intact participants, 123 were included as control participants in the present study.

2.3 | Procedures

All participants underwent an approximately 90-minute assessment, including a structured demographic and medical interview, the 15-item or the two-stage or 5/15-item Geriatric Depression Scale (GDS),[21,22] and the CNTB. All participants were assessed in their primary language using bilingual researchers or interpreters when necessary. Education was measured as years of formal education, and ethnicity was classified according to country of birth. The study was approved by the relevant ethics and data protection authorities at each site and adhered to the Declaration of Helsinki for research involving human subjects.

2.4 | Statistical analysis

The significance of differences on continuous variables was determined by Mann-Whitney *U* tests. Effect size was calculated as Pearson's *r*. Fisher exact test was used to test the significance of differences in the distribution of categorical variables. Spearman ρ was used to assess associations between continuous variables. Linear regression analysis was used to evaluate the effects of education, age, gender, ethnic group, and the use of an interpreter on the MCE in the control participants and to develop a demographic correction regression formula. A receiver operating characteristic curve (ROC) was applied to examine the area under the curve (AUC) and the sensitivity and specificity of the RUDAS and MCE using the diagnosis of dementia as provided by the multidisciplinary team as the reference standard. The method proposed by DeLong et al[23] was used to compare the ROC curves of the RUDAS and MCE.

Clinical research calculators from the VassarStats website were used to calculate the sensitivity, specificity, positive likelihood ratio (LR+), and negative likelihood ratio (LR−) with 95% confidence interval (CI) (www.vassarstats.net/clin1.html). All other analyses were performed with SPSS statistical software (version 19.0; SPSS Inc., Chicago, IL, USA). $P < .05$ (two-tailed) was considered significant.

3 | RESULTS

3.1 | Participant characteristics

Demographic and cognitive characteristics of the included participants are summarized in Table 1. There were no significant differences between patients with dementia and control participants in age, years of education, proportion of participants with no formal education, distribution of gender, or GDS score. However, significantly more patients with dementia had minority ethnic background (Fisher exact test, $P = .03$). Of the 66 patients with dementia, 35 were diagnosed with AD, four with vascular dementia (VaD), 18 with mixed AD/VaD, three with dementia with Lewy bodies (DLB)/Parkinson's disease dementia (PDD), three with frontotemporal dementia (FTD), two with normal pressure hydrocephalus (NPH), and one with dementia due to a combination of exposure to organic solvents, stroke, and anoxia. Among the 189 participants in the study, 96 had minority ethnic background: 51 originated from Turkey; 17 from former Yugoslavia; 16 from Poland; seven from Pakistan/India; and five from Morocco. Among the 93 majority ethnic participants, 40 were Belgian, 16 Danish, 14 German, 12 Norwegian, and 11 Swedish. Participants with minority ethnic background were significantly younger (72.8 ± 6.9 years vs 78.3 ± 5.7 years; $U = 2481$, $P < .001$) and had fewer years of education (5.2 ± 5.7 years vs 11.6 ± 4.1 years; $U = 1668$,

TABLE 1 Demographic and cognitive characteristics

Characteristic	Dementia, Mean (SD)	Control, Mean (SD)
n	66	123
Age, years	76.7 (6.8)	74.9 (6.9)
Gender, n (male/female)	33/33	49/74
Education, years	7.6 (5.8)	8.8 (5.9)
No formal education, n	13	26
Ethnicity, n (majority/minority)*	25/41	68/55
GDS	2.2 (3.4)	1.0 (1.6)
MCE (maximum points)		
RUDAS [24]**	19.7 (5.6)	27.1 (2.2)
RPT immediate recall [10]**	3.2 (1.8)	7.6 (1.3)
RPT delayed recall [10]**	1.6 (1.9)	7.9 (1.7)
RPT recognition [10]**	7.3 (3.5)	9.9 (0.3)
Supermarket fluency [25]**	8.8 (4.4)	18.8 (5.3)
CRT [12]**	7.7 (3.5)	10.8 (1.7)
MCE (composite score) (100)		
Uncorrected**	48.3 (15.0)	82.1 (8.0)
Corrected**	54.7 (14.6)	86.9 (7.0)

Abbreviations: CRT, Clock Reading Test; GDS, Geriatric Depression Scale; MCE, Multicultural Cognitive Examination; n, number; RPT, Recall of Pictures Test; RUDAS, Rowland Universal Dementia Assessment Scale; SD, standard deviation.

*$P < .05$.

**$P < .001$.

$P < .001$) compared with majority ethnic participants, but there were no significant differences in the distribution of genders.

Significant differences were present between control participants and patients with dementia on all MCE components with moderate (CRT, $r = .43$) to large effect sizes (RUDAS, RPT, supermarket fluency, $r = .65$-$.80$). The mean MCE composite score was 82.1 ± 8.0 in control participants and 48.3 ± 15.0 in patients with dementia ($U = 129$, $P < .001$, $r = .80$).

3.2 | Correlations

The MCE composite score was correlated with all subcomponents. Among the subcomponents, supermarket fluency was most highly correlated with the MCE composite score, $\rho(189) = .92$, $P < .001$, followed by the RUDAS, $\rho(189) = .88$, $P < .001$, RPT immediate recall, $\rho(189) = .78$, $P < .001$, RPT delayed recall, $\rho(189) = .78$, $P < .001$, RPT recognition, $\rho(189) = .68$, $P < .001$, and the CRT, which had the weakest, but still robust, correlation, $\rho(189) = .61$, $P < .001$.

3.3 | Impact of demographic variables

When the impact of age, education, gender, and ethnic group was evaluated with regression analyses in the control sample, education and age were related to the composite score, $F(2, 122) = 20.66$, $P < .001$, $R^2 = .26$), whereas gender and ethnic group were not. The unique variance accounted for was 20% for education and 6% for age. The demographic correction regression formula was as follows: raw score − .792 × education + .324 × age. Mean demographically corrected MCE scores were 86.9 ± 7.0 in control participants and 54.7 ± 14.6 in patients with dementia ($U = 76$, $P < .001$, $r = .81$). A total of 36 control participants were assessed with the help of an interpreter. Adding the use of an interpreter to the regression analyses did not significantly impact on the MCE composite score.

3.4 | Diagnostic accuracy

ROC curve analysis revealed that both the RUDAS and MCE were highly accurate in differentiating patients with dementia from cognitively intact control participants. AUCs are illustrated in Figure 1, and AUC values, cutoff scores, sensitivity, specificity, and likelihood ratios are presented in Table 2. Both the MCE composite ($z = 3.97$, $P < .001$) and demographically corrected composite scores ($z = 4.03$, $P < .001$) were better than the RUDAS in their ability to differentiate patients with dementia from control participants, whereas there were no significant differences between the MCE composite and demographically corrected composite scores. Fourteen patients with dementia had scores above the cutoff for cognitive impairment on the RUDAS. Among these, 10 were correctly classified as cognitively impaired by the MCE composite score and 12 by the demographically corrected MCE composite score.

Overall, diagnostic accuracy of the MCE did not significantly differ between minority and majority ethnic groups with AUCs for the MCE composite and demographically corrected composite of .99 (95% CI, .98-1.00) and 1.00 (95% CI, .99-1.00), and .98 (95% CI, .95-1.00) and .99 (95% CI, .97-1.00) in the minority and majority groups, respectively.

3.5 | Differentiation of AD dementia from non-AD dementia

Of the 66 patients, 35 were diagnosed with AD and 13 with non-AD dementia (four VaD, three DLB/PDD, three FTD, two NPH, and one with dementia due to a combination of exposure to organic solvents, stroke, and anoxia). Comparison of the AD and non-AD dementia subgroups on the different components of the MCE revealed significantly poorer performance of AD patients on RPT immediate ($U = 327$, $P = .02$, $r = .34$) and delayed recall ($U = 322$, $P < .02$, $r = .34$) and a trend for poorer performance on RPT recognition ($U = 305$, $P < .07$, $r = .27$) (Table 3).

4 | DISCUSSION

As the minority ethnic populations with neurocognitive disorders are expected to increase considerably in Europe during the coming decades (Nielsen et al[2]), it is important to improve diagnostic rate, diagnostic accuracy, and appropriate follow-up for these patient

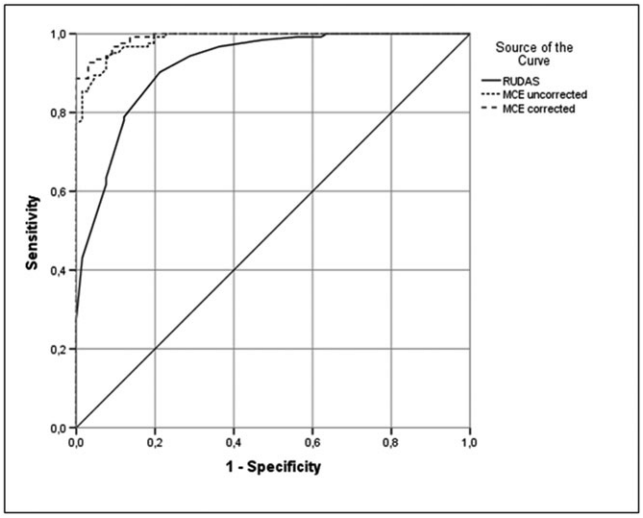

FIGURE 1 Receiver operating characteristic (ROC) curves for the RUDAS and MCE for detecting dementia (n = 189). Abbreviations: RUDAS, Rowland Universal Dementia Assessment Scale; MCE, Multicultural Cognitive Examination

TABLE 2 Diagnostic accuracy of the RUDAS and MCE for dementia

Parameter	RUDAS (95% CI)	MCE Uncorrected (95% CI)	MCE Corrected (95% CI)
AUC	.92 (.88-96)	.98* (.97-1.00)	.99* (.98-1.00)
Cutoff	<25	<70	<78
Sensitivity	.79 (.67-.88)	.92 (.82-.97)	.97 (.89-.99)
Specificity	.90 (.83-.95)	.93 (.87-.97)	.89 (.81-.93)
LR+	8.08 (4.65-14.02)	14.21 (7.25-27.87)	8.52 (5.19-13.98)
LR−	.24 (.15-.37)	.05 (.03-.19)	.03 (.01-.13)

Abbreviations: AUC, area under the curve; LR+, positive likelihood ratio; LR −, negative likelihood ratio; MCE, Multicultural Cognitive Examination; RUDAS, Rowland Universal Dementia Assessment Scale.

*P < .001 compared with the RUDAS.

groups to ensure them proper treatment for their specific dementia disorders and reduce ethnic inequalities in dementia care. In this study, a brief instrument for the detection and classification of dementia in multicultural populations was designed and validated in minority and majority ethnic populations in Western Europe. By expanding the evaluation of cognitive functions covered by the RUDAS, the MCE improves the diagnostic accuracy in cross-cultural evaluations of early or mild dementia and may particularly be a resource in settings where neuropsychological support is not readily available. The major difference between the RUDAS and the MCE is the expanded evaluation of memory, verbal fluency, and visuospatial function. The memory component of the MCE was greatly expanded by adding the RPT because of the importance of episodic memory impairment in early detection of AD.[26] Learning and recall of pictures has previously been shown to be unaffected by education, including illiteracy, across a

TABLE 3 Comparison of mean scores on MCE subcomponents for patients with AD and non-AD dementia

Component	AD, Mean (SD) (n=35)	Non-AD, Mean (SD) (n=13)
RUDAS	20.1 (5.8)	20.7 (4.8)
RPT immediate recall*	3.0 (1.9)	4.4 (1.0)
RPT delayed recall*	1.4 (2.0)	2.9 (2.0)
RPT recognition**	6.8 (3.3)	8.5 (2.3)
Supermarket fluency	9.4 (4.0)	9.1 (5.4)
CRT	8.3 (3.2)	7.6 (2.5)

Abbreviations: AD, Alzheimer's disease; CRT, Clock Reading Test; n, number; RPT, Recall of Pictures Test; RUDAS, Rowland Universal Dementia Assessment Scale; SD, standard deviation.

*P < .05.

**P = .07.

variety of cultural groups while remaining sensitive to memory impairment in AD and other dementia disorders.[11,12,27-29] The MCE also includes a measure of verbal fluency. A category-based fluency task using supermarket items was chosen as this category has good ecological validity across cultural, educational, and literacy groups and is less biased by these factors compared with the commonly used animal category included in the RUDAS.[10,24,25,30] As category fluency taps into several cognitive functions, including executive function, language, and semantic memory, performance is affected across several dementia disorders. Inclusion of a phonetic fluency task may have improved the ability of the MCE to differentiate between dementia subtypes because of its higher specificity to executive dysfunction seen in disorders such as FTD. However, this task is not easily applied across languages (eg, non-alphabetical languages) and is extremely difficult for people with low education.[31,32] The CRT was added to further evaluate visuospatial function. In contrast to commonly used tests of visuospatial function, including clock drawing and figure copying tests, the CRT does not require visuoconstructional abilities and is considerable less biased by low education and illiteracy.[10,12]

Although more advanced methods could have been used for tabulating the MCE score, the high intercorrelation between MCE components makes unweighted summation of components a valid and straightforward method,[33] which is supported by the fact that this procedure resulted in MCE composite scores that differentiated between control participants and patients with dementia with high accuracy.

In this study, the MCE composite score was unaffected by ethnic background and gender, while education and to a lesser extent age affected performances. Correcting for these factors by applying a regression equation generally elevated MCE scores in both patients with dementia and control participants but only slightly improved the psychometric properties of the MCE. This supports the previous findings of limited influence of cultural, linguistic, and educational factors on the diagnostic properties on the MCE subcomponents.[11] Although the RUDAS was highly accurate in differentiating patients with dementia from control participants in this study, the MCE

performed significantly better. Importantly, among 14 patients classified as cognitively intact by the RUDAS, 10 and 12 were correctly classified as impaired by the MCE composite and demographically corrected composite score, respectively. Differences in diagnostic properties of the MCE composite and demographically corrected MCE composite scores were minimal, and in clinical practice, using the uncorrected composite score seems to be the most straightforward scoring method.

A distinction is often made between AD dementia with primary pathology in the medial temporal lobe and non-AD dementia due to diseases involving greater degree of pathology in other cortical and subcortical areas, including FTD, DLB, and VaD.[26] When comparing relatively small subgroups of patients with AD and non-AD dementia, no differences were present in RUDAS performances, while significant differences were found on supplemental components of the MCE. Specifically, patients with AD dementia performed poorer than those with non-AD dementia on RPT immediate and delayed recall, and there was a trend for poorer performance on RPT recognition, consistent with the known neuropsychological profile of AD. This finding supports the clinical utility of the MCE as it not only improves diagnostic accuracy for dementia in general but may also be able to help identifying profiles of cognitive impairment that differentiate AD from non-AD dementia. However, this needs replication in larger and better characterized samples.

This study has some limitations, which should be taken into consideration. Although clinical diagnosis represents a well-established gold standard, it has limited diagnostic validity compared with postmortem neuropathology,[34] and there is the possibility of some misclassification of patients with dementia. Especially in the case of patients from ethnic minorities, this may be a limitation as there is no gold standard for cross-cultural dementia diagnostics.[35,36] The RUDAS was a principal part of the standard diagnostic assessment of patients from ethnic minorities in some of the participating memory clinics, which may have led to an overestimation of the psychometric properties of the RUDAS by circular evidence. However, diagnoses were based on a comprehensive assessment and the consensus of a multidisciplinary team of senior clinicians. Also, the distribution of participants with majority and minority background differed between the patient and control groups. This was mainly due to the specific focus on inclusion of patients with dementia from ethnic minorities as well as our efforts to match patients and control participants. Many cognitively intact participants with minority ethnic background from the normative study had to be excluded because of young age. Another limitation was the small groups used to compare performances of AD and non-AD dementia and the heterogeneity of etiologies in the non-AD group. Considering this, the results on differentiating AD from non-AD dementia must be regarded as preliminary.

The need for brief cognitive screening instruments that are less affected by cultural, linguistic, and educational factors, easy to administer, and sensitive to early cognitive deficits in dementia disorders is increasing because of an increasing number of elderly with diverse cultural and linguistic backgrounds being referred for evaluation of possible dementia.[36] Conventional cognitive screening instruments are generally biased by these factors, which increase the risk of misdiagnosis.[37-40] With the increasing opportunities for early interventions, early and accurate diagnosis is becoming increasingly important as failure to identify cognitive deficits may delay the diagnosis and the opportunity for therapeutic intervention as well as psychosocial support, whereas misdiagnoses may unduly cause emotional distress on patients and family members, lead to unnecessary treatments, and potentially result in increased health-care burden and costs.[41]

The MCE is a brief test that does not require any specialized training and may be particularly useful for classification of mild dementia or dementia subtypes when neuropsychological support is not readily available. A strong advantage of the MCE is that it can be applied across several languages and cultures and across a broad educational range, including no formal education. The MCE components are easy to administer both with and without the help of an interpreter and have been applied in more than 20 languages without need to change the content. Demographic correction of the MCE composite score slightly increased diagnostic accuracy, but use of the uncorrected composite score seems to be the most straightforward scoring method for clinical practice. Test materials are freely available and consist of a two-page scoring sheet as well as a three-page booklet with stimulus materials that can be produced in a standard color printer.* Although the MCE requires more time to complete compared with using the RUDAS alone, it rarely adds more than 15 to 20 minutes to the total administration time. The MCE seems easily implemented in most clinical settings and may help increase diagnostic accuracy in patients from ethnic minorities to ensure them proper treatment and reduce ethnic inequalities in dementia care. However, further validation studies are necessary to establish the clinical utility of the MCE, preferably in larger patient groups including a variety of well-characterized dementia disorders as well as depressive disorders.

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CONFLICT OF INTEREST

The authors report no conflicts of interest.

*MCE test materials and score sheets are freely available by contacting the main author. Free access to RUDAS materials is available online.

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REFERENCES

1. Prince M, Bryce R, Albanese E, Wimo A, Ribeiro W, Ferri CP. The global prevalence of dementia: a systematic review and metaanalysis. *Alzheimers Dement*. 2013;9(1):63-75.
2. Nielsen TR, Antelius E, Spilker RS, et al. Dementia care for people from ethnic minorities: a Nordic perspective. *Int J Geriatr Psychiatry*. 2015;30(2):217-218.
3. Livingston G, Leavey G, Kitchen G, Manela M, Sembhi S, Katona C. Mental health of migrant elders—the Islington study. *Br J Psychiatry*. 2001;179:361-366.
4. Adelman S, Blanchard M, Livingston G. A systematic review of the prevalence and covariates of dementia or relative cognitive impairment in the older African-Caribbean population in Britain. *Int J Geriatr Psychiatry*. 2009;24(7):657-665.
5. Folstein MF, Folstein SE, McHugh PR. "Mini-mental state". A practical method for grading the cognitive state of patients for the clinician. *J Psychiatr Res*. 1975;12(3):189-198.
6. Tombaugh TN, McIntyre NJ. The mini-mental state examination: a comprehensive review. *J Am Geriatr Soc*. 1992;40(9):922-935.
7. Nielsen TR, Vogel A, Gade A, Waldemar G. Cognitive testing in non-demented Turkish immigrants—comparison of the RUDAS and the MMSE. *Scand J Psychol*. 2012;53(6):455-460.
8. Storey JE, Rowland JT, Basic D, Conforti DA, Dickson HG. The Rowland Universal Dementia Assessment Scale (RUDAS): a multicultural cognitive assessment scale. *Int Psychogeriatr*. 2004;16(1):13-31.
9. Naqvi RM, Haider S, Tomlinson G, Alibhai S. Cognitive assessments in multicultural populations using the Rowland Universal Dementia Assessment Scale: a systematic review and meta-analysis. *CMAJ*. 2015;187(5):E169-E175.
10. Nielsen TR, Segers K, Vanderaspoilden V, et al. Performance of middle-aged and elderly European minority and majority populations on a Cross-Cultural Neuropsychological Test Battery (CNTB). *Clin Neuropsychol*. 2018;1-20.
11. Nielsen TR, Segers K, Vanderaspoilden V, et al. Validation of a European Cross-Cultural Neuropsychological Test Battery (CNTB) for evaluation of dementia. *Int J Geriatr Psychiatry*. 2019;34(1):144-153.
12. Nielsen TR. Effects of illiteracy on the European Cross-Cultural Neuropsychological Test Battery (CNTB). *Arch Clin Neuropsychol*. 2018; https://doi.org/10.1093/arclin/acy076 [Epub ahead of print;13.
13. Nielsen TR, Vogel A, Waldemar G. Comparison of performance on three neuropsychological tests in healthy Turkish immigrants and Danish elderly. *Int Psychogeriatr*. 2012;24(9):1515-1521.
14. Strauss E, Sherman EMS, Spreen O. *A Compendium of Neuropsychological Tests. Administration, Norms, and Commentary*. 3rd ed. New York: Oxford University Press; 2006.
15. Schmidtke K, Olbrich S. The Clock Reading Test: validation of an instrument for the diagnosis of dementia and disorders of visuo-spatial cognition. *Int Psychogeriatr*. 2007;19(2):307-321.
16. Association AP. *Diagnostic and Statistical Manual of Mental Disorders. Fourth Edition, Text Revision ed. Washington DC: American Psychiatric Association*; 2000.
17. Roman GC, Tatemichi TK, Erkinjuntti T, et al. Vascular dementia: diagnostic criteria for research studies. Report of the NINDS-AIREN International Workshop. *Neurol*. 1993;43(2):250-260.
18. Dubois B, Feldman HH, Jacova C, et al. Research criteria for the diagnosis of Alzheimer's disease: revising the NINCDS-ADRDA criteria. *Lancet Neurol*. 2007;6(8):734-746.
19. McKhann GM, Albert MS, Grossman M, Miller B, Dickson D, Trojanowski JQ. Clinical and pathological diagnosis of frontotemporal dementia: report of the Work Group on Frontotemporal Dementia and Pick's Disease. *Arch Neurol*. 2001;58(11):1803-1809.
20. McKeith IG, Galasko D, Kosaka K, et al. Consensus guidelines for the clinical and pathologic diagnosis of dementia with Lewy bodies (DLB): report of the consortium on DLB international workshop. *Neurol*. 1996;47(5):1113-1124.
21. Weeks SK, Kenney S, Paul EM, Teresa KM, Brenda WJHP. Comparing various short-form Geriatric Depression Scales leads to the GDS-5/15. *J Nurs Scholarsh*. 2003;35(2):133-137.
22. Yesavage JA, Rose T, Lum O, Huang V, Adey M, Leirer V. Development and validation of a geriatric depression screening scale: a preliminary report. *J Psychiatr Res*. 1983;17:37-49.
23. DeLong ER, DeLong DM, Clarke-Pearson DL. Comparing the areas under two or more correlated receiver operating characteristic curves: a nonparametric approach. *Biometrics*. 1988;44(3):837-845.
24. da Silva CG, Petersson KM, Faisca L, Ingvar M, Reis A. The effects of literacy and education on the quantitative and qualitative aspects of semantic verbal fluency. *J Clin Exp Neuropsychol*. 2004;26(2):266-277.
25. Stokholm J, Jorgensen K, Vogel A. Performances on five verbal fluency tests in a healthy, elderly Danish sample. *Neuropsychol Dev Cogn B Aging Neuropsychol Cogn*. 2013;20(1):22-33.
26. Salmon DP, Bondi MW. Neuropsychological assessment of dementia. *Annu Rev Psychol*. 2009;60:257-282.
27. Nitrini R, Caramelli P, Herrera JE, et al. Performance of illiterate and literate nondemented elderly subjects in two tests of long-term memory. *J Int Neuropsychol Soc*. 2004;10(4):634-638.
28. Kempler D, Teng EL, Taussig M, Dick MB. The common objects memory test (COMT): a simple test with cross-cultural applicability. *J Int Neuropsychol Soc*. 2010;16(3):537-545.
29. Takada LT, Caramelli P, Fichman HC, et al. Comparison between two tests of delayed recall for the diagnosis of dementia. *Arq Neuropsiquiatr*. 2006;64(1):35-40.
30. Nielsen TR, Waldemar G. Effects of literacy on semantic verbal fluency in an immigrant population. *Neuropsychol Dev Cogn B Aging Neuropsychol Cogn*. 2016;23(5):578-590.
31. Ardila A. Cultural values underlying psychometric cognitive testing. *Neuropsychol Rev*. 2005;15(4):185-195.
32. Ardila A, Bertolucci PH, Braga LW, et al. Illiteracy: the neuropsychology of cognition without reading. *Arch Clin Neuropsychol*. 2010;25(8):689-712.
33. Chandler MJ, Lacritz LH, Hynan LS, et al. A total score for the CERAD neuropsychological battery. *Neurol*. 2005;65(1):102-106.
34. Wollman DE, Prohovnik I. Sensitivity and specificity of neuroimaging for the diagnosis of Alzheimer's disease. *Dialogues Clin Neurosci*. 2003;5(1):89-99.
35. Prince M. Methodological issues for population-based research into dementia in developing countries. A position paper from the 10/66 Dementia Research Group. *Int J Geriatr Psychiatry*. 2000;15(1):21-30.
36. Nielsen TR, Vogel A, Riepe MW, et al. Assessment of dementia in ethnic minority patients in Europe: a European Alzheimer's Disease Consortium survey. *Int Psychogeriatr*. 2011;23(1):86-95.

37. Nielsen T, Vogel A, Phung T, Gade A, Waldemar G. Over- and under-diagnosis of dementia in ethnic minorities: a nationwide register-based study. *Int J Geriatr Psychiatry*. 2010.
38. Parker C, Philp I. Screening for cognitive impairment among older people in black and minority ethnic groups. *Age Ageing*. 2004;33(5):447-452.
39. Lindesay J. Diagnosis of mental illness in elderly people from ethnic minorities. *Advances in Psychiatric Treatment*. 1998;4(4):219-229.
40. Nielsen TR, Andersen BB, Kastrup M, Phung TK, Waldemar G. Quality of dementia diagnostic evaluation for ethnic minority patients: a nationwide study. *Dement Geriatr Cogn Disord*. 2011;31(5):388-396.
41. Pedraza O, Mungas D. Measurement in cross-cultural neuropsychology. *Neuropsychol Rev*. 2008;18(3):184-193.

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