Detecting Dementia With the Mini-Mental State Examination in Highly Educated Individuals

Sid E. O'Bryant, PhD; Joy D. Humphreys, MA; Glenn E. Smith, PhD; Robert J. Ivnik, PhD; Neill R. Graff-Radford, MD; Ronald C. Petersen, MD, PhD; John A. Lucas, PhD

Objectives: To evaluate the utility of Mini-Mental State Examination (MMSE) scores in detecting cognitive dysfunction in a sample of highly educated individuals.

Setting: Mayo Clinic Alzheimer Disease Research Center and Alzheimer Disease Patient Registry cohort.

Patients: A total of 1141 primarily white (93%) individuals with 16 or more years of self-reported education were identified. These included 307 (164 men and 143 women) patients with dementia (any type), 176 (106 men and 70 women) patients with mild cognitive impairment, and 658 (242 men and 416 women) control participants without dementia.

Main Outcome Measures: Diagnostic accuracy estimates (sensitivity, specificity, and positive and negative predictive power) of MMSE cut scores in detecting cognitive dysfunction.

Results: In this sample of highly educated, largely white older adults, the standard MMSE cut score of 24 (23 or below) yielded a sensitivity of 0.66, a specificity of 0.99, and an overall correct classification rate of 89% in detecting dementia. A cut score of up to 27 (26 or below) resulted in an optimal balance of sensitivity and specificity (0.89 and 0.91, respectively) with an overall correct classification rate of 90%. In a cognitively impaired group (dementia and mild cognitive impairment), a cut score of 27 (sensitivity, 0.69; specificity, 0.91) or 28 (sensitivity and specificity, 0.78) might be more appropriate.

Conclusion: Older patients with a college education who present with complaints of cognitive decline (reported by themselves or others) and score less than 27 on the MMSE are at a greater risk of being diagnosed with dementia and should be referred for a comprehensive dementia evaluation, including formal neuropsychological testing.

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Table 1. Sensitivity and Specificity Estimates for Detecting Dementia Using the MMSE

<table>
<thead>
<tr>
<th>Cut Score</th>
<th>Sensitivity (95% CI)</th>
<th>Specificity (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;16</td>
<td>0.22 (0.17-0.27)</td>
<td>1.00 (0.99-1.00)</td>
</tr>
<tr>
<td>&lt;17</td>
<td>0.24 (0.19-0.29)</td>
<td>1.00 (0.99-1.00)</td>
</tr>
<tr>
<td>&lt;18</td>
<td>0.27 (0.22-0.32)</td>
<td>1.00 (0.99-1.00)</td>
</tr>
<tr>
<td>&lt;19</td>
<td>0.31 (0.26-0.36)</td>
<td>1.00 (0.99-1.00)</td>
</tr>
<tr>
<td>&lt;20</td>
<td>0.34 (0.29-0.40)</td>
<td>1.00 (0.99-1.00)</td>
</tr>
<tr>
<td>&lt;21</td>
<td>0.40 (0.35-0.47)</td>
<td>1.00 (0.99-1.00)</td>
</tr>
<tr>
<td>&lt;22</td>
<td>0.50 (0.44-0.55)</td>
<td>1.00 (0.99-1.00)</td>
</tr>
<tr>
<td>&lt;23</td>
<td>0.58 (0.52-0.63)</td>
<td>1.00 (0.99-1.00)</td>
</tr>
<tr>
<td>&lt;24</td>
<td>0.66 (0.61-0.71)</td>
<td>0.99 (0.99-1.00)</td>
</tr>
<tr>
<td>&lt;25</td>
<td>0.74 (0.67-0.79)</td>
<td>0.99 (0.97-0.99)</td>
</tr>
<tr>
<td>&lt;26</td>
<td>0.80 (0.75-0.84)</td>
<td>0.96 (0.95-0.98)</td>
</tr>
<tr>
<td>&lt;27</td>
<td>0.89 (0.85-0.92)</td>
<td>0.91 (0.88-0.93)</td>
</tr>
<tr>
<td>&lt;28</td>
<td>0.92 (0.88-0.95)</td>
<td>0.78 (0.74-0.81)</td>
</tr>
<tr>
<td>&lt;29</td>
<td>0.96 (0.93-0.98)</td>
<td>0.57 (0.53-0.61)</td>
</tr>
<tr>
<td>&lt;30</td>
<td>0.99 (0.97-1.00)</td>
<td>0.27 (0.23-0.30)</td>
</tr>
</tbody>
</table>

Abbreviations: CI, confidence interval; MMSE, Mini-Mental State Examination.

Results

Estimates of sensitivity and specificity were calculated for MMSE cut scores from 16 (ie, 15 and below) to 30 (ie, 29 and below). Results comparing control participants without dementia with participants diagnosed with some form of dementia are presented in Table 1 and illustrated with a receiver operating characteristic plot in the Figure. The traditional cut score of 24 (23 or below) yielded a moderate estimate of sensitivity (0.66) with very high specificity (0.99) and an overall correct classification rate of 88.9%. The modest test sensitivity reflects the failure of the traditional cut score to identify a sizeable number of patients with dementia in this highly educated sample. Specifically, 104 patients with dementia (34%) in this sample were misclassified as not having dementia.

An optimal balance between sensitivity (0.89) and specificity (0.91) was obtained with a cut score of 27 (26 or below). This yielded only a slight improvement in the overall correct classification rate (90.1%), but identified 70 of the 104 patients with dementia who were missed using the traditional cutoff. The cut score of 27 yields a likelihood ratio of 9.6, indicating that college graduates

Archival data were reviewed for 4248 consecutive participants recruited into the Mayo Clinic Alzheimer Disease Research Center and Alzheimer Disease Patient Registry database. The Rochester Mayo Alzheimer Disease Patient Registry is responsible for recruiting patients with dementia and control participants without dementia for studies on the progression of Alzheimer disease through the Department of Community and Internal Medicine, and does not operate in Jacksonville. The Rochester and Jacksonville Alzheimer Disease Research Center sites acquire patients with dementia from the Behavioral Neurology Division of the Department of Neurology. The Jacksonville Alzheimer Disease Research Center site also recruits community control participants through churches and community agencies. The same inclusion/exclusion criteria are applied for control participants across both recruitment sites and have been published extensively through analyses of the Mayo’s Older Americans Normative Studies16-19 and Mayo’s Older African Americans Normative Studies20-22 data. Patients with memory concerns raised by either the patient, a family member, or a physician undergo a comprehensive neurological evaluation and neuropsychological testing to confirm or rule out dementia and Alzheimer disease.

A total of 1141 individuals with 16 or more self-reported years of education were identified. The sample included 1064 (93%) individuals who identified themselves as white and 77 (7%) who identified themselves as African American. Of the 1141 participants, 658 individuals (242 men and 416 women) had no dementia and were considered to be cognitively within normal limits (see Ivnik et al19 for full criteria used to define normal cognition). The remaining 307 participants (164 men and 143 women) carried diagnoses of dementia established via consensus by the Alzheimer Disease Research Center investigators and based on published diagnostic criteria. Diagnoses included 202 patients with probable Alzheimer disease (66%), 48 with dementia with Lewy bodies (16%), 18 with frontotemporal dementia (6%), 13 with vascular dementia (4%), and 25 with other dementia etiologies (8%). A sample of 176 patients (106 men and 70 women) diagnosed with mild cognitive impairment was also included for comparison purposes.

The total sample included 512 men (45%) and 629 women (55%), with a mean (SD) age of 75.9 (7.2) years and a mean (SD) self-reported educational level of 17.1 (1.5) years. There were no significant differences between groups (dementia vs no dementia) in terms of age, sex, or level of education.

While the MMSE was available in diagnostic meetings, the diagnosis of dementia (and particularly of subtype) was arrived at by consensus, taking into account information from the neurological examination, clinical interview, laboratory results, imaging, informant ratings of activities of daily living, and neuropsychological test data. Therefore, the MMSE had minimal effect on diagnostic decisions in the dementia cohort and was not considered at all as part of the determination of control status.

Methods

Archival data were reviewed for 4248 consecutive participants recruited into the Mayo Clinic Alzheimer Disease Research Center and Alzheimer Disease Patient Registry database. The Rochester Mayo Alzheimer Disease Patient Registry is responsible for recruiting patients with dementia and control participants without dementia for studies on the progression of Alzheimer disease through the Department of Community and Internal Medicine, and does not operate in Jacksonville. The Rochester and Jacksonville Alzheimer Disease Research Center sites acquire patients with dementia from the Behavioral Neurology Division of
with an MMSE score of 26 and with complaints of cognitive decline (reported by themselves or others) are nearly 10 times more likely to have dementia than those who obtain a score of 27 or higher.

As expected, the improved sensitivity obtained when the cut score is raised to 27 is achieved by sacrificing specificity. As a result, 61 (9%) participants without dementia fall below the higher cutoff, compared with only 3 (<1%) participants with false-positive identification with the traditional cut score of 24.

Because clinicians regularly evaluate patients with cognitive dysfunction with and without dementia, the above-mentioned analyses were calculated on a cognitively impaired group (mild cognitive impairment and dementia) vs control participants to determine if an appropriate cut score could be obtained. Estimates of sensitivity and specificity are presented in Table 2. The traditional cut score of 24 yields very poor sensitivity (0.45) but perfect specificity (1.0) (Table 2). Raising the cut score to 27 yields an increased sensitivity (0.69) with a concomitantly declined, though still impressive, specificity (0.91).

Although sensitivity and specificity measures are important to establish the diagnostic validity of test measures such as the MMSE, the diagnostic utility of a particular score earned by a particular patient is represented by the test’s predictive values. Positive predictive values (PPV) represent the probability that a patient with a score below cutoff actually has the condition of interest. Conversely, negative predictive values (NPV) represent the probability that a patient with a score above cutoff does not have the condition of interest. Unlike sensitivity and specificity, PPV and NPV are influenced by the base rate of the condition of interest in the target population. In the current study, where the base rate of dementia (dementia-only group) was 32%, the PPV and NPV for the traditional cutoff of 24 were 0.97 and 0.86, respectively. Using a cutoff of 27 yielded a lower PPV (0.82), but a higher NPV (0.94). When looking at the cognitively impaired group (mild cognitive impairment and dementia), the standard cut score of 24 yields very low sensitivity (0.45), but perfect specificity (1.0) (Table 2). Raising the cut score to 27 yields a lower PPV (0.82), but a higher NPV (0.94). The optimal balance of sensitivity and specificity were found at cut scores of 27 (PPV, 0.78; NPV, 0.86) or 28 (PPV, 0.63; NPV, 0.88). Table 3 presents predictive value calculations from the both groups for clinicians who wish to apply these data in settings where base rates of cognitive impairment and/or dementia differ from that of the current study.

The current findings suggest that the traditional MMSE cut score of 24 does not yield optimal classification accuracy in highly educated white patients with dementia. Instead, a more stringent cut score of 27 yields greater clinical utility for identifying dementia in highly educated individu-

### Table 2. Sensitivity and Specificity Estimates for Detecting Cognitive Impairment (Mild Cognitive Impairment and Dementia) Using the MMSE

<table>
<thead>
<tr>
<th>Cut Score</th>
<th>Sensitivity (95% CI)</th>
<th>Specificity (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;16</td>
<td>0.14 (0.11-0.18)</td>
<td>1.00 (0.99-1.00)</td>
</tr>
<tr>
<td>&lt;17</td>
<td>0.16 (0.13-0.19)</td>
<td>1.00 (0.99-1.00)</td>
</tr>
<tr>
<td>&lt;18</td>
<td>0.17 (0.14-0.21)</td>
<td>1.00 (0.99-1.00)</td>
</tr>
<tr>
<td>&lt;19</td>
<td>0.20 (0.17-0.24)</td>
<td>1.00 (0.99-1.00)</td>
</tr>
<tr>
<td>&lt;20</td>
<td>0.22 (0.19-0.26)</td>
<td>1.00 (0.99-1.00)</td>
</tr>
<tr>
<td>&lt;21</td>
<td>0.27 (0.23-0.31)</td>
<td>1.00 (0.99-1.00)</td>
</tr>
<tr>
<td>&lt;22</td>
<td>0.33 (0.29-0.37)</td>
<td>1.00 (0.99-1.00)</td>
</tr>
<tr>
<td>&lt;23</td>
<td>0.38 (0.34-0.43)</td>
<td>1.00 (0.99-1.00)</td>
</tr>
<tr>
<td>&lt;24</td>
<td>0.45 (0.41-0.50)</td>
<td>1.00 (0.99-1.00)</td>
</tr>
<tr>
<td>&lt;25</td>
<td>0.52 (0.48-0.57)</td>
<td>0.98 (0.97-0.99)</td>
</tr>
<tr>
<td>&lt;26</td>
<td>0.59 (0.54-0.63)</td>
<td>0.96 (0.95-0.98)</td>
</tr>
<tr>
<td>&lt;27</td>
<td>0.69 (0.65-0.73)</td>
<td>0.91 (0.88-0.93)</td>
</tr>
<tr>
<td>&lt;28</td>
<td>0.78 (0.74-0.82)</td>
<td>0.78 (0.74-0.81)</td>
</tr>
<tr>
<td>&lt;29</td>
<td>0.89 (0.86-0.91)</td>
<td>0.57 (0.53-0.61)</td>
</tr>
<tr>
<td>&lt;30</td>
<td>0.96 (0.93-0.97)</td>
<td>0.27 (0.23-0.30)</td>
</tr>
</tbody>
</table>

Abbreviations: CI, confidence interval; MMSE, Mini-Mental State Examination.

### Table 3. The PPV and NPV of Traditional and Optimal MMSE Cut Scores for Highly Educated White Patients Seen in Clinical Settings With Different Base Rates of Dementia or Cognitive Impairment

<table>
<thead>
<tr>
<th>Base Rate</th>
<th>0.01</th>
<th>0.02</th>
<th>0.05</th>
<th>0.10</th>
<th>0.15</th>
<th>0.20</th>
<th>0.25</th>
<th>0.30</th>
<th>0.40</th>
<th>0.50</th>
</tr>
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<tbody>
<tr>
<td>Dementia</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cut score of 24</td>
<td>0.40</td>
<td>0.47</td>
<td>0.78</td>
<td>0.88</td>
<td>0.92</td>
<td>0.96</td>
<td>0.97</td>
<td>0.98</td>
<td>0.99</td>
<td>0.99</td>
</tr>
<tr>
<td>PPV</td>
<td>1.00</td>
<td>0.99</td>
<td>0.98</td>
<td>0.96</td>
<td>0.94</td>
<td>0.92</td>
<td>0.90</td>
<td>0.87</td>
<td>0.81</td>
<td>0.74</td>
</tr>
<tr>
<td>NPV</td>
<td>0.09</td>
<td>0.17</td>
<td>0.34</td>
<td>0.52</td>
<td>0.64</td>
<td>0.71</td>
<td>0.77</td>
<td>0.81</td>
<td>0.87</td>
<td>0.91</td>
</tr>
<tr>
<td>Cut score of 27</td>
<td>0.09</td>
<td>0.17</td>
<td>0.34</td>
<td>0.52</td>
<td>0.64</td>
<td>0.71</td>
<td>0.77</td>
<td>0.81</td>
<td>0.87</td>
<td>0.91</td>
</tr>
<tr>
<td>PPV</td>
<td>1.00</td>
<td>1.00</td>
<td>0.99</td>
<td>0.99</td>
<td>0.98</td>
<td>0.97</td>
<td>0.96</td>
<td>0.95</td>
<td>0.93</td>
<td>0.89</td>
</tr>
<tr>
<td>NPV</td>
<td>1.00</td>
<td>1.00</td>
<td>0.99</td>
<td>0.99</td>
<td>0.97</td>
<td>0.95</td>
<td>0.93</td>
<td>0.91</td>
<td>0.89</td>
<td>0.84</td>
</tr>
</tbody>
</table>

Abbreviations: MMSE, Mini-Mental State Examination; NPV, negative predictive values; PPV, positive predictive values.

*Comment*
als. Although there is an expected concomitant increase in false-positive identifications using the higher cut score, a sacrifice in specificity in exchange for a significant gain in sensitivity is preferred when the goal of the mental status screen is early detection of possible dementia.

The current analyses also demonstrate that when mild cognitive impairment is considered, obtaining an optimal balance between sensitivity and specificity is very difficult. Table 2 demonstrates that optimal balances between sensitivity and specificity are found at cut scores of either 27 (sensitivity, 0.69; specificity, 0.91) or 28 (sensitivity and specificity, 0.78). The NPV and PPV for the cognitively impaired group using the traditional cut score of 24 is impressive even at low base rates; however, this is a function of perfect specificity and the low base rates. What this translates to for practicing clinicians is a very high false-negative rate (often ≥ 50%) meaning that, because of the small number of true cases in low base rate settings, a large portion of those individuals suffering from cognitive dysfunction will not be detected and referred for a comprehensive evaluation and/or treatment. Table 3 allows the individual clinician to make the determination as to what cut score(s) he or she wishes to implement, given the nature of the clinic population (eg, demographics, appropriate base rate), additional information obtained in the medical examination (ie, screening for cognitive impairment vs dementia if information regarding functional change is obtained), as well as his or her preferences for potential diagnostic error (ie, false-negative and false-positive rates).

The vast majority of published literature examining the relationship between cognitive test performance and education focuses on populations with less education without considering individuals with more education. In fact, research suggests that lower cut scores on the MMSE are appropriate when evaluating populations with less education,11 and correction formulas have been published. Educational attainment is often considered a manifestation of cognitive reserve, with higher education levels associated with greater reserve and a greater ability to withstand neuropathological burden before exhibiting detectable signs of disease.13 Individuals with greater cognitive reserve are believed to maintain higher levels of cognitive functioning in the early stages of degenerative dementia. By the time cognitive symptoms are first manifesting, these patients are believed to have significantly greater disease burden and faster subsequent decline. Identifying such individuals at an earlier stage of disease development and progression is desirable for both treatment and research purposes.

There was not enough data in the current sample to test the comparative accuracy of individual cut scores between highly educated individuals across ethnic groups. Therefore, the current findings with white individuals are appropriate when evaluating populations with less education,11 and correction formulas have been published. Educational attainment is often considered a manifestation of cognitive reserve, with higher education levels associated with greater reserve and a greater ability to withstand neuropathological burden before exhibiting detectable signs of disease. Individuals with greater cognitive reserve are believed to maintain higher levels of cognitive functioning in the early stages of degenerative dementia. By the time cognitive symptoms are first identified, these patients are believed to have significantly greater disease burden and faster subsequent decline. Identifying such individuals at an earlier stage of disease development and progression is desirable for both treatment and research purposes.

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The MMSE was not used as a screening measure of cognitive functioning in this sample and might perform differently when used in this context (eg, epidemiological studies). The current findings are not intended to encourage the diagnosis of cognitive impairment or dementia based on total MMSE scores alone. Instead these results provide practitioners with revised criteria for appropriate management of highly educated older white patients. Specifically, older patients who present with memory complaints (reported by themselves or others) who have attained a college degree or higher level of education and who score below 27 on the MMSE are at increased risk of cognitive dysfunction and dementia and should be referred for a comprehensive evaluation, including formal neuropsychological studies. When early identification is the primary goal of screening, the cost associated with evaluating individuals further who are subsequently found not to have dementia is outweighed by the benefit of identifying a considerably larger number of individuals who are in the earliest stages of dementia, where early intervention and/or participation in clinical trials may provide maximum benefit.

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Correspondence: Sid E. O’Bryant, PhD, Department of Neuropsychiatry and Behavioral Science, Texas Tech University Health Sciences Center, 3601 4th St, STOP 8321, Lubbock, TX 79430 (sid.obryant@ttuhsc.edu).

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Author Contributions: Study concept and design: O’Bryant, Ivnik, Petersen, and Lucas. Acquisition of data: Smith, Ivnik, Graff-Radford, and Lucas. Analysis and interpretation of data: O’Bryant, Humphreys, Smith, and Lucas. Drafting of the manuscript: O’Bryant and Petersen. Critical revision of the manuscript for important intellectual content: O’Bryant, Humphreys, Smith, Ivnik, Graff-Radford, and Lucas. Statistical analysis: O’Bryant and Lucas. Obtained funding: Graff-Radford and Petersen. Administrative, technical, and material support: Humphreys, Smith, Ivnik, and Lucas. Study supervision: Ivnik and Lucas.

REFERENCES


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6. Benedict RH, Brandt J. Limitation of the Mini-Mental State Examination for the
Restrictions of the Mini-Mental State Examination in acute stroke. Arch Clin
8. Tombaugh TN, McIntyre NJ. The mini-mental state examination: a comprehen-
10. Bravo G, Hebert R. Age- and education-specific reference values for the Mini-
Mental and modified Mini-Mental State Examinations derived from a non-
11. Crum RM, Anthony JC, Bassett SS, Folstein MF. Population-based norms for the
Mini-Mental State Examination by age and educational level. JAMA. 1993;269
(18):2386-2391.
12. Tombaugh T, McDowell I, Kristjansson B, Hubley A. Mini-Mental State Exami-
nation (MMSE) and the Modified MMSE (3MS): a psychometric comparison and
14. Scarmeas N, Albert SM, Manly JJ, Stern Y. Education and rates of cognitive de-
cline in incident Alzheimer’s disease. J Neurol Neurosurg Psychiatry. 2006;
77(3):308-318.
15. Stern Y, Albert S, Tang M-X, Tsai W-Y. Rate of memory decline in AD is related
to education and occupation: cognitive reserve? Neurology. 1999;53(9):1942-
1947.
16. Steinberg BA, Bielisakas LA, Smith GE, Ivnik RJ. Mayo’s Older Americans Nor-
mative Studies: age- and IQ-adjusted norms for the Trail-Making Test, the Stroop
19(3-4):229-237.
17. Steinberg BA, Bielisakas LA, Smith GE, Ivnik RJ, Malec JF. Mayo’s Older Ameri-
cans Normative Studies: age- and IQ-adjusted norms for the Auditory Verbal Learn-
464-523.
18. Lucas JA, Ivnik RJ, Smith GE, et al. Normative data for the Mattis Dementia Rat-
19. Ivnik RJ, Malec JF, Smith GE, Tangalos EG, Petersen RC. Neuropsychological
tests’ norms above age 55 COWAT, BNT, MAE Token, WRAT-R Reading, AM-
20. O’Bryant SE, Lucas JA, Willis FB, Smith GE, Graff-Radford NR, Ivnik RJ. Dis-
crepancies between self-reported years of education and estimated reading level
among elderly community-dwelling African-Americans: analysis of the MOAANS
Studies: norms for Boston Naming Test, Controlled Oral Word Association, Cat-
egory Fluency, Animal Naming, Token Test, WRAT-3 Reading, Trail Making Test,
(2):243-269.

Announcement

Calendar of Events

On the Calendar of Events site, available at http://pubs.ama-assn.org/cgi/calendarcontent and linked off the
home page of the Archives of Neurology, individuals can submit meetings to be listed. Just go to http://pubs.ama-assn.org/cgi/cal-submit/ (also linked off the Cal-
endar of Events home page). The meetings are re-
viewed internally for suitability prior to posting. This
feature also includes a search function that allows search-
ing by journal as well as by date and/or location. Meet-
ings that have already taken place are removed
automatically.