A brief cognitive test battery to differentiate Alzheimer’s disease and frontotemporal dementia

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Objective: To validate a simple bedside test battery designed to detect mild dementia and differentiate AD from frontotemporal dementia (FTD).

Methods: Addenbrooke’s Cognitive Examination (ACE) is a 100-point test battery that assesses six cognitive domains. Of 210 new patients attending a memory clinic, 139 fulfilled inclusion criteria and comprised dementia (n = 115) and nondementia (n = 24) groups. The composite and the component scores on the ACE for the two groups were compared with those of 127 age- and education-matched controls. Norms and the probability of diagnosing dementia at different prevalence rates were calculated. To evaluate the ACE’s ability to differentiate early AD from FTD, scores of the cases diagnosed with dementia with a Clinical Dementia Rating \\#1 (AD = 56, FTD = 24, others = 20) were compared.

Results: Two cut-off values for the ACE composite score (88 and 83) were of optimal utility depending on the target population. The ACE had high reliability, construct validity, and sensitivity (93%, using 88 as cut-off). Using the lower cut-off of 83, the ACE had a higher sensitivity (82%) and predictive value than the Mini-Mental State Examination for a wide range of dementia prevalence. The ACE differentiated AD from FTD, and the VLOM ratio (derived using component scores: [verbal fluency + language]/[orientation + memory]) of <2.2 for FTD and >3.2 for AD was highly discriminating.

Conclusion: The ACE is a brief and reliable bedside instrument for early detection of dementia, and offers a simple objective index to differentiate AD and FTD in mildly demented patients.


The need for screening and diagnostic tests to provide an objective measure of cognitive function has increased over the last two decades largely as a result of three developments: 1) the realization that a substantial proportion of patients previously diagnosed with AD have other pathologies, notably dementia with Lewy bodies and frontotemporal dementia (FTD); 2) the advent of disease-modifying treatments for AD, making it vital to establish an early and accurate diagnosis, preferably in the pre-dementia stage of the disease; and 3) the enormous increase in memory clinics, reflecting a growing concern in the general community about failing memory in late life.

Several screening and diagnostic tests for dementia have been developed, but no single test is the established standard. More comprehensive cognitive batteries such as the cognitive section (CAMCOG) of the Cambridge Examination for Mental Disorders of the Elderly (CAMDEX) and the Dementia Rating Scale (DRS) require specialized test equipment or trained personnel to administer, and are beyond the scope of routine bedside cognitive evaluation. The Mini-Mental State Examination (MMSE) is one of

See also pages 1601, 1609, and 1621

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the widely used and validated bedside instruments for mental status evaluation, but has certain limitations, such as insensitivity to the early stages of AD when the deficits are confined to an amnestic syndrome and to isolated frontal or linguistic deficits found in early FTD and inability to differentiate the type of dementia. This insensitivity stems from a lack of measures of executive ability and the use of extremely simple tasks for memory and language functions that fail to detect deficits until they are advanced. Modifications to the MMSE are warranted and have been attempted. Bearing these factors in mind, we developed a new, theoretically motivated, brief test battery for the detection and classification of dementia based upon our research over the last decade. Addenbrooke’s Cognitive Examination (ACE) surveys key aspects of cognition without the use of specialized test equipment. It is a bedside or clinic-based schedule that incorporates the MMSE, expands memory, language, and visuospatial components, and adds tests of verbal fluency.

The ACE has been administered over the last 3 years to all patients referred to the Cambridge Memory Clinic with cognitive complaints. We describe the psychometric properties and normative values for the instrument, compare it with the MMSE, and explore its ability to differentiate AD and FTD in a group of patients with early dementia. The latter is of particular relevance as a substantial proportion of younger patients with dementia have FTD and, to date, simple cognitive batteries have failed to differentiate AD from FTD.

**Methods.** The instrument. The ACE, which can be viewed as an Appendix on the Neurology Web site (www.neurology.org), consists of six components evaluating separate cognitive domains. A maximum score of 100 is weighted as follows: orientation (10), attention (8), memory (35), verbal fluency (14), language (28), and visuospatial ability (5). The orientation and attention components are as in the MMSE. The memory component evaluates episodic memory (recall of three items from the MMSE plus a “name and address learning and delayed recall” test) and semantic memory. The language component includes naming 12 line drawings, comprehension, repeating words and sentences, reading regular and irregular words, and writing. Visuospatial testing consists of copying overlapping pentagons (from the MMSE) plus a wire cube, and drawing a clock face. Verbal fluency consists of letter fluency for words beginning with the letter P and category fluency for animals. Raw scores are used for all items except for verbal fluency: a scaled scoring system for the letter and category fluency was derived using a Gaussian distribution of the raw scores from normal controls included in this study (see the Appendix at www.neurology.org). Scores for each of the six domains can be calculated separately and their sum gives the composite score on the ACE. The MMSE score can also be calculated. The ACE can be administered in 15 to 20 minutes.

**Participants and procedure.** The study evaluated the ACE in 266 subjects consisting of two groups—a clinic group (n = 139) and a control group (n = 127).

The 139 subjects in the clinic group were selected by reviewing the case files of the 210 newly evaluated patients attending the Cambridge Memory Clinic between June 1996 and October 1998. In this multidisciplinary clinic patients undergo clinical, radiologic (SPECT scan, CT, or MRI), and laboratory evaluation. In addition to standard neuropsychiatric and neuropsychological test batteries (including the Neuropsychiatric Inventory, Weschler’s Adult Intelligence Scale–Revised, Wechsler’s Memory Scale–Revised, Graded Naming Test, copying the Rey Complex Figure, and Verbal Fluency Test) they are also administered the ACE and the Clinical Dementia Rating (CDR) scale. Patients with suspected organic dementia syndromes are followed up in the clinic every 6 to 12 months. The diagnosis is based on the consensus of the senior neurologist, psychiatrist, and neuropsychologist in the team using evidence from all clinical and investigational results, but not the ACE. Based on postmortem verification of previously studied samples, our diagnostic accuracy has been high—among 70 cases undergoing autopsy between 1992 and 1999, all 30 diagnosed in life with AD had Alzheimer pathology, sometimes with other secondary pathologies.

Patients. Of the 210 patients attending the clinic, 139 fulfilled the following criteria: 1) follow-up of at least 12 months; 2) able to complete full assessment; and 3) CDR and neuropsychological tests completed within 90 days of the ACE. Patients were excluded if they had 1) evidence of two or more pathologies (e.g., AD with multiple infarcts on neuroimaging), either of which could independently be the cause of dementia; 2) major depression by Diagnostic and Statistical Manual of Mental Disorders, 4th edition (DSM-IV) or other psychiatric illness; and 3) causes of cognitive impairment other than degenerative or vascular pathology (e.g., closed head injuries, alcoholism). Of note was the fact that 51 patients (36%) required a follow-up of 6 to 12 months before a consensus diagnosis could be reached.

Patients in the clinic group were classified into dementia (n = 115) or nondementia (n = 24) groups according to DSM-IV. For subclassification, the diagnosis of AD (n = 69) was based on National Institute of Neurological and Communicative Disorders and Stroke–AD and Related Disorders Association criteria and vascular dementia (VaD; n = 14) on National Institute of Neurological Disorders and Stroke–Association Internationale pour la Recherche et l’Enseignement en Neurosciences criteria. In keeping with our previous studies, the term FTD was used as a general label for all focal lobar degenerations, which includes patients with core feature of personality and behavioral changes (frontal variant FTD), nonfluent spontaneous speech (progressive nonfluent aphasia), and fluent empty spontaneous speech with semantic breakdown (semantic dementia). All patients diagnosed with FTD (n = 29) conformed to the consensus criteria. Patients who failed to fulfill the criteria for AD, VaD, or FTD were grouped as others (n = 27) and consisted of patients with dementia with Lewy bodies, corticobasal degeneration, or other miscellaneous organic syndromes. The severity of dementia was assessed using the CDR grading. It is worth emphasizing that not all patients who fulfilled the criteria for FTD met the DSM-IV criteria for dementia, as impairment in memory, which is a core feature of DSM-IV, is often absent in early FTD.
The control group consisted of 127 age- and education-matched individuals who were either attendees at an orthopaedic (n = 36) or gynecologic (n = 28) clinic, spouses of the attendees at the above clinics (n = 26), or members of the Medical Research Council subject panel (n = 37). Subjects with a history of head injury, drug abuse, alcoholism, and neurologic or cognitive complaints were excluded.

Results. Table 1 summarizes the demographic characteristics and mean (SD) individual component and composite scores on the ACE for the dementia, nondementia, and control groups. Age and education were not significantly different between the groups. The dementia group had significantly lower scores than the control group on all components and the nondementia group on all except letter fluency.

Normative data and validity. Two methods were used to calculate the norms for the composite score on the ACE. The first cut-off score of 88 represented a value two standard deviations below the mean composite score for the control group. The second cut-off was obtained by estimating the probability of diagnosing dementia (in terms of positive [PPV] and negative [NPV] predictive values) in the 139 subjects in the clinic group. We estimated the sensitivity, specificity, and predictive values for diagnosing dementia at different prevalence rates (5, 10, 20, and 40%) for each ACE cut-off score from 80 to 90. A broad range of

<table>
<thead>
<tr>
<th>Test/cut-off score</th>
<th>Sensitivity</th>
<th>Specificity</th>
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<tbody>
<tr>
<td></td>
<td>Dementia</td>
<td>PPV at different base rates</td>
</tr>
<tr>
<td></td>
<td>5%</td>
<td>10%</td>
</tr>
<tr>
<td>ACE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>88</td>
<td>0.93</td>
<td>0.71</td>
</tr>
<tr>
<td>83</td>
<td>0.82</td>
<td>0.96</td>
</tr>
<tr>
<td>MMSE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>27</td>
<td>0.74</td>
<td>0.96</td>
</tr>
<tr>
<td>24</td>
<td>0.52</td>
<td>0.96</td>
</tr>
</tbody>
</table>

Figures in parentheses are the corresponding negative predictive values.

ACE = Addenbrooke’s Cognitive Examination; MMSE = Mini-Mental State Examination.
prevalence rates was chosen to encompass the wide variation reported in various clinic31,32 and community-based33,34 studies. A cut-off of 88 had high sensitivity (93%) at a specificity of 71% (table 2). A cut-off score of 83 had an optimal sensitivity (82%) and specificity (96%), and maintained a reasonably high PPV and NPV at different prevalence rates of dementia. Table 2 also shows the sensitivity, specificity, and predictive values for diagnosing dementia using the MMSE with the conventional cut-off of 24 and a higher cut-off of 27 for the same sample population. The performance of the MMSE, although comparable to the ACE in terms of specificity, was poor in terms of sensitivity and predictive values.

Criterion validity. The DSM-IV was used as the gold standard to estimate criterion validity of the ACE (composite score) in diagnosing dementia. The trade-off between sensitivity (true positive rate) and 1-specificity (false positive rate) of the ACE in diagnosing dementia is shown in the receiver operating characteristics (ROC) curve in figure 1. The area under the ROC curve is 0.91 (95% CI 0.85 to 0.99), which suggests that the ACE has a high specificity for a large range of sensitivities. A false positive diagnosis of dementia was made in 7 (5%) patients on using the higher cut-off on the ACE, and in only 1 (0.7%) when the lower ACE cut-off (83) or either of the MMSE cut-off scores were used.

Construct validity. Construct validity evaluates how well the results of a new test correlate with those of a standard test for the same domain of interest. Construct validity for the ACE for diagnosing dementia (as measured against the DSM-IV) was good (κ = 0.62) using a cut-off score of 88 and moderate (κ = 0.59) using a cut-off score of 83. The construct validity for the components of the ACE was evaluated using data from neuropsychological tests administered to a subgroup of controls, and was good for the name and address delayed recall (κ = 0.69; against story recall from Wechsler’s Memory Scale–Revised21) and verbal fluency (κ = 0.60; against verbal fluency test with letters F, A, and S24) and moderate for naming line drawings (κ = 0.41; against Graded Naming Test22) and visuospatial component (κ = 0.53; against copying the Rey Complex Figure23).

Reliability. Reliability of the ACE was measured in terms of internal consistency, using Cronbach’s alpha coefficient. The Cronbach’s alpha for the ACE was 0.78 (>0.8 is considered excellent and >0.7 good).36

MMSE versus ACE. Table 3 shows the details of the type and severity of dementia in cases correctly diagnosed by the MMSE and the ACE. When compared with the lower cut-off score of 83 on the ACE, the MMSE with a conventional cut-off score of 24 missed dementia in 50% of FTD cases, 26% of AD cases, and 30% of all dementia cases. Even at a higher cut-off score of 27, the MMSE still missed the dementia in 23% of FTD cases. The ACE with higher cut-off of 88 had the highest sensitivity for detecting dementia in the clinic group, including in those with AD (96%) and FTD (91%).

Severity of dementia and the ACE. A correct diagnosis of dementia using the ACE (cut-off score 88) was achieved in 82% of patients with CDR < 1.0, 98% with CDR = 1.0, and 100% with CDR > 1 (see table 3). Even with the lower cut-off score of 83, the ACE diagnosed 79 of the 100 mild or lesser grades of dementia cases (CDR ≤ 1), which was considerably better than either of the MMSE cut-offs. Almost all dementia patients missed by the MMSE (cut-off

<table>
<thead>
<tr>
<th>Dementia type (n)</th>
<th>Dementia by ACE</th>
<th>Dementia by MMSE</th>
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<tbody>
<tr>
<td></td>
<td>Cut-off 88</td>
<td>Cut-off 83</td>
</tr>
<tr>
<td>Total (115)</td>
<td>107 (93)</td>
<td>94 (82)</td>
</tr>
<tr>
<td>AD (69)</td>
<td>66 (96)</td>
<td>60 (87)</td>
</tr>
<tr>
<td>Frontotemporal dementia (22)</td>
<td>20 (91)</td>
<td>17 (77)</td>
</tr>
<tr>
<td>Vascular dementia (14)</td>
<td>12 (86)</td>
<td>8 (57)</td>
</tr>
<tr>
<td>Others (10)</td>
<td>9 (90)</td>
<td>9 (90)</td>
</tr>
<tr>
<td>Severity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CDR &lt; 1 (39)</td>
<td>32 (82)</td>
<td>26 (67)</td>
</tr>
<tr>
<td>CDR = 1 (61)</td>
<td>60 (98)</td>
<td>53 (87)</td>
</tr>
<tr>
<td>CDR &gt; 1 (15)</td>
<td>15 (100)</td>
<td>15 (100)</td>
</tr>
</tbody>
</table>

ACE = Addenbrooke’s Cognitive Examination; MMSE = Mini-Mental State Examination; CDR = Clinical Dementia Rating.
24) but detected by the ACE (cut-off 83) had a CDR ≤ 1. The ACE thus maintained a good sensitivity for diagnosing dementia in subgroups with differing dementia type and severity.

**Differentiating AD and FTD.** Of the 139 patients in the clinic group, the ACE (cut off score 88) identified 114 as having dementia, of whom 100 (56 AD, 24 FTD, 10 VaD, and 10 others) had a CDR ≤ 1. Comparison of the AD and FTD subgroups on different components of the ACE revealed significant differences on orientation, attention, and memory, which were worse in AD, and letter fluency, language, and naming, which were worse in FTD (table 4).

Figure 2 contrasts the performance of patients with AD and FTD on the most discriminating subtests. In order to translate this pattern of scoring into an index useful in differentiating AD and FTD subgroups, we calculated the ratio of scores on verbal fluency plus language to orientation plus name and address delayed recall memory. This value, \((V+L)/(O+M)\) — the VLOM ratio—tended to be higher in patients with AD and lower in those with FTD. For data on the sensitivity, specificity, and predictive values (at prevalence rates of 10, 20, 30, and 40%) of various VLOM ratios for differentiating AD from non-AD (and FTD from non-FTD), please access www.neurology.org. It is clear that a VLOM ratio of 3.2 optimally differentiates AD from non-AD (sensitivity 75% and specificity 84%), and a ratio of < 2.2 optimally differentiates FTD from non-FTD (sensitivity 58% and specificity 97%). Figure 3 shows that in the patient subgroup with an ACE score <88 and CDR ≤ 1 the majority with a VLOM ratio below 2.2 had FTD, whereas above a ratio of 3.2 most had AD. Between 2.2 and 3.2, patients could have FTD, AD, or one of the other dementias.

The demographic variables of age, years of education, and gender were added to a logistic regression model as covariates to determine their effect on the predictive outcome (dementia or nondementia) obtained using each of the instruments—ACE (cut-off scores 88 and 83) and MMSE (cut-off scores 24 and 27). Whereas none of these demographic variables was significant at the 0.05 level for either of the ACE cut-off scores, age \((p = 0.05)\) and gender

### Table 4 Comparison of mean scores on components of the Addenbrooke’s Cognitive Examination: AD with non-AD and frontotemporal dementia (FTD) with non-FTD

<table>
<thead>
<tr>
<th>Components</th>
<th>AD, n = 56</th>
<th>FTD, n = 24</th>
<th>p Value*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Orientation</td>
<td>7.1 (2.2)</td>
<td>9.0 (1.3)†</td>
<td>0.000</td>
</tr>
<tr>
<td>Attention</td>
<td>5.8 (2.0)</td>
<td>7.1 (1.3)†</td>
<td>0.005</td>
</tr>
<tr>
<td>Memory Total</td>
<td>16.5 (7.4)</td>
<td>22.3 (7.2)†</td>
<td>0.002</td>
</tr>
<tr>
<td>Name and address learning</td>
<td>13.6 (5.7)</td>
<td>16.0 (4.2)</td>
<td>0.065</td>
</tr>
<tr>
<td>Name and address delayed recall</td>
<td>1.0 (1.7)</td>
<td>3.2 (2.4)†</td>
<td>0.000</td>
</tr>
<tr>
<td>Verbal Fluency</td>
<td>6.7 (2.8)</td>
<td>5.5 (3.0)</td>
<td>0.101</td>
</tr>
<tr>
<td>Letter</td>
<td>4.0 (1.8)†</td>
<td>2.9 (1.8)</td>
<td>0.012</td>
</tr>
<tr>
<td>Category</td>
<td>2.6 (1.5)</td>
<td>2.6 (1.6)</td>
<td>0.987</td>
</tr>
<tr>
<td>Language</td>
<td>25.0 (4.0)†</td>
<td>21.8 (5.5)</td>
<td>0.003</td>
</tr>
<tr>
<td>Naming</td>
<td>10.7 (2.2)†</td>
<td>8.5 (4.0)</td>
<td>0.014</td>
</tr>
<tr>
<td>Visuospatial</td>
<td>3.1 (1.7)</td>
<td>3.9 (1.3)</td>
<td>0.066</td>
</tr>
</tbody>
</table>

Values are mean (SD). Bold type indicates significance.

* Mann–Whitney U-test two-tailed significance.
† Higher mean score where \(p < 0.05\).
Discussion. Extensive experience with the ACE suggests that it is a reliable instrument for the early detection of dementia and meets most of the standards required by such an instrument.

How the ACE differs from the MMSE. Since the introduction of the MMSE over two decades ago there has been an enormous increase in our knowledge of the dementias and of normal cognition. The major differences between the ACE and the MMSE lie in the evaluation of memory, fluency, and language. The memory component of the ACE was expanded to reflect the importance of episodic memory impairment in the early detection of AD. The name and address delayed recall test appears to be a particularly sensitive measure in AD. The ACE also incorporates verbal fluency, which relies upon frontal executive function. Additionally, letter-based fluency depends upon phonologic processing and category-based fluency on semantic memory. Whereas letter-based fluency is particularly sensitive to FTD, category fluency is a marker of semantic memory breakdown, including that in AD.

The naming task in the ACE was made more difficult by having 12 line drawings of medium or low frequency concept, based on the finding that naming is highly dependent upon the concept frequency and age of acquisition. In this study, the AD patients performed well on naming tasks, reflecting their mild disease. The changes to the nonsemantic aspects of language evaluation in the ACE are intended for early detection of FTD, particularly the progressive aphasic variants. Changes to the visuospatial section include adding a three-dimensional wire cube copying and a clock face drawing test, which have greater scope for detecting impaired constructional abilities than copying a two-dimensional figure. Both the AD and FTD groups performed well on this component, reflecting the very mild nature of the dementia in this cohort.

Psychometric properties of the ACE. The reliability of the ACE is evident in its high internal consistency, which indicates that all its component scores contribute to the measurement of cognitive functions and correlate well with the composite score, which in turn determines the presence or absence of dementia. Among its various components, construct validity was best for memory and verbal fluency showing good concordance with standard neuropsychological tests. The ACE also showed good construct validity for the diagnosis of dementia and had a high sensitivity, even with the lower cut-off score of 83.

Early diagnosis with the ACE. In the evaluation of any new instrument, an important question to be answered is how advanced dementia needs to be before the instrument can detect it. To address this issue we used the CDR to grade the severity of dementia in functional terms. The majority of patients in this study had only mild or lesser grades of dementia (CDR ≤ 1) when they received the ACE. When the lower cut-off score of 83 was used, the ACE detected dementia in 79% of all patients with dementia, a third more than that achieved using the conventional cut-off score of 24 on the MMSE. It appeared particularly sensitive in FTD where it nearly doubled the detection rate when compared to the MMSE. In a third of all patients with dementia in this study a clinical consensus diagnosis based upon data from extensive assessments could only be reached after a further follow-up of 6 to 12 months. These facts highlight the utility of the ACE in the early diagnosis of dementia.

Differentiating AD and FTD at an early stage with the ACE. Predicting the type of dementia that patients will eventually develop is often difficult early in the course of the disease. We are unaware of any other bedside instrument capable of differentiating patients at an early stage of dementia. On the ACE, the patients with FTD performed better on tests of orientation and episodic memory, whereas the patients with AD did relatively better on verbal fluency and language, consistent with the known neuropsychological profiles of the two disorders. Based upon this pattern of performance, we devised the VLOM ratio to differentiate AD and FTD. To illustrate this point, consider the example of a patient presenting to a typical memory clinic in which the prevalence rate of AD is around 40% and FTD is lower, at 10%. If the patient has a VLOM ratio >3.2, then the probability of AD is 76% and if the ratio is ≤ 3.2, then the probability of not having AD is about 83%. If the patient’s VLOM ratio is <2.2, then the probability of FTD is 71% and conversely, if the ratio is ≥ 2.2, then FTD can be excluded with 95% certainty. It is evident that the confidence with which a diagnosis of AD (or FTD) can be made, or excluded, depends on the prevalence rate of AD (or FTD) in the population in question. The predictive values of different cut-offs for different prevalence rates can be found at www.neurology.org. Although not infallible, an objective and simply calculated index such as the VLOM ratio will be helpful in prognosticating and planning future management of patients.

Applications of the ACE. When screening an at-risk population for dementia, a test instrument should have a high sensitivity for mild dementia as a missed diagnosis can delay implementation of useful social and pharmacologic interventions. At a specificity of 71%, a cut-off score of 88 on the ACE offered a high sensitivity of 93%. At a dementia prevalence rate of 40% (such as in a memory clinic) a very high proportion (68%) of those who screen positive will have dementia and 94% of those who score above the cut-off will not. The lower cut-off score of 83 might be more appropriate for research studies or therapeutic trials, which require a high specificity, or when screening populations with a low base rate of dementia. At a sensitivity of 82%, a cut-off score of 83 had a high specificity of 96%. In a population with a 10% dementia prevalence rate, 69% of those who fail the
test will eventually meet diagnostic criteria for dementia, and only 2% of those with dementia will escape detection.

The influence of age, gender, education, and cultural background on the ACE and the MMSE needs further evaluation. In our patient sample, age, number of years of education, or gender did not influence the predictive outcome using the ACE, but both age and gender influenced the predictive outcome using the MMSE.

Alterations in personality and behavior are well-recognized features of early FTD. There are, however, no reliable patient-based measures of behavior. We deliberately avoided carer-based measures in our instrument with the intention of designing a brief objective test. Although sensitive to early dementia on its own, the ACE may prove even more useful when used in combination with carer-based instruments for behavior, such as the Neuropsychiatric Inventory.¹⁹

Limitations and future directions. The problem of false positive diagnosis with the higher cut-off score on the ACE is likely to be more apparent than real in this study. Early AD patients are typically only amnestic¹¹ and do not fulfill the DSM-IV criteria for dementia. However, they often fail on the ACE because of the deliberately large weighting (35 of the 100 points) toward memory. Patients with other isolated cognitive deficits, such as aphasia, which occur in early FTD, are also likely to appear as false positives on the ACE. In our sample, three of the seven patients receiving a false positive diagnosis on the ACE had FTD and all three had progressive nonfluent aphasia.

The ACE requires more time than the MMSE to complete but rarely takes in excess of 15 to 20 minutes, except in very demented subjects. It is most useful, however, in patients with early and mild dementia. The loss in brevity is offset by a gain in the complete but rarely takes in excess of 15 to 20 minutes. Although sensitive to early dementia on its own, the ACE may prove even more useful when used in combination with carer-based instruments for behavior, such as the Neuropsychiatric Inventory.¹⁹

Our results apply to a clinic-based patient population, age 44 to 88 years, with predominantly degenerative dementia. The applicability of the ACE in the community requires investigation. The inter-rater and intrarater reliability of the ACE could not be evaluated in this retrospective analysis, but as the ACE assesses cognitive functions in an objective manner the rater related bias is likely to be low.

The index for differentiating AD from FTD (VLOM ratio) is derived using a sample population that is relatively large (n = 100). Nevertheless, these findings clearly need to be replicated in an independent and prospectively studied sample.

References


