Simplifying Detection of Cognitive Impairment: Comparison of the Mini-Cog and Mini-Mental State Examination in a Multiethnic Sample

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OBJECTIVES: To compare detection of cognitive impairment using the Mini-Cog and Mini-Mental State Examination (MMSE) and to identify sociodemographic variables that influence detection in an ethnoculturally diverse sample.

DESIGN: Cross-sectional.

SETTING: A registry of the University of Washington Alzheimer's Disease Research Center Satellite.

PARTICIPANTS: A heterogeneous community sample (n = 371) of predominantly ethnic minority elderly assessed using a standardized research protocol, 231 of whom met criteria for dementia or mild cognitive impairment (MCI).

MEASUREMENTS: Demographic data, a standardized research protocol for cognitive assessment and dementia diagnosis, MMSE, and Mini-Cog.

RESULTS: Both screens effectively detected cognitive impairment, the Mini-Cog slightly better than the MMSE ($P < .01$). Overall accuracy of classification was 83% for the Mini-Cog and 81% for the MMSE. The Mini-Cog was superior in recognizing patients with Alzheimer-type dementias ($P = .05$). Low education negatively affected detection using the MMSE ($P < .001$), whereas education did not affect the Mini-Cog, and low literacy minimally affected it.

CONCLUSION: The Mini-Cog detects clinically significant cognitive impairment as well as or better than the MMSE in multiethnic elderly individuals, is easier to administer to non-English speakers, and is less biased by low education and literacy. **J Am Geriatr Soc 53:871–874, 2005.**

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Supported by grants from the National Institute on Aging (AG-05136, University of Washington Alzheimer Disease Research Center, Satellite Core) and the Health Resources and Services Administration Alzheimer's Disease Respite Project.

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DOI: 10.1111/j.1532-5415.2005.53269.x

Key words: dementia screening; ethnic minority; mild cognitive impairment

The value of detecting dementia in older adults is widely accepted, but physicians cite time constraints and uncertainty about which patients to screen among reasons for avoiding it, some reporting that current screening methods such as the Mini-Mental State Examination (MMSE) are too long[1] or do not improve their ability to detect dementia.[1,2] To address these problems, the Mini-Cog, a 3-minute cognitive screen designed for primary care use, was developed.[3–5] The Mini-Cog was developed in a purposively ethnolinguistically diverse sample[3] and validated in a population-based mainstream sample of older adults[5] and performed as well as or better than the MMSE with less confounding by education effects.[3,6–12] The present study extends previous work on dementia detection in multiethnic elderly subjects, comparing the Mini-Cog and the MMSE as screening tools for cognitive impairment of varying severity and differing etiologies in a larger community sample.

METHODS

Subjects and Assessments

Participants were 371 elderly community residents enrolled in the University of Washington Alzheimer Disease Research Center Satellite registry after community-based screening or referral by social service agencies, word of mouth, print advertisements in ethnic newspapers, and enrolled study participants. The sample was developed, between 1992 and 2002, to overrepresent members of underserved ethnic minority groups and individuals with cognitive impairment. Asian Americans constituted 48% of the sample, African Americans 22%, Hispanic 17%, white non-Hispanic 7%, and Native American/other 6%. Other demographic data included age, sex, primary spoken language, years of education, and informant assessed literacy

0002-8614/05/$15.00

(literate (had regularly used reading and writing skills), semiliterate (had been able to read/write well enough for simple transactions), and illiterate (never learned to read or write)).

All subjects completed a clinical research assessment adapted from the Consortium to Establish a Registry for Alzheimer's Disease (CERAD) protocols,[13] including a semistructured informant interview describing subjects' cognitive history, Clinical Dementia Rating,[14] and a detailed medical history and examination, to which the 16-item Informant Questionnaire on Cognitive Decline in the Elderly[15] and Lawton-Brody basic and independent activity of daily living scales[16] were added. Subjects were classified into three groups (dementia unlikely, impairment possible or very mild, and dementia likely) by a consensus process that excluded results of formal cognitive testing to avoid confounding. Based on this initial classification, cognitive impairment was judged to be present in 62% of the total group (n = 231). This proportion is, as expected by the recruitment design, much higher than would be found in a population-based sample of elderly persons.

The direct cognitive assessment used in this study was the Cognitive Abilities Screening Instrument (CASI), a cognitive minibattery validated in cross-ethnic studies,[17,18] from which MMSE scores were computed using a standardized algorithm provided by its author. Because this CASI-derived MMSE correlated highly (correlation coefficient = 0.99) with traditional MMSE scores in a subset of 75 subjects, all the MMSE scores reported here are CASI-derived. The CERAD neuropsychological battery was not used, because it had not been validated for use in multilingual, multiethnic populations with widely varying levels of education.

The CASI-derived MMSE was compared with the Mini-Cog against clinical diagnoses. The Mini-Cog combines a three-item word-learning and recall task (0–3 points; each correctly recalled word = 1 point), with a simple clock drawing task (abnormal clock = 0 points; normal clock = 2 points) used as a distraction task before word recall. Mini-Cog total possible scores range from 0 to 5, with 0 to 2 suggesting high and 3 to 5 suggesting low likelihood of cognitive impairment. Interrater reliability of the Mini-Cog averaged greater than 95% in this research group and 93% with an independent research group (unpublished data). In the initial validation study[3] conducted in a defined multiethnic sample containing 50% demented and 50% nondemented subjects (excluding mild cognitive impairment (MCI); subjects in the development sample represent about half of those included here), the Mini-Cog correctly classified 96% of subjects, the CASI 94%, and the MMSE 92%. In a population-based, better-educated (all > 6 years), mainly Caucasian sample of which 6.4% were demented,[5] its sensitivity and specificity for dementia were 76% and 89%, respectively, comparable with the MMSE and a much longer validated neuropsychological battery.

After all data were collated, subjects were given provisional etiological diagnoses using the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition,[19] and National Institute of Neurological and Communicative Disorders and Stroke/Alzheimer's Disease and Related Disorders Association[20] criteria for AD, research criteria for vascular dementia,[21] and published criteria for mixed,[22] Lewy body,[23,24] and frontotemporal[25] dementias. MCI, regardless of suspected etiology, was designated by Clinical Dementia Rating (CDR) of 0.5, because neuropsychological classifications of MCI depend on tests that are influenced by education and are not validated for multiethnic populations.[26] Post hoc analyses supported this approach; mean CASI scores in the MCI group were intermediate between those of normal and demented groups and just below the usual screening cutpoint (80/100).

One hundred forty subjects were classified as cognitively unimpaired. Seventy-seven had a CDR of 0.5, of which 71 were judged minimally or unimpaired in everyday function ("true" MCI) and six were judged as having very mild AD. One hundred fifty-four were classified as demented (CDR = 1.0). Average ages for normal subjects and those with MCI and dementia were 73, 74, and 78, respectively (demented older, $P < .01$). Average years of education were 11.5, 10.4, and 8.5, respectively (demented less than normal and MCI, $P < .01$). Groups did not differ in sex (69% women) or proportion of non-English speakers (64%). CDR stages and MMSE and CASI scores all showed appropriate mean differences between controls and subjects with MCI and dementia (CDR = 0.0, 0.5, 1.7; MMSE = 26.3, 23.3, 14.9; CASI = 88, 75, and 49, respectively; all groups differ at $P < .01$). Using its total scale score of 0 to 5, mean Mini-Cog scores were 3.9 ± 1.2 for CDR of 0, 2.5 ± 1.4 for CDR of 0.5, 1.2 ± 1.2 for CDR of 1.0, 0.22 ± 0.6 for CDR of 2.0, and 0 ± 0 for CDR of 3 or higher. The stage-specific means for the MMSE were 26.3 ± 2.7, 23.1 ± 3.3, 19.2 ± 4.4, 12.8 ± 4.1, and 7.0 ± 3.8, respectively.

Data Analysis

Analyses were designed to compare the two screening tests in detecting cognitive impairment overall, by severity and cognitive diagnosis, and in the presence of demographic confounders. The McNemar statistic was used to examine differences between cognitive screens in correctly classifying cognitively impaired subjects over all subjects, within each stage, and within clinical dementia types. To maximize statistical power and stability in analyzing demographic confounders, only groups representing more than 10% of the sample were tested for effects of ethnicity. Demographic variables examined were age, sex, language: English versus non-English, ethnicity (African-American, Asian-American, Hispanic), education (high: > 9 years, low: < 8 years), and literacy (literate: 76%, semi- and illiterate: 24%). All variables were tested as predictors in bivariate and regression analyses.

RESULTS

Overall Accuracy

The MMSE, with the conventional cutpoint of 23, detected impairment at a rate slightly lower than the Mini-Cog using its published algorithm.[3] The Mini-Cog and the MMSE both identified 77% of cognitively impaired subjects (CDR = 0.5 to ≥3), Mini-Cog identified 7% not detected by MMSE, MMSE identified 4% not detected by Mini-Cog, and both screens missed 12%. False-positive rates in subjects clinically judged to be cognitively normal did not differ

(Mini-Cog 17%, MMSE 16%). When the two screens competed directly in a stepwise logistic regression predicting cognitive impairment across all subjects (CDR = 0 vs CDR = 0.5 to ≥3), the Mini-Cog entered into the equation first, followed by the MMSE (Mini-Cog Wald chi-square (χ^2) = 44.0, $P < .001$, MMSE $\chi^2 = 35.3$, $P < .001$; Mini-Cog > MMSE, $P < .01$).

The overall accuracy of the Mini-Cog and MMSE in classifying subjects as cognitively impaired or normal, represented by the formula (true positives+true negatives/true positives+true negatives+false positives+false negatives) was 83% and 81%, respectively.

Predictors of Detection

Dementia Severity

Figure 1 displays the proportion of subjects correctly classified by the Mini-Cog and MMSE within each CDR stage. There was no significant difference between the screens at any individual stage.

Dementia Subtype

Table 1 shows the relative performance of the Mini-Cog and the MMSE in detecting cognitive impairment of different etiologies. The Mini-Cog detected probable AD slightly more accurately (99%) than the MMSE (95%), which missed five mildly demented subjects detected by the Mini-Cog. The MMSE was in no case significantly more sensitive.

Demographic Factors: Multivariate Analyses

The relative influence of demographic confounders on classification of subjects using the two cognitive screens was examined, using Mini-Cog and MMSE classifications as dependent outcomes in logistic regressions and dementia severity (CDR scores), dementia etiology (AD vs other types), and sociodemographic confounders as predictors. Binary scores were used to indicate cognitive classification using the Mini-Cog algorithm[3] and the conventional MMSE cutoff (>23 coded as 0—unimpaired, ≤23 coded as 1—impaired). The final predictive equation for Mini-Cog classification included CDR stage ($\chi^2 = 8.7$, $P < .001$), etiology (AD vs other dementias, $\chi^2 = 5.0$, $P < .02$), and literacy (semi- and nonliterate vs literate, $\chi^2 = 5.2$, $P < .05$). The final predictive equation for MMSE classification included CDR stage ($\chi^2 = 22.7$, $P < .001$) and education (low vs high, $\chi^2 = 11.9$, $P < .001$). Literacy would have been a significant predictor of MMSE classification ($P < .005$) had education not been included in the equation but was eliminated in stepwise regressions, probably because of shared variance (correlation coefficient = 0.5).

Close examination of the influence of education and literacy on detection of cognitive impairment using the Mini-Cog and MMSE revealed differences that may have practical consequences. For example, education effects on the Mini-Cog classification were not found in this sample, and literacy effects were weak; the Mini-Cog properly identified 92% of non- and semiliterate subjects with cognitive impairment, with a false-positive rate of 27% in the low-literacy group. In contrast, the MMSE had a false-positive rate of 64% of the non- and semiliterate group and 46% of poorly educated subjects.

Table 1. Detection of Specific Cognitive Disorders Using Mini-Cog and Mini-Mental State Examination (MMSE)

Diagnosis	n (% of total)	Detection Rate, n (%)	
		Mini-Cog	MMSE
Dementia			
Probable AD	112 (47)	111 (99)	106 (95)*
AD plus vascular dementia	22 (10)	20 (91)	20 (91)
Vascular dementia	15 (6)	15 (100)	14 (93)
Other dementia	11 (6)	9 (82)	11 (100)
Mild cognitive impairment	71 (32)	39 (55)	36 (51)
Total	231	194 (84)	187 (81)

* MMSE significantly less sensitive to probable Alzheimer's disease (AD) than Mini-Cog ($P = .05$).

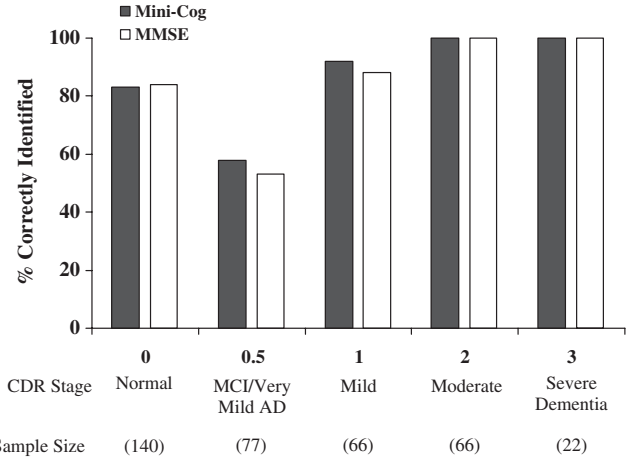

Figure 1. Classification of impairment using the Mini-Cog versus the Mini-Mental State Examination (MMSE) (all subjects). CDR = Clinical Dementia Rating; MCI = mild cognitive impairment; AD = Alzheimer's disease.

DISCUSSION

This study confirms the findings of a previous population-based study comparing the Mini-Cog with the MMSE[5] and extends initial developmental work with the Mini-Cog to a larger and ethnoculturally and diagnostically more diverse multiethnic sample. In this, as in the earlier studies, the Mini-Cog met or exceeded the performance of the MMSE in accuracy of screening for cognitive impairment but required much less time and effort. This study may have particular implications for multicultural older populations, because the Mini-Cog avoids some of the MMSE's susceptibility to bias by demographic variations and produces considerably fewer false-positives in the least-advantaged subjects. It should be noted that the CASI-derived MMSE version used here may underestimate true MMSE bias, because the CASI, explicitly designed for cross-cultural studies, excludes some traditional MMSE items (e.g., name the county) that are less likely to be known by non-English speakers.

Limitations of this study include nonrandom and nonrepresentative sampling. The performance of screens in this sample will be better than expected in epidemiological surveys of representative samples owing to much higher prevalence of dementia and may not reflect typical performance in randomly sampled populations. Ethnic minorities (especially Asian Americans) were greatly overrepresented relative to their proportions in the Pacific northwest, as were individuals with dementia, and white non-Hispanics were greatly underrepresented. However, concern about the effect of ethnocultural selection bias is mitigated by a previous demonstration of comparable performance of the Mini-Cog and the MMSE in a representative sample of mainstream Caucasian elderly.[5]

Other limits to generalizability include possible differences in cognitive performance of subjects in this sample, measured using the CASI and MMSE, in comparison with the more highly educated and literate subjects who are typically the subjects of research. For instance, subjects with MCI in this sample had a mean MMSE score of 23; this is attributable to the fact that this group included some illiterate individuals and some with 0 to 4 years of education, whose lower scores, despite similarly nondemented functional status, will lower the mean.

This study addresses the utility of a brief and simple tool to accurately detect cognitive impairment in a diverse sample of older patients. Clinicians should consider sociodemographic factors that will influence a patient's performance to avoid incorrectly classifying normal individuals as cognitively impaired. This study does not address the controversy over whether routine cognitive screening is good geriatric healthcare policy,[27] but it strengthens the argument that screening can be simple and reasonably accurate even in populations in whom identification of cognitive impairment is problematic. Future investigations should determine whether incorporating the Mini-Cog into primary care practice improves the accuracy, timeliness, and outcome of dementia detection.

ACKNOWLEDGMENTS

J. Breitner made valuable comments on a previous version of this paper. S. Neher helped in the preparation of the manuscript. This study was made possible by the support of many individuals (J. Cashman, P. W. Ng, H. F. Chen, J. Chen, C. Lau, S. Wan, C. Wu, N. Quiroz, J. Roques, H. Hauptman, L. Korte, and others), agencies (Kin On Community Health Care, Chinese Information and Service Center, Sea Mar Community Clinic, Korean Women's Association, Washington State Aging and Disability Services, and the Alzheimer's Association of Western and Central Washington).

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