Greek validation of the Seven-Minute Screening Battery for Alzheimer's disease in the elderly

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Abstract

The increasing prevalence of Alzheimer's disease (AD) suggests that there is an increasing need for accurate and easily administered screening instruments. The Seven-Minute Screen is a neurocognitive screening battery consisting of four brief tests (enhanced cued recall, temporal orientation, verbal fluency, and clock drawing). We studied 55 outpatients with probable AD, 40 healthy volunteers of comparable age, sex, and education and 31 elderly patients with other neuropsychological disorders. The aim of our study was to determine the validity and reliability of this test. Differences on individual tests were evaluated using the Student t *test. (Recall: 6.4 ± 5.02/15.38 ± 0.95; Orientation: 48.76 ± 42.74/0.2 ± 0.52; Verbal: 8.2 ± 4.94/18.05 ± 4.63; Clock drawing: 2.07 ± 2.56/6.03 ± 11.25 for AD patients and control subjects, respectively). Mean scores for patients with AD and control subjects on all four individual tests were significantly different (for each, $p < 0.001$). The mean time to complete the test for healthy control subjects was nine minutes and 18 seconds, for neuropsychological disorders nine minutes and six seconds, and for AD patients 13 minutes and 32 seconds ($p < 0,001$). Logistic regression analysis was used to determine the degree to which the battery discriminated between control subjects and patients with AD (sensitivity 92.73 percent and specificity 97.50 percent). We then separated the patients with MMSE > 20 and the same model of regression analysis was used. Sensitivity was 81.25 percent and specificity was 96.55 percent using 0.7 as the cutoff probability, and 93.75 and 96.55 percent, respectively, using 0.5 as the cutoff probability. Neither age nor education and gender had an effect on the results. The Seven-Minute Screen appears highly sensitive to AD patients and may*

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be useful in helping to make initial distinctions between patients with early dementia and normal elderly.

Key words: dementia, screening, Seven-Minute Screen, validation

Introduction

Dementia is a clinical and public health issue of growing importance as life expectancy increases across the planet. Alzheimer's disease (AD), which affects 10 percent of the population from the age of 75 years old and up, is the most common type of dementia. The incidence of AD increases with age.[1] Screening for dementia is critical for secondary prevention, early diagnosis, and treatment, as well as for disability limitation and prevention of complications.[2] There is an increasing need for accurate and easily administered screening instruments. Suggestions are given for further research on the current measures and for the development of new screening tests that would meet a broader range of clinical purposes.[3] Several useful methods exist to screen for cognitive impairments, and clinicians need to be familiar with the strengths and limitations of their preferred screening methods. The Mini-Mental State Examination (MMSE),[4] the most widely used brief cognitive screening test[5] for mental status examination, was originally developed to evaluate psychiatric patients and has been criticized both for its level of sensitivity[6] and specificity[7,8] as well as the influence that education and age have on performance.[9,10] Other batteries have also been shown to be useful in diagnosing AD.[11] The Seven-Minute Screening Battery is used to identify patients with AD from healthy elderly people. We selected this battery of tests based on recent data published by Solomon *et al.*[12]

The purpose of this study is to examine the acceptance and screening efficacy of a new screening test, the Seven-Minute Screening Battery, in the Greek elderly population and determine if we can distinguish patients with early dementia from elderly control subjects, as well as patients with mild cognitive impairment (MCI) and other neuropsychological disorders from elderly control subjects.

Subjects and methods

The Seven-Minute Screening Battery[12] consists of four brief tests representing four cognitive areas typically compromised in AD:

1. Memory[13] (enhanced cued recall): 16 items that are presented four at a time on four individual cards. The subject is asked to free-recall as many of the pictures as possible. This test was initially described in a longer form by Grober and colleagues.[14]

2. Verbal Fluency[15] (category fluency): The task has been shown to be sensitive to AD.[16,17] The test requires that the subject generate as many words as possible from a semantic category in a fixed time period.

3. Orientation for Time[18] (Benton Temporal Orientation Test): Solomon *et al.* used the Benton modification of this test[19] to provide greater sensitivity to AD.[12] The maximum total error score is 113.

4. Visuospatial and Visuoconstruction[20] (clock drawing): A number of investigators have shown that clock drawing is sensitive to dementia of the Alzheimer's type,[21] with low false negative and false positive rates.[22] There are several scoring methods.[23] Solomon *et al.* have developed a simplified version of that used by Freedman *et al.*[24,25]

The Seven-Minute Screening Battery was administered to 106 elderly people, divided into three groups who contacted the 3rd Department of Neurology of Aristotle University of Thessaloniki. The first group consisted of 55 outpatients with probable AD as diagnosed by accepted criteria such as DSM-IV[26] and the National Institute of Neurological and Communicative Disorders and Stroke–Alzheimer's Disease and Related Disorders Association criteria (NINCDS-ADRDA).[27] Forty healthy elderly people were the second group (control group). None had a history of psychiatric or neurological disorder and none was taking antidepressant or other psychoactive medication. In addition, we studied the validity of the battery by administering the Seven-Minute Screen to 31 elderly subjects without dementia, but with coexisting neurological or psychiatric disorders (19 with depression, five with MCI, three with stroke, three with psychosis, and one with Parkinson's disease) (third group). We compared the scores of this group with the ones of healthy control subjects as well as with AD patients. We used the same statistical methods (student *t* test and logistic regression analysis).

Subjects from all groups underwent neuropsychological testing, including the MMSE, the Cambridge Cognitive Examination for the Elderly (CAMCOG), and the Functional Rating Scale for Symptoms of Dementia (FRSSD). We also used, for assessment of depression, the Hamilton Rating Scale (HRS) and the Geriatric Depression Scale (GDS) for all subjects.

Statistical methods

Differences on neuropsychological test scores, demographic variables and individual tests, which consist of the Seven-Minute Screen, were evaluated using the student *t* test. Logistic regression analysis was used to determine the degree to which the battery discriminated between control subjects and patients with AD or patients with other neurological disorders. These statistical methods were used at first for all subjects, and we then separated a group of patients with MMSE > 20 (fourth group). Logistic regression analysis was also used to examine the effect of age, education, and gender on the results.

Logistic regression

To determine the degree to which the battery discriminated between control subjects and patients with AD, a logistic regression model was estimated using the four tests from the screening battery as the predictor variables.

Because of the clear non-normality of the data from the battery, discriminant analysis was rejected as a possible alternative method. Specifically, the following model was estimated where ECR indicates enhanced cued recall; CF, category fluency; BTO, Benton Temporal Orientation; and CD, clock drawing.

$$\log\left(\frac{p_i}{1-p_i}\right) = \beta_0 + \beta_1 * \mathrm{ECR}_i + \beta_2 * \mathrm{CF}_i + \beta_3 * \mathrm{BTO}_i + \beta_4 * \mathrm{CD}_i + e_i$$

The response,

$$\log\left(\frac{p_i}{1-p_i}\right)$$

can be viewed as the natural logarithm of the odds in favor of having AD. For clarity, we then transformed this response back to the probability of having the disease, p_i. We classified someone as likely to have AD if $p_i > 0.7$ and unlikely to have AD if $p_i < 0.3$. We categorized patients with $0.3 < p_i < 0.7$ (p_i indicating probability of AD) as requiring further testing (diagnosis deferred).

Estimating the model on the 95 subjects (55 patients with AD and 40 control subjects) gave the following model, with SEs of the estimated coefficients given within parentheses.

$$\log\left(\frac{p_i}{1-p_i}\right) = \underset{(4.01)}{10.3} \; \underset{(0.26)}{-0.52*\mathrm{ECR}} \; \underset{(0.12)}{-0.14*\mathrm{CF}} \; \underset{(0.59)}{+1.19*\mathrm{BTO}} \; \underset{(0.38)}{-0.51*\mathrm{CD}}$$

Results

Demographics

There were no significant differences in mean age and education (years of education) between patients with AD and control subjects (t = -1.96, $p > 0.05$ and t =1.93, $p > 0.05$, respectively).There was also no significant difference between the two groups (A and B) in the ratio of male-female subjects ($\chi_2 < 1$ and $p > 0.05$) (Table 1).

We separated a group of patients with MMSE > 20 and an age-matched control group from the groups A and B, respectively. The demographic data of these groups are shown in Table 2. There was also no significant difference between these two new groups in the ratio of male-female subjects ($\chi_2 < 1$ and $p > 0.05$).

There were no significant differences in mean age and education between patients with AD and MMSE > 20 and control subjects (Table 2).

Neuropsychological battery

Tables 3, 4, and 5 summarize the neuropsychological data from patients with AD, patients with other neuropsychological disorders, patients with AD and MMSE > 20, and control subjects. Statistical analysis (t tests) on MMSE, CAMGOG, and FRSSD indicated that the patients with AD performed significantly worse than control subjects. There was no significant difference in the HRS and GDS scales for depression between these two groups. There was a significant difference only in MMSE between nondemented patients with neurological disorders and healthy control subjects, which means that these patients had only MCI (Table 4).

There was a significant difference only in MMSE and CAMCOG without any difference in the FRSSD. That means that the group of patients with MMSE > 20 had a very mild dementia with a mild impairment in Activities of Daily Living (ADLs) (Table 5).

Individual tests

To determine if patients with AD and control subjects differed significantly on individual tests in the Seven-Minute Screen, we performed t tests between the mean test scores. Mean scores and t values are shown in Tables 6, 7, and 8. As the tables show, there were significant differences on all measures ($p < 0.001$) in the groups with patients with AD (Table 6).

Figure 1 shows the distribution of scores for each of the individual tests for patients with AD and control subjects.

It is very interesting that, although in the other cognitive or functional scales there was no significant difference

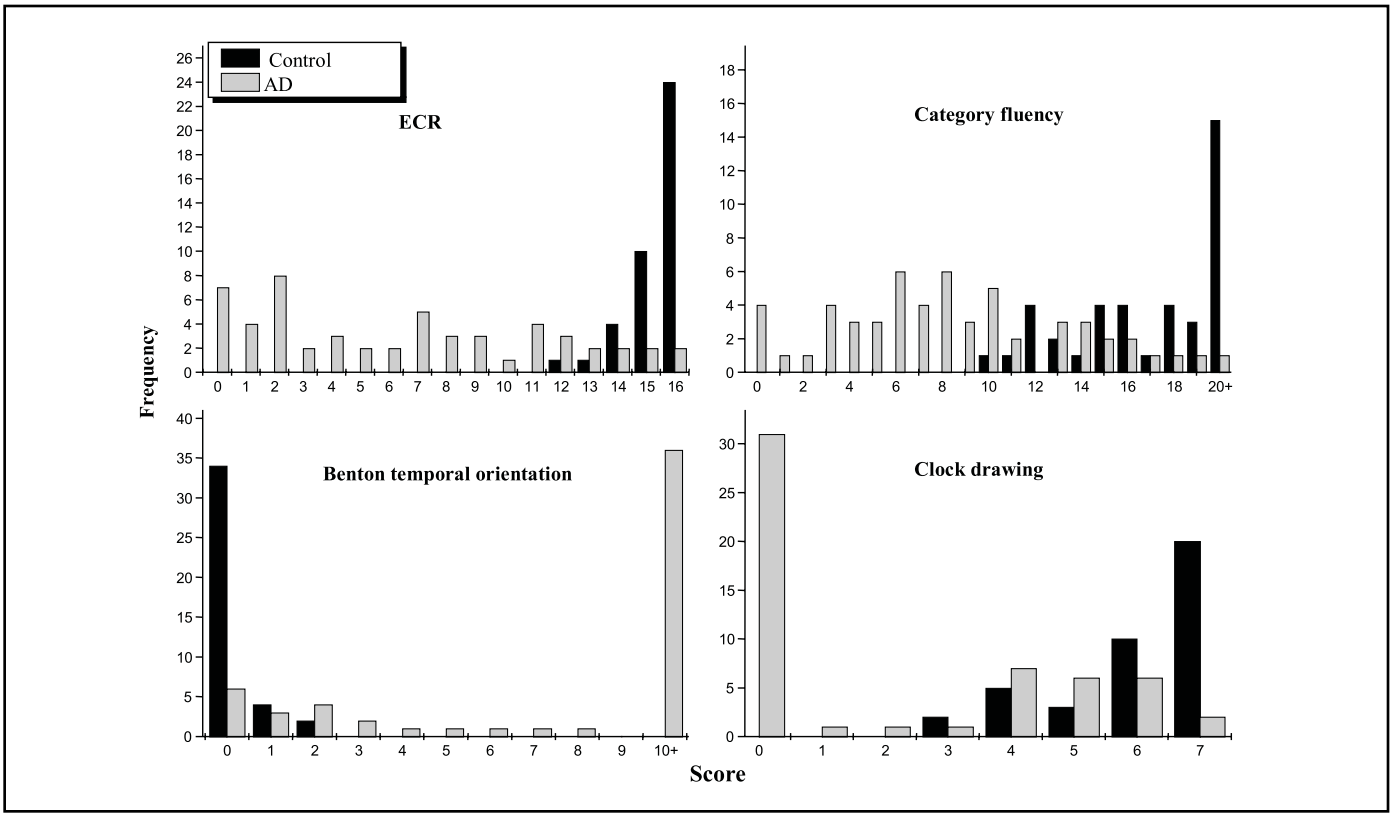

Figure 1. Frequency distributions of individual test scores for patients with AD and healthy control subjects. ECR indicates Enhanced Cued Recall.

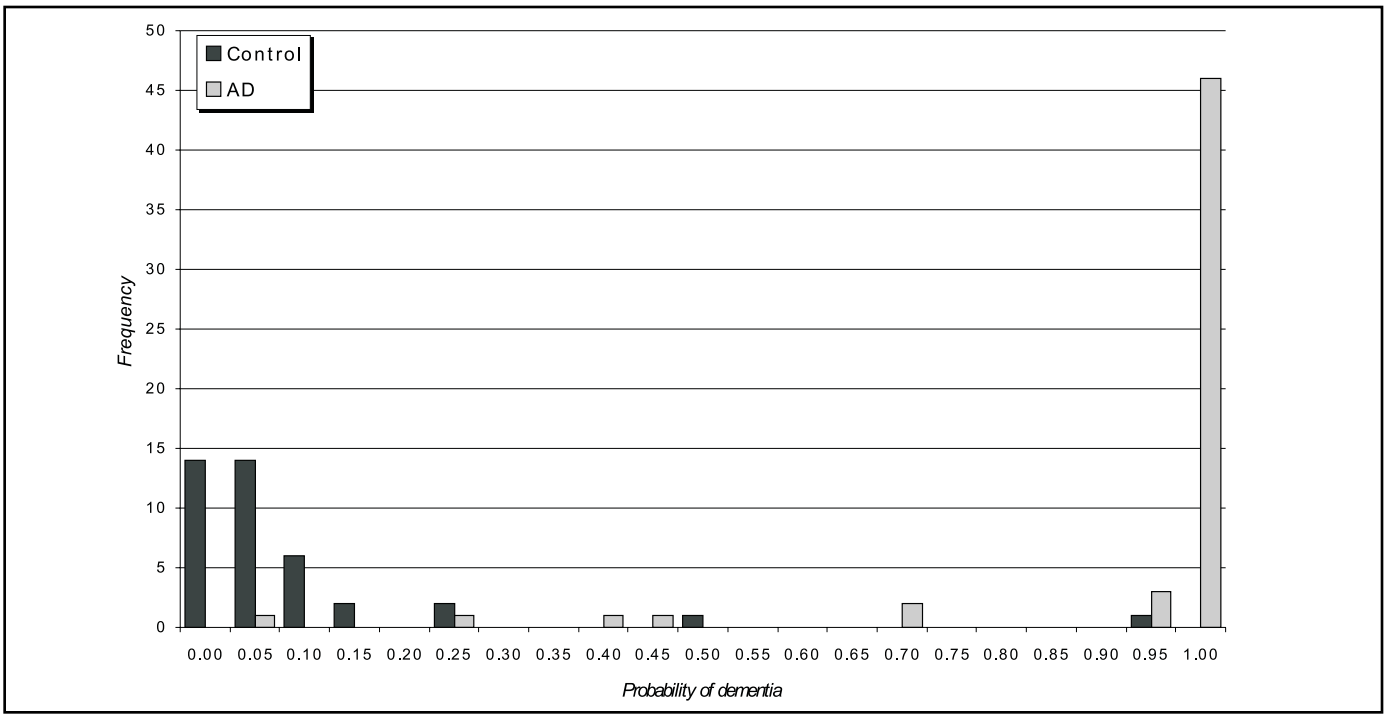

Figure 2. Frequency distribution of probabilities for patients with AD and healthy control subjects.

Table 1. Demographic characteristics			
Characteristics	**Patients with Alzheimer's disease (n = 55) (group A)**	**Healthy control subjects (n = 40) (group B)**	**Nondemented patients with neurological disorder (n = 31) (group C)**
Education (mean years)	6.75	8.5	7.15
Educational level range	0 – 16	0 – 18	0 – 16
Mean age in years (range)	70.67 (51 – 86)	67.75 (52 – 82)	63.71 (48 – 81)
Sex (M/F)	21/34	16/24	3/28

except for MMSE, in the individual tests there is a significant difference with the exception of the Benton Temporal Orientation Test (Table 7).

There is also a significant difference in all tests between the patients with AD and MMSE > 20 and healthy age-matched controls (Table 8).

The model of regression analysis that was used resulted in a sensitivity of 92.73 percent and a specificity of 97.5 percent using 0.7 as a cutoff probability. In fact, 38 of the 40 control subjects had $p_i < 0.3$ and 51 of the 55 patients with AD had $p_i > 0.7$. We also calculated the positive and negative predictive values (Table 9).

Figure 2 shows the distribution of probabilities for patients with AD and control subjects.

Two of the predictors (clock drawing and category fluency) in the model in the first equation were not statistically significant at the $\alpha = 0.05$ level using the *t* statistic. A stepwise procedure resulted in a model dropping the clock drawing and the Benton Temporal Orientation Test score with the two remaining predictors statistically significant.

A model using age, years of education, and sex of patient was also considered.

Since sex showed no predictive ability, a second model with only age and years of education was estimated. Using a probability of disease of only 0.5 as a cutoff probability for diagnosis, the model had a sensitivity of only 79.63 percent (43/54) and a specificity of 50 percent (20/20). Probabilities for the patients with AD ranged from 0.24 to 0.82 (mean 0.62), while the control subjects ranged from 0.19 to 0.82 (mean 0.52). Thus, while age and years of education have some ability to predict AD, it is a weak mean of estimation. Additionally, when these terms were added to the model above as covariates, neither age, education, nor sex was statistically significant.

In Tables 10 and 11 one can see the high sensitivity and specificity of this test in patients with AD and MMSE > 20.

In patients with other neurological diseases and cognitive decline, age and education did not have a prognostic value ($\alpha = 0.05$). Analysis of the neuropsychological data from nondemented patients with neurological disorder and control subjects showed that this group performed significantly worse on MMSE (mean 24.5 ± 3.07 and mean 27.15 ± 1.95, respectively). There was no significant

Table 2. Demographic characteristics of patients with AD with MMSE > 20		
Characteristics	**Patients with Alzheimer's disease (n = 16)**	**Healthy control subjects (n = 29)**
Education (mean years)	6.75	8.80
Educational level, range	3 – 12	0 – 18
Mean age in years (range)	72.69 (59 – 86)	68.28 (54 – 82)
Sex (M/F)	5/11	12/17

Table 3. Neuropsychological test results of patients with AD and controls			
Tests	**Patients with Alzheimer's disease Mean (SD) (n = 55)**	**Healthy control subjects Mean (SD) (n = 40)**	**t**
MMSE	16.52 (5.73)	27.16 (1.95)	12.276*
CAMCOG	50.67 (18.53)	89.38 (7.65)	11.522*
FRSSD	11.50 (7.11)	3.33 (3.06)	-3.809**
GDS	4.67 (3.49)	5.45 (3.05)	0.674
HRS	11.37 (5.13)	14.54 (6.23)	1.627
*For each, $p < 0.001$; ** $p < 0.05$.			

difference in the other scales (CAMGOG, FRSSD, HRS, GDS). On individual tests in the Seven-Minute Screen, we also performed *t* tests between the mean test scores. There were significant differences on the enhanced cued recall, the verbal fluency, and the clock drawing task. ($p < 0.05$). The sensitivity and specificity given from logistic regression were 58.06 percent and 80 percent, respectively.

Nondemented patients with neurological disorders, when compared with patients with AD, showed a significant difference in all other scales but FRSSD and GDS (for each $p > 0.05$). On individual tests in the Seven-Minute Screen, *t* tests between the mean test scores indicated that there were significant differences on all measures ($p < 0,001$). Logistic regression gave sensitivity and specificity of 89.09 percent and 93.55 percent, respectively.

Table 4. Neuropsychological test results of nondemented patients			
Tests	**Nondemented patients with neurological disorder Mean (SD) (n = 31)**	**Healthy control subjects Mean (SD) (n = 40)**	**t**
MMSE	24.50 (3.08)	27.15 (1.99)	3.997*
CAMCOG	82.87 (10.52)	89.37 (7.65)	1.979
FRSSD	6.00 (4.76)	3.34 (3.05)	-0.839
GDS	5.57 (2.76)	5.45 (3.04)	-0.100
HRS	17.29 (7.61)	14.54 (6.23)	-0.998
*For each, $p < 0.001$.			

Table 5. Neuropsychological test results of patients with AD with MMSE > 20			
Tests	**Patients with Alzheimer's disease Mean (SD) (n = 16)**	**Healthy control subjects Mean (SD) (n = 29)**	**t**
MMSE	22.68 (2.21)	27.24 (1.99)	7.055*
CAMCOG	68.28 (8.74)	90.14 (7.27)	7.339*
FRSSD	7.23 (5.13)	3.34 (3.05)	-1.244
GDS	3.19 (3.40)	5.45 (3.05)	1.651
HRS	9.20 (6.46)	13.90 (6.17)	1.663
* For each, $p < 0.001$.			

Administration time

The mean time to complete the test for control subjects was nine minutes and 18 seconds (range: six to 20 minutes) and for patients with AD it was 13 minutes and 32 seconds (range: nine to 20 minutes). There was a significant difference in the mean administration time between the two groups ($p < 0.001$). The mean time to complete the test for patients with AD and MMSE > 20 is 10 minutes and two seconds. Finally, the mean time to complete the test for patients with other neuropsychological disorders is nine minutes and six seconds. Education had no effect on the administration time. In our study of Greek elderly people, the mean time administration for this battery was 10 minutes and 38 seconds.

Discussion

No single instrument for cognitive screening is suitable for global use.[28] Objective cognitive testing appears to be the most logical approach to screening for dementia. The limitations of screening should be recognized.[29] Recent investigations have suggested the utility of brief, psychometric screening batteries in the early detection of abnormal mental decline.[2] This study extended the investigation of one of these batteries

Table 6. Results of individual tests of patients with AD			
Tests	**Patients with Alzheimer's disease Mean (SD) (n = 55)**	**Healthy control subjects Mean (SD) (n = 44)**	**t**
Enhanced cued recall	6.40 (5.02)	15.38 (0.95)	12.950*
Category fluency	8.20 (4.94)	18.05 (4.63)	9.848*
Benton Temporal Orientation Test	48.76 (42.74)	0.20 (0.52)	-8.427*
Clock drawing	2.07 (2.56)	6.03 (1.25)	9.937*
*For each, $p < 0.001$.			

Table 7. Results of individual tests of nondemented patients with other neurological disorders			
Tests	**Nondemented patients with neurological disorder Mean (SD) (n = 55)**	**Healthy control subjects Mean (SD) (n = 44)**	**t**
Enhanced cued recall	14.42 (1.84)	15.37 (0.95)	2.632*
Category fluency	15.71 (4.32)	18.05 (4.63)	2.173*
Benton Temporal Orientation Test	0.42 (1.15)	0.20 (0.52)	-1.077
Clock drawing	5.16 (1.89)	6.02 (1.25)	2.305*
* For each, $p < 0.05$.			

(Seven-Minute Screen) to identify patients with AD.

This study provides initial validity data for this brief screening battery to identify patients with AD. The data from the present study suggest that the battery is sensitive (92.73 percent) in detecting patients with AD and shows a degree of specificity of 97.50 percent in detecting healthy subjects. The sensitivity and specificity levels of the present battery seem to compare favorably with the most commonly used tests of mental status in elderly patients. A review of the MMSE[30] found that the majority (about 75 percent) of studies using the 23/24 cutoff points reported sensitivity in the 80 percent to 90 percent range. However, this range decreases substantially (44 percent to 68 percent) when the group with dementia is less impaired (*i.e.*, mean MMSE score > 20). The present battery was well within the range of the MMSE for sensitivity and specificity for the entire sample. The battery was able to detect four out of four patients with MMSE scores above 23, a group of patients who would generally be considered to be mildly demented. These patients would have been classified as within normal limits by the MMSE using the 23/24 cutoff criterion.

A particular problem is posed by elderly populations with low educational levels, as performance on most cognitive tests is affected by education. Thus, a healthy but poorly educated population may obtain test scores in the range considered impaired in the clinical setting.[31] The MMSE and the Mattis Dementia Rating Scale are

Table 8. Results of individual tests of patients with AD and MMSE > 20			
Tests	**Patients with Alzheimer's disease Mean (SD) (n = 16)**	**Healthy control subjects Mean (SD) (n = 29)**	**t**
Enhanced cued recall	10.35 (3.65)	15.48 (0.83)	5.521*
Category fluency	10.69 (4.10)	18.38 (5.03)	5.232*
Benton Temporal Orientation Test	14.75 (26.05)	0.21 (0.56)	-2.231**
Clock drawing	2.81 (2.84)	6.21 (1.15)	4.589*
* For each, $p < 0.001$; ** For each, $p < 0.05$.			

Table 9. Measures of validity of the Seven-Minute Screening Battery (%) with cutoff probability 0.5 (in all patients with AD and control subjects)	
Positive predictive value	98.10%
Negative predictive value	90.69%
Specificity	97.50%
Sensitivity	92.73%

Table 10. Measures of validity of the Seven-Minute Screening Battery (%) with cutoff probability 0.5 (in patients with AD and MMSE > 20 and age matched controls)	
Positive predictive value	93.75%
Negative predictive value	96.55%
Specificity	96.55%
Sensitivity	93.75%

Table 11. Measures of validity of the Seven-Minute Screening Battery (%) with cutoff probability 0.7 (in patients with AD and MMSE > 20 and age matched controls)	
Positive predictive value	92.86%
Negative predictive value	90.33%
Specificity	96.55%
Sensitivity	81.25%

among the most commonly used screening tests for dementia. There is a relationship between dementia test scores and both age and educational level.[32]

One ongoing criticism of the MMSE is its sensitivity to education. For example, Anthony *et al.*[33] found that for patients with less than an eighth-grade education, specificity decreased from 82 percent to 63 percent. Similarly, O'Connor *et al.*[7] reported that false negatives are much more likely to occur in patients with high educational levels. The correlation between MMSE score and reading skills is stronger than the correlation with other sociodemographic variables. Proper interpretation of MMSE scores requires knowledge of patients' reading levels.[34] The present battery does not appear to be as sensitive to education. Adding years of education to the logistic regression analysis as a covariate did not significantly affect the predictions. The MMSE has also been shown to be sensitive to age. Most of the age-related changes begin from 55 to 60 years, and dramatically accelerate over the age of 75 to 80 years.[30] The present battery does not appear to show as much sensitivity to age and gender. Adding age and gender to the logistic regression analysis as a covariate did not significantly affect the predictions. Though age and years of education have some ability to predict AD, it is weak. Additionally, when these terms were added to the model above as covariates, neither age nor education was statistically significant.

In our study, using a stepwise procedure in logistic regression resulted in model dropping the clock drawing and the Benton Temporal Orientation Test score with the two remaining predictors statistically significant, while in the study of Solomon *et al.* only the individual test of clock drawing was dropped.

It is very interesting that, although in the other cognitive or functional scales (CAMCOG-FRSSD), there was no significant difference except on the MMSE in patients with AD and MMSE > 20, in the individual tests there was a significant difference with the exception of the Benton Temporal Orientation Test. That means that the Seven-Minute Screen is a very useful instrument in the screening of early dementia.

In our study, the mean time of administration for this battery was longer than in the Solomon *et al.* study (10 minutes and 38 seconds). Perhaps this difference can be explained by the difference in personnel who examined the patients. In our study, trained psychologists examined the patients and controls, while in Solomon's study trained personnel carried out the exams.

Nondemented patients with neurological disorders, when compared with patients with AD, showed a significant difference for all other scales but FRSSD and GDS (for each, $p > 0.05$). On individual tests in the Seven-Minute Screen, *t* tests between the mean test scores indicated that there were significant differences on all measures ($p < 0.001$). Logistic regression gave sensitivity and specificity, 89.09 percent and 93.55 percent, respectively. That means that we can distinguish patients with other neurological disorders and cognitive decline from

patients with AD with the Seven-Minute Screen. However, we cannot distinguish them from normal controls (sensitivity 58.06 percent and specificity 80 percent).

This study confirms the first data on the Seven-Minute Screen by Solomon *et al.* and suggests that this test can be used widely as a screening test with high sensitivity and specificity. So that we can use it in prevalence and incidence studies, we have to examine whether it can distinguish patients with MCI from normal elderly people, and if it can differentiate AD from other types of dementia such as vascular dementia, Lewy Body disease, frontal dementia, and frontotemporal dementia. The next useful step is to correlate it with ADLs and monitor elderly people every year.

In summary, the Seven-Minute Screen appears to be highly sensitive and specific in its ability to discriminate between patients with AD and healthy control subjects. It can be rapidly administered, although in some centers or countries the administration time may be longer than in the English study.

References

1. Evans DA, Funkenstein HH, Albert MS, *et al.*: Prevalence of Alzheimer's disease in a community population of older persons: Higher than previously reported. *JAMA*. 1989; 261: 2551-2556.
2. Nelson DV, Harper RG, Kotik-Harper D, *et al.:* Brief neuropsychologic differentiation of demented versus depressed elderly inpatients. *Gen Hosp Psychiatry.* 1993; 15(6): 409-416.
3. Nelson A, Fogel BS, Faust D: Bedside cognitive screening instruments. A critical assessment. *J Nerv Ment Dis*. 1986; 174(2): 73-83.
4. Folstein MF, Folstein SE, McHugh PR: "Mini-Mental State": A practical method for grading cognitive states of patients for the clinician. *J Psychiatr Res*. 1975; 12: 189-198.
5. Heinik J, Hes JP, Avnon M: Diagnosis of dementia by different specialties. *Isr J Psychiatry Relat Sci.* 1995; 32(1): 55-64.
6. Glasako D, Klauber MR, Hofstetter CR, *et al.*: The Mini-Mental State Examination in the early diagnosis of Alzheimer's disease. *Arch Neurol*. 1990; 47: 49-52.
7. O'Connor DW, Pollitt PA, Hyde JB, *et al.*: The reliability and validity of the Mini Mental State in a British community survey. *J Psychiatr Res*. 1975; 12: 189-198.
8. Hodges JR, Salmon DP, Butters N: Differential impairment of semantic and episodic memory in Alzheimer's and Huntington's diseases: A controlled prospective study. *J Neurol Neurosurg Psychiatry*. 1990; 53: 1089-1095.
9. Kluger A, Ferris SH: Scales for the assessment of Alzheimer's disease. *Psychiatr Clin North Am*. 1991; 14: 309-326.
10. Uhlmann RF, Larson EB: Effect of education on the Mini-Mental State Examination as a screening test for dementia. *J AM Geriatr Soc*. 1991; 39: 876-880.
11. Mattis S: Mental status examination for organic mental syndrome in the elderly patients. In Bellack R, Karasu B (eds.): *Geriatric Psychiatry*. New York: Grune and Stratton, 1976, 77-121.
12. Solomon PR, Hirschoff A, Kelly B, *et al.*: A 7 minute neurocognitive screening battery highly sensitive to Alzheimer's disease. *Arch Neurol.* 1998; 55(3): 349-355.
13. Grober E, Buschke H, Crystal H, *et al.*: Screening for dementia by memory testing. *Neurology*. 1988; 38: 900-903.
14. Grober E, Buschke H: Genuine memory deficits in dementia. *Dev Neuropsychol*. 1987; 3: 13-36.
15. Monsch AU, Bondi MW, Butters N, *et al.*: Comparison of verbal fluency tasks in detection of dementia of the Alzheimer type. *Arch Neurol*. 1992; 49: 1253-1257.
16. Rosen W: Verbal fluency in aging and dementia. *J Clin Neuropsychol*. 1980; 2: 135-146.
17. Huff FJ, Corkins S, Growdon JH: Semantic impairment and anomia in Alzheimer's disease. *Brain Lang*. 1986; 28: 235-249.
18. Winogrond JR, Fisk AA: Alzheimer's disease: Assessment of functional status. *J Am Geriatr Soc*. 1983; 31: 780-785.
19. Benton AL: *Contributions to Neuropsychological Assessment*. New York: Oxford University Press, 1983.
20. Wolf-Klein GP, Silverstone FA, Levy AP, *et al.*: Screening for Alzheimer's disease by clock drawing. *J Am Geriatr Soc*. 1989; 37: 730-734.
21. Sunderland T, Hill JL, Melow AM, *et al.*: Clock drawing in Alzheimer's disease: A novel measure of dementia severity. *J Am Geriatr Soc.* 1989; 37: 725-729.
22. Brodathy H, Moore CM: The Clock Drawing Test for dementia of the Alzheimer's type: A comparison of three scoring methods in a memory disorders clinic. *Int J Geriatr Psychiatry*. 1997; 12(6): 619-627.
23. Libon DJ, Malamut BA, Swenson R, *et al.*: Further analysis of clock drawings among demented and nondemented older subjects. *Arch Clin Neurol.* 1996; 11: 193-205.
24. Freedman M, Leach L, Kaplan E, *et al.*: *Clock drawing: A Neuropsychological Analysis*. New York: Oxford University Press, 1994.
25. Watson YI, Arfken CL, Birge SL. Clock completion: An objective screening test for dementia. *J Am Geriatr Soc.* 1993; 41(11): 1235-1240.
26. American Psychiatric Association. *Diagnostic and Statistical Manual of Mental Disorders*, 4th ed. (DSM-IV). Washington DC: American Psychiatric Press, 1994.
27. McKhann GD, Drachman D, Folstein M, *et al.*: Clinical diagnosis of Alzheimer's disease: Report of the NINCDS-ADRDA Work Group under the auspices of Department of Health and Human Services Task Force on Alzheimer's disease. *Neurology*. 1984; 34: 939-944.
28. Brodaty H, Clarke J, Ganguli M, *et al.*: Screening for cognitive impairments in general practice: Toward a consensus. *Alzheimer Dis Assoc Discord.* 1998; 12(1): 1-13.
29. Ganguli M: The use of screening instruments for the detection of dementia. *Neuroepidemiology.* 1997; 16(6): 271-280.
30. Tombaugh TN, Mclntyre NJ: The Mini-Mental State Examination: A comprehensive review. *J Am Geriatr Soc*. 1992; 40: 922-935.
31. Ganguli M, Belle S, Ratcliff G, *et al.*: Sensitivity and specificity for demented of population-based criteria for cognitive impairment: The MoVIES project. *J Gerontol.* 1993; 48: 4 M152-M161.
32. Freidl W, Schmidt R, Stronegger WJ, *et al.*: Sociodemographic predictors and concurrent validity of the Mini-Mental State Examination and the Mattis Dementia Rating Scale. *Eur Arch Psychiatry Clin Neurosci*. 1996; 246(6): 317-319.
33. Anthony JC, LaResche L, Niaz U, *et al.*: Limits of the "Mini Mental State" as a screening test for dementia and delirium among hospital patients. *Psychol Med*. 1982; 12: 397-408.
34. Weiss BD, Reed R, Kligman EW, *et al.*: Literacy and performance on the Mini-Mental State Examination. *J Am Geriatr Soc*. 1995; 43(7): 807-810.