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Six-Item Screener to Identify Cognitive Impairment Among Potential Subjects for Clinical Research

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OBJECTIVE. To design a brief cognitive screener with acceptable sensitivity and specificity for identifying subjects with cognitive impairment

DESIGN. Cohort one is assembled from a community-based survey coupled with a second-stage diagnostic evaluation using formal diagnostic criteria for dementia. Cohort two is assembled from referrals to a specialty clinic for dementing disorders that completed the same diagnostic evaluation.

SETTING. Urban neighborhoods in Indianapolis, Indiana and the Indiana Alzheimer Disease Center.

PATIENTS. Cohort one consists of 344 community-dwelling black persons identified from a random sample of 2212 black persons aged 65 and older residing in Indianapolis; cohort two consists of 651 subject referrals to the Alzheimer Disease Center.

MEASUREMENTS. Formal diagnostic clinical assessments for dementia including scores on the Mini-mental state examination (MMSE), a six-item screener derived from the MMSE, the Blessed Dementia Rating Scale (BDRS), and the Word List Recall. Based on clinical evaluations, subjects were categorized as no cognitive impairment, cognitive impairment-not demented, or demented.

RESULTS. The mean age of the community-based sample was 74.4 years, 59.4% of the sample were women, and the mean years of education was 10.1. The prevalence of dementia in this sample was 4.3% and the prevalence of cognitive impairment was 24.6%. Using a cut-off of three or more errors, the sensitivity and specificity of the six-item screener for a diagnosis of dementia was 88.7 and 88.0, respectively. In the same sample, the corresponding sensitivity and specificity for the MMSE using a cut-off score of 23 was 95.2 and 86.7. The performance of the two scales was comparable across the two populations studied and using either cognitive impairment or dementia as the gold standard. An increasing number of errors on the six-item screener is highly correlated with poorer scores on longer measures of cognitive impairment.

CONCLUSIONS. The six-item screener is a brief and reliable instrument for identifying subjects with cognitive impairment and its diagnostic properties are comparable to the full MMSE. It can be administered by telephone or face-to-face interview and is easily scored by a simple summation of errors. (Med Care 2002; 40:771–781)

Scientists interested in enrolling older adults in clinical research studies often seek to identify subjects with cognitive impairment as an initial assessment in the consideration of more specific

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inclusion or exclusion criteria. Excluding subjects with cognitive impairment may be desirable when the study relies on self-reports of functioning, mood, health-related quality of life, or health services utilization as outcome measures. Other investigators may adjudge that adherence to specific self-care behaviors, study protocols, or other complex tasks require intact cognitive function. Scientists studying dementing disorders often seek to efficiently screen a large numbers of subjects in a first-stage assessment to identify those patients most likely to meet criteria for dementia in a second-stage assessment. Despite the frequent goal to efficiently identify older adults with cognitive impairment or identify those with a high probability of dementing disorders, there is no consensus on how to best balance the need for accuracy with limited resources and time.

Clearly, these issues are not limited to research. Clinicians faced with the resource constraints of daily clinical practice also seek screening tests, which can balance accuracy with efficiency. There are already numerous measures of cognitive impairment developed for use in clinical settings. These instruments typically range from 10 to 30 items. Most of these questionnaires have demonstrated sensitivity and specificity as an aid to the diagnosis of dementia. Unfortunately, these instruments can take from 7 to 15 minutes to complete and some require props, paper, and pencil, or other face-to-face interactions. In addition, these longer scales do not always perform with greater accuracy in comparison to shorter scales.[1] One solution to the time burdens of these longer questionnaires has been two-stage screening. For example, Lachs et al[2] have suggested using three-item recall as an initial screen for cognitive impairment followed by the Mini-Mental State Examination (MMSE) for those patients unable to recall all three items. This first-stage screen is reported to have excellent sensitivity (97%), but poor specificity (43%) which makes it useful as an initial screen to identify those subjects unlikely to have the condition.[3]

However, in some clinical trials, investigators may be more interested in optimizing specificity. For example, in the design of an ongoing multisite study of late life depression, investigators were faced with the challenge of balancing the need to exclude older adults who would be unable to provide self-reports or adhere to the protocol with the competing goal to include older adults who might have poor cognitive performance because of a treatable depression.[4] Indeed, it is often difficult to determine what magnitude of cognitive impairment renders a potential subject ineligible for meaningful participation. Many patients with mild cognitive impairment may be capable of providing self-reports and following study protocols. An overzealous exclusion of subjects with mild cognitive impairment might unnecessarily reduce the generalizability of a study. Thus, different studies would be expected to make different choices in balancing the competing needs for sensitivity and specificity.

We sought to develop a brief screen for cognitive impairment that would balance diagnostic accuracy with the logistic demands of screening a large group of subjects in an efficient manner. This report provides a detailed description of the sensitivity, specificity, and predictive value of a six-item screener for cognitive impairment among older adults. There are several advantages of this six-item screener over existing scales in addition to its brevity. First, each of the six items comes from the MMSE, which allows for comparison among the many studies utilizing this longer questionnaire. Second, the six-item screener can be administered over the telephone and it is scored simply by summing the number of errors. Third, the diagnostic performance of the scale can be varied by choosing a cut-off score to match the study goals. The six-item screener is offered as an efficient tool to identify patients with cognitive impairment either as a one-stage screen with acceptable specificity to exclude those with moderate to severe impairment, or as the first stage of a two-stage screen to identify probable cases of dementia.

Materials and Methods

Study Samples

The impetus for this study was the need for a brief cognitive screener to efficiently exclude patients with moderate to severe cognitive impairment in a multisite study of late life depression.[4] The data for this study come from two projects funded by the National Institute on Aging that are investigating the prevalence, incidence, risk factors, and treatment of dementia. The first source of subjects is a study on the prevalence of dementia among a community-based sample of black persons. The second source is from the subjects

assembled from referrals to the Indiana Alzheimer Disease Center. Both groups of subjects complete the same clinical evaluation process by the same group of clinicians associated with the Indiana Alzheimer Disease Center. However, in the first sample, subjects are identified by a community-based screening program and in the second sample, subjects are referred to the Center. The two samples are described below followed by a description of the common clinical evaluation.

For the community-based sample, the geographic target area consisted of 29 contiguous census tracts with a total population of 82,387 and total households of 32,954 in the 1990 US Census. Black persons comprised 86% of this population, which also represents more than two-thirds of Indianapolis' elderly black population. A random sample of 60% of residential addresses was constructed by the Indianapolis Water Company using all residential addresses in the target area, and identified homes were then visited by interviewers from May 1, 1992-April 30, 1993. Patients residing in nursing homes are not included in this sample. Eligible subjects had to be (1) a resident at a sampled address, (2) black, and (3) age 65 years or older. A total of 7590 households were approached, 4915 of which did not have an eligible resident. Of the 2582 eligible persons, 2212 (85.7%) agreed to participate. These subjects were screened with the Community Screening Instrument for Dementia (CSI-D).

Details of the development, content, scoring, and psychometric properties of the CSI-D have been previously published.[5,6] Briefly, the CSI-D is composed of two parts: a 33-item scale assessing the subject's cognitive performance and a 24-item scale assessing a relative's perception of a decline in the subject's functional or social abilities. Items for the CSI-D were selected from several widely used screening instruments including the Cambridge Mental Disorders in the Elderly Examination,[7] the Mini-Mental State Examination,[8] the Dementia Rating Scale,[9] the Comprehensive Assessment and Referral Evaluation,[10] and the East Boston Memory Test.[11] The items selected test cognitive function across multiple domains but specifically exclude literacy dependent items. A discriminant function was derived in developmental work on the CSI-D to establish an empirically derived cut-off score that best differentiated between demented and nondemented with a structured clinical assessment as the gold standard. Subjects were classified into "poor," "intermediate," or "good" performance groups based on their discriminant function score. In a community prevalence study, the sensitivity of the CSI-D was 87% and the specificity was 83%.[6]

A stratified sample of the community-based subjects was selected for full clinical assessments based on their performance on the CSI-D. All subjects who scored poorly on the CSI-D were invited for clinical assessments and we also selected a 50% sample of those with intermediate performance, and a 5% sample of those with good performance. Patients aged 75 and older were over-sampled in the 5% sample so that 75% of the patients with good performance on the CSI-D would be 75 years of age or older. Rates of cognitive impairment, dementia, and Alzheimer's disease among this community-based sample have been previously published.[12,13] The impact of age, gender, education, and occupation on cognitive performance in this sample has also been previously published.[14,15] There were 351 patients selected for full clinical assessments but seven were too severely impaired to complete the standardized questionnaires. Data for the remaining 344 (98%) subjects are included here.

The second set of subjects comes from patient referrals to the Alzheimer Disease Center at the Indiana University School of Medicine. The differences in sampling strategies for these two samples are considerable and are reflected in the demographic and clinical characteristics provided in Table 1. Patients are referred to this Center both for diagnosis and for treatment and it is the only Center of its kind in Indiana. Notably, patients from this sample are not initially screened but referred by family, caregivers, or providers for evaluation. Thus, the CSI-D is not performed as the first stage assessment of the clinical sample. The clinical sample is not limited to black persons who were the focus of the community-based study described above. There were 662 subjects referred for the clinical assessment, but eleven were too severely impaired to complete the standardized questionnaires. Data for the remaining 651 (98%) subjects are included here.

Clinical Assessments

All clinical assessments of subjects from the community-based cohort were made blinded to the screening status. A geriatric psychiatrist or neurologist conducted a complete physical and

TABLE 1. Characteristics of Patient Samples

	Community-Based Sample	Alzheimer Disease Center Sample	*P* Value
Sample size	344	651	<0.001
Mean age (range)	74.4 (65–99)	69.6 (21–92)	<0.001
% women	59.4	57.1	<0.698
% black	100	16.1	<0.001
Mean years of education (range)	10.4 (0–16)	12.5 (0–20)	<0.001
% cognitively impaired	26.4	61.3	<0.001
% with dementia	4.3	53.0	<0.001
Mean errors on six-item screener	1.3	2.6	<0.001
Mean score on MMSE	26.1	21.7	<0.001
Mean score on Word List Recall	13.8	12.6	0.012
Mean score on Blessed Dementia Rating Scale	4.3	7.4	<0.001

neurologic examination. Cognitive assessments included the MMSE, the cognitive performance portion of the CAMDEX, and the Consortium for Establishment of Registry for Alzheimer Disease (CERAD) battery.[16] In addition to the MMSE, the CERAD battery includes the Animal Fluency Test (a measure of semantic fluency in which subjects generate as many names of animals as possible in 60 seconds), the Boston Naming Test (a 15-item test of confrontation naming of line drawings of objects), Constructional Praxis (a test of graphomotor skill in which subjects copy geometric figures), and the Word List Recall (a 10-item word list is presented three times with free recall and recognition assessed after a brief, filled interval). Where possible, a relative of the subject was also interviewed. A research nurse met with a spouse or other relative and completed the semi-structured Informant Interview. The interview provides information on the presence, duration, and severity of symptoms of memory, language, judgment and reasoning, and personality change. Informants are also asked to characterize the subject's performance of instrumental and basic activities of daily living (ADLs). The CERAD-modified version of the Blessed Dementia Scale[9] was calculated from the Informant Interview for those subjects where an informant could be interviewed. The Blessed consists of 11 items assessing memory, comprehension, shopping/money management, performance of household chores, dressing, feeding, and toileting.

On the basis of the above evaluation, participants were classified as normal, cognitive impairment-not demented, or demented. Patients were diagnosed as cognitive impairment-not demented if: (1) the informant reported a clinically significant decline in cognition; (2) the physician detected a clinically significant impairment in cognition; or (3) the participant's scores on cognitive testing fell below the 7th percentile; and if there was no clinically important impairment in the performance of activities of daily living.[17] The 7th percentile is approximately equivalent to 1.5 standard deviations (SD) below the mean, the level of impairment specified by Mayo Clinic in their criteria for mild cognitive impairment. For a diagnosis of dementia both DSM-III-R and ICD-10 criteria had to be satisfied.[18,19] On the basis on this clinical assessment, patients were dichotomized into demented and nondemented groups. Patients with dementia were then further categorized into those with and without possible or probable Alzheimer disease as defined by NINCDS/ADRDA criteria.[20] For the purposes of the current study, we focus on the diagnosis of normal, cognitive impairment-not demented, or dementia. In all tables, the cognitive impairment group includes both patients with the "cognitive impairment-not demented" diagnosis and the dementia diagnosis.

Design of Six-Item Screener

In designing the six-item screener, we sought to balance the instrument's diagnostic properties with brevity, ease of administration, and validity. Because investigators working on different projects might seek to optimize sensitivity as opposed to specificity or vice versa, we also sought

to design a screener that would allow a variety of "cut-off points." The hallmark of dementia is a deficit in short-term memory. The MMSE is heavily loaded with memory items though some are more sensitive than others. For example, temporal disorientation occurs before disorientation to place. Within temporal orientation, problems with day of the week, month, and year are rarely seen in those not experiencing dementia (high specificity). Three-object recall is the best assessment of new learning ability in the MMSE and has consistently been identified as having excellent discrimination for identification of subjects with cognitive impairment (high sensitivity). Three-object registration has more to do with language, hearing, and attention. Although registration is a necessary step in successful recall, it does not in itself discriminate well between those with and without dementia. The rest of the MMSE items tap language, attention, or praxis and while any of these may be impaired in any given patient with dementia, no one domain or item is reliably implicated, some of these items are more sensitive to education, and some require props or motor skills not assessable by telephone. Thus, we chose the three-item recall (apple, table, penny) and three-item temporal orientation (day of the week, month, year) to design the six-item screener. Notably, the three-item recall question in the CSI-D is "boat, house, and fish" consistent with prior work on this instrument.[12]

We present the sensitivity, specificity, predictive value, and area under the receiver operating characteristic (ROC) curve for the six-item screener using cognitive impairment as the gold standard and then with dementia as the gold standard. Analyses of the community-based sample analyses are weighted, with individual weights being inversely proportional to the sampling proportion in that stratum. To compare the performance of the six-item screener with the full MMSE, we present the diagnostic properties of the MMSE in this same population and report the mean scores and ranges on the MMSE, Word List Recall, and Blessed Dementia scale at each level of subject performance on the six-item screener. As noted above, approximately 2% of both sample populations could not be tested on the MMSE because of the severity of their impairment. Among the subjects adjudged to be testable, coding of responses to the MMSE required that the respondent provide the correct answer or the item was coded as incorrect. However, 21% of the community-based sample and 8% of the clinical sample either refused or could not perform the Word List Recall. Also, 53% of the community-based sample and 31% of the clinical sample did not have an informant and therefore do not have scores on the Blessed Dementia Rating Scale.

Results

Table 1 provides the clinical characteristics of the two samples. As would be expected from the differences in sampling strategy, the community-based sample consists of black persons who are older, less educated, and less likely to have cognitive impairment or dementia as compared with the Alzheimer Disease Center sample.

Tables 2 to 5 present the diagnostic properties of the six-item screener as compared with the MMSE

TABLE 2. Sensitivity, Specificity, and Predictive Value of Six-Item Screener Among the Community-Based Sample

Six-item Screener		Cognitive Impairment as Gold Standard				Dementia Diagnosis as Gold Standard			
Errors	N	Sens	Spec	PPV	NPV	Sens	Spec	PPV	NPV
≥0	344	100.0	0.0	26.4		100.0	0.0	4.3	
≥1	273	97.7	49.2	40.8	98.3	100.0	38.4	6.7	100.0
≥2	190	74.2	80.2	57.4	89.6	96.8	68.6	12.1	99.8
≥3	120	50.4	97.4	87.2	84.5	88.7	88.0	24.8	99.4
≥4	75	27.8	99.4	93.9	79.3	75.2	95.2	40.9	98.9
≥5	45	14.8	100.0	100.0	76.6	56.1	98.4	61.1	98.1
6	18	4.7	100.0	100.0	74.5	24.2	99.8	83.3	96.7

MMSE = Mini-mental state examination; Sens = sensitivity; Spec = specificity; PPV = positive predictive value; NPV = negative predictive value; ADC = Alzheimer's Disease Center.

TABLE 3. Sensitivity, Specificity, and Predictive Value of the MMSE Among the Community-Based Sample

MMSE		Cognitive Impairment as Gold Standard				Dementia Diagnosis as Gold Standard			
Score	N	Sens	Spec	PPV	NPV	Sens	Spec	PPV	NPV
≤27	269	91.5	56.2	42.9	94.9	100.0	45.6	7.6	100.0
≤26	241	76.5	12.9	50.4	89.6	98.4	62.5	10.5	99.9
≤25	206	71.5	87.3	66.9	89.5	98.4	74.9	14.9	99.9
≤24	172	53.3	92.1	70.9	84.6	98.4	83.6	21.1	99.9
≤23	149	44.4	93.2	70.1	82.4	95.2	86.7	24.2	99.8
≤22	123	38.9	94.8	72.8	81.2	87.1	89.1	26.3	99.4
≤21	108	36.1	95.8	75.5	80.7	87.1	90.7	29.4	99.4

MMSE = Mini-mental state examination; Sens = sensitivity; Spec = specificity; PPV = positive predictive value; NPV = negative predictive value; ADC = Alzheimer's Disease Center.

using cognitive impairment or dementia as the gold standard in both the community-based and clinic-based patient populations. It must be stressed that these two instruments are being compared in the same population(s) of patients against a separate gold standard clinical diagnosis. In addition to sensitivity and specificity, we present the positive and negative predictive values. Predictive value is a property both of the sensitivity and specificity of the test and the prevalence of the disease in the population under study. A test with higher sensitivity optimizes negative predictive value whereas a test with higher specificity optimizes positive predictive value.

As demonstrated in Tables 2 to 5, the six-item screener performs well in comparison with the longer MMSE. In both populations and using either gold standard, one can identify a cut-off score on the six-item screener that would compare favorably with the MMSE in terms of diagnostic accuracy. Indeed, as a first stage screening tool among a community-based population to identify subjects with cognitive impairment the six-item screener performs at least as well as the MMSE. The six-item screener performs less well in comparison to the full MMSE when one compares the instruments in a population with a high prevalence of disease and using dementia as the gold standard. However, even in this population, one can choose a cut-off score that optimizes sensitivity and specificity. Table 6 compares the area under the ROC curves for the six-item screener as compared with the MMSE.

Table 7 compares the mean scores of three other commonly used instruments to screen for cognitive impairment with scores on the six-item screener. Mean MMSE, Word List recall, and Blessed Dementia Scale scores progressively worsen as the number of errors on the six-item screener increase. This finding is consistent across all three comparison scales and at each level of

TABLE 4. Sensitivity, Specificity, and Predictive Value of Six-Item Screener Among the ADC Clinical Sample

Six-item Screener		Cognitive Impairment as Gold Standard				Dementia Diagnosis as Gold Standard			
Errors	N	Sens	Spec	PPV	NPV	Sens	Spec	PPV	NPV
≥0	651	100.0	0.0	61.3		100.0	0.0	53.0	
≥1	477	93.7	59.1	78.4	85.6	96.8	53.3	70.0	93.7
≥2	372	84.0	85.3	90.1	77.1	89.6	79.4	83.1	87.1
≥3	306	74.2	96.0	96.7	70.1	80.6	90.9	90.9	80.6
≥4	245	60.9	99.2	99.2	61.6	67.5	96.1	95.1	72.4
≥5	173	43.1	99.6	99.4	52.5	49.0	98.7	97.7	65.2
6	107	26.6	99.6	99.1	46.1	30.4	99.4	98.1	55.9

MMSE = Mini-mental state examination; Sens = sensitivity; Spec = specificity; PPV = positive predictive value; NPV = negative predictive value; ADC = Alzheimer's Disease Center.

TABLE 5. Sensitivity, Specificity, and Predictive Value of MMSE Among the ADC Clinical Sample

MMSE		Cognitive Impairment as Gold Standard				Dementia Diagnosis as Gold Standard			
Score	N	Sens	Spec	PPV	NPV	Sens	Spec	PPV	NPV
≤27	445	93.0	70.6	83.4	86.4	98.0	65.0	76.0	96.6
≤26	393	88.2	83.7	89.6	81.8	94.5	78.1	83.0	92.6
≤25	357	82.7	89.3	92.4	76.5	89.3	84.0	86.3	87.4
≤24	322	77.2	94.4	95.7	72.3	84.6	90.2	90.7	83.9
≤23	301	73.4	96.8	97.3	69.7	81.5	93.5	93.4	81.7
≤22	279	68.9	98.4	98.6	66.7	76.8	95.4	95.	78.5
≤21	261	64.9	99.2	99.2	64.1	73.0	97.1	96.6	76.2

MMSE = Mini-mental state examination; Sens = sensitivity; Spec = specificity; PPV = positive predictive value; NPV = negative predictive value; ADC = Alzheimer's Disease Center.

performance on the six-item screener. Using this table, an investigator can extrapolate mean scores on the six-item screener to corresponding scores on the longer scales if one seeks to compare levels of cognitive impairment to studies using the longer scales. As shown in Table 8, the number of errors on the six-item screener is highly correlated with performance on the other three scales.

Discussion

We propose the six-item screener as an efficient and accurate method to screen subjects for cognitive impairment. The scale was specifically developed for studies that must screen large numbers of subjects and for studies that rely on subjects' cognitive ability to participate in a complex intervention and/or provide self-reports. A specific inclusion criterion in such a study is often the requirement that a patient have the cognitive capacity to understand questions about their current symptoms, emotion, or function, and be able to follow the study protocol. Although this scale was originally conceived for use in research studies, the diagnostic characteristics are comparable to the MMSE or the Blessed Dementia Rating Scale and thus the six-item screener could also be used in clinical practice as a first stage assessment for cognitive impairment.

There are several important logistic features of the six-item screener that make it particularly well-suited for use in research studies compared with other brief screens recently developed.[21–24] First, the scale is short and unobtrusive so that it can be readily incorporated into an initial patient assessment of eligibility. The scale takes only 1 to 2 minutes to complete as compared with 7 to 15 minutes for longer scales.[8,9,24,25] Second, the scale does not include any visuospatial or motor skill tasks, it does not require any props or visual cues, and scoring requires only the simple addition of the number of errors.[21–24,26,27] Thus, the six-item screener can be easily administered by telephone or in face-to-face interviews. Third, the investigator can alter the cut-off score to match the goals of the study and the targeted population.

We have demonstrated the diagnostic characteristics of the six-item screener in a community-based sample where the screening scale used (CSI-D) was independent from the six-item

TABLE 6. Area Under ROC Curves for MMSE Compared with Six-Item Screener

	Gold Standard	Six-item screener	MMSE
Community-based sample			
	Cognitive Impairment	0.86	0.84
	Dementia	0.95	0.96
Clinical sample			
	Cognitive Impairment	0.91	0.93
	Dementia	0.92	0.95

TABLE 7. Means, Medians, and Ranges of other Screening Instruments by Number of Errors on Six-item Screener Among Community-Based Sample and Alzheimer Disease Center Sample

No. of Errors	Sample	MMSE			Word List Recall			Blessed Dementia Scale		
		Mean	Median	Range	Mean	Median	Range	Mean	Median	Range
0	Comm	28.4	29.0	17–30	16.0	16.0	7–24	3.6	3.5	3.0 –7.5
	Clinical	28.9	29.0	23–30	20.0	20.0	9–30	3.7	3.0	2.8–12.0
1	Comm	27.0	27.0	17–29	14.6	15.0	5–23	4.4	4.0	3.0–11.6
	Clinical	26.9	27.0	20–29	15.9	15.0	5–28	4.9	4.0	3.0–11.5
2	Comm	25.8	26.0	16–28	12.1	12.0	4–20	3.8	3.5	3.0–14.3
	Clinical	24.8	25.0	15–28	13.1	13.0	6–24	6.4	6.5	3.0–17.6
3	Comm	22.4	25.0	10–27	10.6	12.0	0–16	3.8	3.5	3.0–10.4
	Clinical	20.6	21.0	9–27	9.3	9.0	0–22	7.3	7.0	3–14.5
4	Comm	19.4	19.0	12–24	8.6	10.0	0–14	5.1	5.5	3.0–13.8
	Clinical	18.9	20.0	5–26	8.8	9.0	0–17	8.1	8.0	3.5–16.5
5	Comm	14.4	16.0	3–23	7.1	6.0	0–13	6.8	6.0	4.4–10.5
	Clinical	14.7	15.5	4–24	5.7	5.5	0–15	9.7	9.5	3.5–18.7
6	Comm	8.9	7.5	0–21	3.3	1.0	0 –9	10.2	9.4	3.9–17.1
	Clinical	10.0	10.0	0–23	4.1	3.0	0–15	10.8	10.0	4.5–22.0

Comm = community-base sample; Clinical = Alzheimer's Disease Center clinical sample.

screener described here. Notably, the six-item screener's performance is based on a gold standard diagnosis of cognitive impairment or dementia rather than its ability to predict a total score on the full MMSE. This is important because the MMSE typically performs in the range of 80% to 85% sensitivity and specificity;[28] in other words, the MMSE does not provide a gold standard for cognitive impairment or dementia. The six-item screener's performance was excellent in both of the populations studied in this report. The scale performed nearly as well as the MMSE in these patient populations and showed a high level of validity when compared with other commonly used screens for cognitive impairment.

Although the six-item screener performed well in these two populations in terms of diagnostic accuracy for identifying older adults with cognitive impairment or dementia, it is important to note the differences in the two patient populations as described in Table 1. The community-based sample is representative of urban, black older adults, but these results may not generalize to other racial groups. Subjects in the clinical sample completed the same evaluation as the community-based sample and this sample comprises both white persons and black persons. Taken together, the two samples thereby represent a fairly broad spectrum of older adults but simply combining the results of these two samples does not create a cohort necessarily generalizable to all older adults. Although our use of a community-based sample of black persons improves upon prior studies relying only on clinical samples, exploring the generalizability of our findings is an important area for future research.

Because both clinicians and researchers seek a brief and accurate method to identify patients or subjects with cognitive impairment, multiple previous investigators have reported on the sensitivity

TABLE 8. Regression Coefficients Comparing Screening Scores Versus Number of Errors on Six-Item Screener

N		Community-based Sample			Alzheimer's Disease Center Sample			
		Regression Coefficient	*P* Value	R^2	N	Regression Coefficient	*P* Value	R^2
344	MMSE	−2.4	<0.001	59.7%	651	−3.1	<0.001	75.4%
273	Word List Recall	−1.9	<0.001	35.9	599	−2.7	<0.001	64.2%
158	Blessed	0.5	<0.001	19.6%	452	1.2	<0.001	45.2%

and specificity of shorter scales. Initially, these attempts included instruments of 10-to-15 items (eg, Short Portable Mental Status Questionnaire)[25] rather than the 30-item scales such as the Mini-Mental State Examination or Blessed Dementia Scale. By the early 1980s, scientists were exploring scales as short as six items. These early efforts were limited by the use of small clinical samples of nursing home residents or medical inpatients,[3,29] and the developers were typically predicting scores on longer screening tests rather than predicting the actual clinical determination of cognitive impairment or dementia.[29–31]

In the 1990s, several authors reporting from Alzheimer Disease Research Centers were able to report on the sensitivity and specificity of a reduced item Mini-mental state examination.[23,32,33] The studies by Galasko and Fillenbaum were limited to patients with Alzheimer's disease who had been referred to the clinical center whereas the study by Wells coupled data from an Alzheimer Disease Research Center with data from the Epidemiologic Catchment Area study. Although all three of these studies demonstrated that a reduced-item Mini-mental State examination had acceptable sensitivity and specificity for identifying patients with Alzheimer's disease, the study by Wells requires the calculation of a discriminant function score and includes a total of nine items. Although limited to Alzheimer disease subjects, the studies by Fillenbaum and Galasko[32,33] have previously demonstrated that three-item recall and orientation items provide excellent discrimination for normal subjects as compared with those with cognitive impairment or Alzheimer Disease.

More recently Buschke et al,[22] reported the performance of a 4-minute, four-item, delayed free- and cued-recall test of memory impairment. The study sample included 286 volunteers recruited from physician offices and senior centers and 197 subjects from the local community identified through Medicare lists. All subjects completed a neurologic evaluation to establish a diagnosis of dementia. These authors reported a sensitivity of 86% and a specificity of 91% in diagnosing dementia using a cut-off score of 5 (range of possible scores 0–8). This level of diagnostic accuracy has not been demonstrated in an unselected community-based population. However, the primary drawback of this test for screening large research populations is the requirement that patients read a visual cue card containing the four items to be recalled, and that testing of recall be delayed from 3 to 4 minutes after reading the card. This makes completion by telephone or in-person more cumbersome.

One of the primary advantages of the six-item screener compared with the other brief cognitive screens mentioned above is its suitability for administration over the telephone. There are at least three other instruments reported in the literature that are designed specifically to assess cognitive function via telephone administration. These include the Telephone Interview for Cognitive Status (TICS),[34] the Minnesota Cognitive Acuity Screen (MCAS),[35] and the Structured Telephone Interview for Dementia Assessment (STIDA).[36] All three instruments have reported acceptable sensitivity and specificity although the MCAS and STIDA studies did not target a representative community-base sample of older adults. The primary disadvantage of these three instruments is their length. Although all three instruments eliminate items that would require props or face-to-face administration, the length of these instruments approximate that of the MMSE and thereby require 10 to 20 minutes to complete. A short-STIDA has also been described but this instrument still requires 10 min to complete and the reported specificity falls to 0.77. Each of these longer telephone assessments could readily be considered as a second-stage cognitive screen to be used in tandem for those older adults scoring positive on the six-item screener.

Conclusion

In conclusion, we have demonstrated that a brief six-item screener that can be readily administered face-to-face or by telephone has diagnostic-test characteristics comparable with the MMSE and other longer scales designed to identify cognitive impairment or dementia. Sensitivity and specificity change precipitously but predictably as one varies the number of errors used as a cut-off point. This scale, which is a subset of the full MMSE, provides investigators with an efficient and accurate mechanism to identify patients with probable cognitive impairment.

References

1. **Stuss DT, Meiran N, Guzman A, et al.** Do long test yield a more accurate diagnosis of dementia than short tests? Arch Neurol 1996;53:1033–1039.

2. **Lachs MS, Feinstein AR, Cooney LM, et al.** A simple procedure for general screening for functional disability in elderly patients. Ann Intern Med 1990;112:699–706.

3. **Klein LE, Roca RP, McArthur J, et al.** Diagnosing dementia: univariate and multivariate analyses of the mental status examination. J Am Geriatr Soc 1985;33:483–488.

4. **Unutzer J, Katon W, Williams JW, et al.** Improving primary care for depression in late life: the design of a multi-center randomized trial. Med Care 2001;39:785–799.

5. **Hall KS, Hendrie HC, Brittain HM, et al.** The development of a dementia screening interview in two distinct languages. Int J Meth Psychiatric Res 1993;3:1–28.

6. **Hall KS, Ogunniyi AO, Hendrie HC, et al.** A cross-cultural community based study of dementias: Methods and performance of the survey instrument Indianapolis, USA, and Ibadan, Nigeria. Int J Meth Psychiatric Res 1996;6:129–142.

7. **Roth M, Tym E, Mountjoy CO, et al.** CAMDEX: a standardized instrument for the diagnosis of mental disorder in the elderly with special reference to the early detection of dementia. Br J Psychiatry 1986;149:698–709.

8. **Folstein MF, Folstein SE, McHugh SE.** Mini-mental state. A practical method for grading the cognitive state of patients for the clinician. J Psychiatr Res 1975;12:189–198.

9. **Blessed G, Tomlinson BE, Roth M.** The association between quantitative meausures of dementia and of senile change in the cerebral gray matter of elderly subjects. Br J Psychiatr 1968;114:797.

10. **Gurland BJ, Kuriansky J, Sharpe L, et al.** The Comprehensive Assessment and Referral Evaluation (CARE) rationale. Rationale, development and reliability. Int J Aging Hum Dev 1977;1:9–42.

11. **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;262:2551–2556.

12. **Hendrie HC, Osuntokun BO, Hall KS, et al.** Prevalence of Alzheimer's disease and dementia in two communities: Nigerian Africans and African Americans. Am J Psychiatry 1995;152:1485–1492.

13. **Hendrie HC, Ogunniyi A, Hall KS, et al.** Incidence of dementia and Alzheimer disease in 2 communities: Yoruba residing in Ibadan, Nigeria, and black persons residing in Indianapolis, Indiana. JAMA 2001;285:739–747.

14. **Callahan CM, Hall KS, Hui SL, et al.** Relationship of age, education, and occupation with dementia among a community-based sample of African-Americans. Arch Neurol 1996;53:134–140.

15. **Unverzagt FW, Hall KS, Torke AM, et al.** Effects of age, education, and gender on CERAD neuropsychological test performance in an African American sample. Clin Neuropsychol 1996;10:180–190.

16. **Morris JC, Heyman A, Mohs RC, et al.** The Consortium to Establish a Registry for Alzheimer's Disease (CERAD). Part I. Clinical and neuropsychological assessment of Alzheimer's disease. Neurology 1989;39:1159–1165.

17. **Unverzagt FW, Gao S, Baiyewu O, et al.** Prevalence of Cognitive Impairment without Dementia: Data from the Indianapolis-Ibadan Dementia Project. Neurology 2001;57:1655-1662.

18. **American Psychiatric Association:** Diagnostic and Statistical Manual of Mental Disorders, Third Edition, Revised (DSM-III-R). Washington DC, American Psychiatric Association, 1987.

19. **ICD-10.** The International Statistical Classification of Diseases and Related Health Problems. American Psychiatry Press. Volumes 1 and 2, 1991;V:1992:3.

20. **McKhann G, Drachman D, Folstein M, et al.** Clinical diagnosis of Alzheimer's disease. Neurology 1984;34:939–944.

21. **Borson S, Scanlan J, Brush M, et al.** The mini-cog: a cognitive "vital signs" measure for dementia screening in multi-lingual elderly. Int J Geriatr Psychiatry 2000;15:1021–1027.

22. **Buschke H, Kuslansky G, Katz M, et al.** Screening for dementia with the Memory Impairment Screen. Neurology 1999;52:231–238.

23. **Wells JC, Keyl PM, Chase GA, et al.** Discriminant validity of a reduced set of Mini-Mental Status Examination items for dementia and Alzheimer's Disease. Acta Psychiatr Scand 1992;86:23–31.

24. **Solomon PR, Hirschoff A, Kelly B, et al.** A 7-minute neurocognitive screening battery highly sensitive to Alzheimer's Disease. Arch Neurology 1998;55:349–355.

25. **Pfeiffer E.** A short portable mental status questionnaire for the assessment of organic brain deficit in elderly patients. J Am Geriatr Soc 1975;23:433–441.

26. **Schulman KI.** Clock-drawing: is it the ideal cognitive screening test? International J Geriatr Psychiatry 2000;15:548–561.

27. **Scanlan J, Borson S.** The mini-cog: receiver operating characteristics with expert and naïve raters. Int J Geriatr Psychiatry 2001;16:216–222.

28. **Tombaugh TN, McIntyre NJ.** The Mini-Mental State Examination: a comprehensive review. J Am Geriatr Soc 1992;40:922–935.

29. **Katzman R, Brown T, Fuld P, et al.** Validation of a short Orientation-Memory-Concentration Test of

cognitive impairment. Am J Psychiatry 1983;140:734–739.

30. **Magaziner J, Bassett SS, Hebel JR.** Predicting performance on the mini-mental state examination. Use of age- and education-specific equations. J Am Geriatr Soc 1987:996–1000.

31. **Braekhus A, Laake K, Engedahl K.** The Mini-Mental State Examination: identifying the most efficient variables for detecting cognitive impairment in the elderly. J Am Geriatr Soci 1991;40:1139–1145.

32. **Galasko D, Klauber MR, Hofstetter R, et al.** The mini-mental state examination in the early diagnosis of Alzheimer's disease. Arch Neurol 1990;47:49–52.

33. **Fillenbaum GG, Wilkinson WE, Welsh KA, et al.** Discrimination between stages of Alzheimer's Disease with subsets of mini-mental state examination items. Arch Neurol 1994;51:16–21.

34. **Brandt J, Spencer M, Folstein M.** The telephone interview for cognitive status. Neuropsychiatry Neuropsychol Behav Neurol 1988;1:111–117.

35. **Knopman DS, Knudson D, Yoes ME, et al.** Development and standardization of a new telephonic cognitive screening test: the Minnesota Cognitive Acuity Screen (MCAS). Neuropsychiatry Neuropsychol Behav Neurol 2000;13:286–296.

36. **Go RC, Duke LW, Harrell LE, et al.** Development and validation of a Structured Telephone Interview for Dementia Assessment (STIDA): the NIMH Genetics Initiative. J Geriatr Psychiatry Neurol 1997;10:161–167.

APPENDIX A. TABLE 1. Six-Item Screener

1. I would like to ask you some questions that ask you to use your memory. I am going to name three objects. Please wait until I say all three words, then repeat them. Remember what they are because I am going to ask you to name them again in a few minutes. Please repeat these words for me: APPLE—TABLE—PENNY. (Interviewer may repeat names 3 times if necessary but repetition not scored.)

Did patient correctly repeat all three words?	*Yes*	*No*
	Incorrect	Correct
1. What year is this?	0	1
2. What month is this?	0	1
3. What is the day of the week?	0	1
What were the three objects I asked you to remember?		
4. *Apple* =	0	1
5. *Table* =	0	1
6. *Penny* =	0	1