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Development and Validation of the Identification and Intervention for Dementia in Elderly Africans (IDEA) Study Dementia Screening Instrument

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Abstract

Aim: The aim of this project was to develop a dementia screening instrument for use in the hospital or community in populations with low levels of formal education. **Methods:** A screening instrument was developed from retrospective data collected in a rural area of Tanzania in 2010. The community screening instrument for dementia was administered to over 95% of the population aged 70 years and older of 6 villages (n = 1198) in Hai district, Tanzania. Factor analysis, regression modeling, and Mokken scale analysis (MSA) were used to develop screening instruments from these data, which were then tested and refined during prospective fieldwork. **Results:** A 5-item screening instrument with an area under the receiver–operating characteristic (AUROC) curve of 0.871, sensitivity of 91.7%, and specificity of 61.7% was developed using a combination of factor analysis and logistic regression modeling and had a higher AUROC (0.786) than a 7-item screening instrument developed using MSA. During prospective testing and refinement (n = 60), the 5-item instrument performed well (AUROC 0.867) and took an average of less than 10 minutes to administer. Its performance was improved by including a matchstick design item added to measure praxis, AUROC 0.888. **Conclusions:** The 6-item brief dementia screening instrument has acceptable properties and will be further tested and validated during future fieldwork. Although developed for use in sub-Saharan Africa, it may be of use in other world regions where the use of other cognitive screening instruments may result in bias due to low levels of formal education.

Keywords

dementia, screening, Tanzania, Africa, older people

Introduction

Dementia is one of a group of mental health disorders which is estimated to represent 13% of the total global burden of disease.[1] In 2010, there were estimated to be 36 million people who had dementia worldwide.[2] The prevalence is expected to double every 20 years as populations age, with 65.7 million affected in 2030 and 115.4 million in 2050. This rise will be disproportionately large in low- and middle-income countries. Currently, it is estimated that 58% of people with dementia live in low- and middle-income countries, rising to 71% by 2050.[2]

Health services in sub-Saharan Africa (SSA) are poorly equipped to diagnose and manage people with dementia, with very few old age psychiatrists, neurologists, or geriatricians.[3,4] As a result, many people with dementia are living undiagnosed in the community.[5] Since diagnosis must preceed management interventions, effective managment of dementia symptoms is rare with many of the benefits of early diagnosis, such as patient empowerment and greater quality of life for caregivers, unrealized.[5]

At present, if someone is admitted to hospital in a confused state, in many parts of SSA, there are no validated, culturally appropriate instruments to assess cognition. Often the Mini-

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Mental State Examination[6] is used which is translated literally from English. However, a basic level of literacy and numeracy is assumed and this is often not the case in many SSA communities and many people are unable to read, write, and have never held a pen.[7] As a consequence, many people score poorly despite having no cognitive impairment.[8,9]

The Indianapolis-Ibadan Dementia Project developed the community screening instrument for dementia (CSI-D) for dementia screening in low- and middle-income countries.[10] The instrument consists of 33 questions asked to the person suspected of having dementia (cognitive section) and 26 questions asked to an informant, usually a close relative or a friend (informant section). It takes 30 to 40 minutes to administer. Although the CSI-D is excellent for research purposes, for routine clinical screening it is far from ideal. Its use requires extensive training, the assessment is lengthy, and computation of disease risk requires the assistance of a calculator or computer software. Furthermore, an informant must be interviewed. Although this may improve the predictive power of the instrument, a reliable informant is not always available.[11] Although a brief version of the CSI-D has been developed from data collected in low- and middle-income countries, it still requires an informant interview and only a small proportion of the data used to develop the instrument were collected in SSA.[12] Much of the data used were collected in South and Central America, China, and India where formal education levels are often higher than that seen in many regions of SSA.

The ''Test of Senegal'' was developed by Touré et al and published in 2008.[13] The test had good sensitivity (93.1%) and specificity (89.6%) when it was tested in a clinical setting. However, it consists of 39 questions and may be too long for routine screening. Although other short cognitive screening instruments are used in low- and middle-income countries, none has been developed or validated for use in populations with low levels of background education.[14-16] Consequently, there is a need for a ''user-friendly'' screening instrument for such populations that takes a matter of minutes to administer and can be used at the hospital bedside, in the outpatient clinic, or in the patient's home with no need for an informant to be present.

The aim of this project was to develop and test a short questionnaire to act as a brief screening instrument for dementia in elderly people living in SSA. It was planned that the instrument developed would be used during a forthcoming study of dementia in Tanzania: the Identification and Intervention for Dementia in Elderly Africans (IDEA) study.

Methods

This study was part of a dementia prevalence study, details of which have already been published.[17] Brief details of the study methods are given subsequently.

Ethical Considerations

The prevalence study and subsequent follow-up were approved by the National Institute of Medical Research, Dar-es-Salaam, Tanzania. Signed informed consent was obtained from each participant. We obtained a thumbprint for those that could not read and write and the purpose and implications of the study were verbally explained. In cases where patients were unable to give valid consent due to cognitive deficit, written assent was obtained from a close relative.

Setting and Study Population

The study population was defined as those aged 70 years and older who were resident in 6 randomly selected villages within a predefined area of the Hai district of Tanzania on the prevalence date, April 12, 2010. The site has been the subject of a number of previous epidemiological studies.[18] Fieldwork for the prevalence study was carried out between April 12 and September 30, 2010. The 6 selected villages had a total population of 34 078, of whom 1277 (3.7%) were aged 70 years and older. After allowing for migration into and out of the study villages since the census, people found to be ineligible due to an incorrect age being recorded and refusals, a cohort of 1198 people was recruited.[17]

Study Design, Data Collection, and Assessment

Initial screening instrument development and validation. The CSI-D was administered to all 1198 patients by local census enumerators, supervised by the study team (S-MP, AL, and AK). A stratified sample of these patients (n = 296) was subsequently followed up and clinically assessed for the presence of dementia according to the *Diagnostic and Statistical Manual of Mental Disorders* (Fourth edition; *DSM-IV*) criteria.[19] Based on CSI-D score, we aimed to assess 100% of those with probable dementia (n = 168 assessed), 50% of those with possible dementia (n = 56 assessed), and 5% of those with no dementia (n = 72 assessed).[17]

The Consortium to Establish a Registry for Alzheimer's Disease (CERAD) 10-word recall test was also administered to all 296 patients followed up.[20] This questionnaire asks patients to remember 10 common words that they would encounter in everyday conversation. The list is read out slowly by the assessor and the patients asked to repeat the list immediately. The number of words they can recall is recorded (immediate recall). The list is repeated and they are asked to recall as many words as possible twice more. The scores for these items are recorded but were not analyzed for the purposes of this study. Finally, the patients are asked to recall as many words as possible from the list, without it being read out, after approximately 5 minutes delay, and this is done after completion of approximately 10 CSI-D items. The patient's score is recorded (delayed recall). The 10-word list has been used in isolation as a screening instrument for dementia in SSA.[21] Questions were coded as set out in Appendix A.

The data set for the 296 patients followed up was randomly split into a model development data set (n = 236, 79.7%) and a validation data set (n = 60, 20.3%). Two screening instruments were constructed using the development data set (see Statistical

Methods section). The performance of the screening instruments constructed was assessed against the validation data set. The area under the receiver–operating characteristic (AUROC) curve was used as a measure of the relative performance of each screening instrument.[22]

Refinement of the Model in Fieldwork Testing

The preferred instrument was then further tested and refined during fieldwork in Hai in June and July 2012. The instrument was administered by a local health care worker (AK) to 30 people randomly selected from the background population of people aged 70 years and older and 30 people who were diagnosed with mild cognitive impairment (MCI) when clinically assessed in 2010. By including people known to have had MCI in 2010, we consciously oversampled for people with some form of cognitive impairment. This was done to try to ensure that a sufficient number of patients with dementia were assessed using the instrument and so give a meaningful measure of sensitivity. No one was excluded from this cohort on the basis of any psychiatric diagnosis secondary to MCI.

Mild cognitive impairment is not necessarily a progressive condition. Thus, by the 2012 follow-up, those with MCI may have gone on to develop dementia or another psychiatric diagnosis, may still have had MCI, or may have returned to normal cognitive function. The study research doctors (S-MP and MS) provided an independent clinical diagnosis of *DSM-IV* dementia on a separate visit. The health care worker was blinded to the clinical diagnosis and the doctors blinded to the responses to the screening instrument.

During this assessment, the 60 patients were asked to complete a task to test praxis. Two of the CSI-D praxis items (drawing interlocking circles and interlocking pentagons) were poorly performed during data collection for the prevalence study, with many people refusing to perform the task. The main reason was suspected to be that many people living in Hai had never held a pen before and were unable to write or draw, rather than being due to any cognitive deficit. A more culturally appropriate question was taken from a screening instrument developed by Baiyewu et al in 2005 from data collected in in Nigeria.[23] We took 1 item from their test battery, which involved placing matchsticks in the design of a garden rake. We use the scoring system described by Baiyewu et al, with scores ranging from 0 (*no matchsticks placed correctly*) to 3 (*all matchsticks placed correctly*).

Statistical Methods

Mokken scale analysis (MSA) was performed using the software package R (version 2.15.0, The R Foundation for Statistical Computing, Vienna, Austria). For all other analyses, the statistical package PASW was used (version 18; PASW, Chicago, Illinois). The underlying distribution of the outcome variable was assumed to be binomial and confidence intervals around odds ratios were calculated based on this assumption. To simplify the analysis and avoid redundancy, some nondichotomous variables were coded. For the CERAD 10-word list items, if 0 to 4 words were remembered then these values were used as the score, 5 or more words were scored as 5. For the animal naming item of the CSI-D, 0 to 3 animals scored 0, 4 to 7 animals scored 1, and >7 animals scored 2. For the story recall item, remembering 0 facts scored 0, remembering 1 to 2 facts scored 1, and remembering >2 facts scored 2. All other items were analyzed without transformation of the published scoring systems. A variety of statistical methods were used to construct the screening instruments.

Factor analysis. Factor analysis was used to identify groups of questions that might be measuring a single underlying trait (or factor). The questions within the cognitive section of the CSI-D are usually divided into domains thought to represent the aspects of cognitive function. Although categorizations vary, Hall et al[10] considered 6 subdomains during the development of the CSI-D, memory (short and long term), orientation (to time and place), understanding and use of language (naming objects, language comprehension, and fluency), abstract thinking (use and understanding of concepts and generalizations), praxis (performance of learned skilled movements), and calculation (arithmetical calculations). Calculation is generally considered to be inappropriate as a test of cognitive ability in low- and middle-income countries since it is more a measure of educational attainment than cognitive ability in a setting where formal education is not universally available.[24] Therefore, questions relating to calculation are not part of the CSI-D and were not considered further in the current study. In order to investigate the validity of these subdomains in relation to our study population, factor analysis was undertaken.

Regression analysis and screening instrument development. Regression models were developed using stepwise methods. The overall fit was assessed using the deviance statistic (D), the Hosmer and Lemeshow statistic, and Nagelkerke's R^2.[25-27] The D was also used as a means of comparing different models, allowing the influence of individual predictors added to the model to be tested. Overfitting was not considered a problem, given the relatively large number of patients included.[28] Overdispersion was considered a problem if the number of degrees of freedom exceeded D.[25] Assumptions regarding the distribution of the residual terms (normality, independence, and constant variance) were examined by plotting the deviance residuals against the predictor variables and the case numbers. The deviance residual was preferred over Pearson residual due to its distribution characteristics and its increased stability at extreme values of π.[29,30] Cook's distances and DFBeta values were also examined. Correlation between predictor variables (multicollinearity) was assessed using tolerance and variance inflation factor statistics and by examining the loading of variables on individual eigenvectors.[25] The parameter estimates from the regression models were converted to user-friendly scoring systems for screening instruments using the methods developed by the Framingham Study group.[31]

Mokken scale analysis. A full discussion of MSA is beyond the scope of this article. The MSA builds on the principles of item

Table 1. Question Split into Domains Identified by Factor Analysis.

Factors	Subdomain	Questions
Factor 1: naming, language, and abstract thinking (15 questions)	Short-term memory (1 question)	Name
	Language fluency (1 question)	Repeat
	Naming (7 questions)	Pencil, watch, chair, shoes, knuckles, elbow, shoulder
	Language comprehension (2 questions)	Nod, point
	Abstract thinking (4 questions)	Bridge, hammer, church, chemist
Factor 2: orientation (10 questions)	Spatial orientation (5 questions)	Chief, town, street, store, address
	Temporal orientation (4 questions)	Day, month, season, year
	Long-term memory (1 question)	Longmem
Factor 3: memory and praxis (8 questions)	Short-term memory (6 questions)	Learn1, recall, nrecall, wordimm, worddel, story
	Language fluency (1 question)	Animals
	Praxis (1 question)	Paper

response theory and involves investigation of the dimensionality and ordering of items within a measurement scale. It is similar to factor analysis and principal component analysis in that it attempts to group items into unidimensional sets. However, item response theory is hierarchical and items that represent a scale of increasing difficulty are grouped together. The method builds on the work of Guttman who developed strictly hierarchical models based on the assumption that if someone responded negatively to 1 item, they could not then go on and answer positively to an apparently more difficult item.[32] The MSA applies item response theory to nonparametric data such as that obtained from responses to dichotomous or polytomous questions on an ordinal scale.[33] Within MSA, 2 models can be developed, the monotone homogeneity model and the double monotonicity model. The double monotonicity model is the most exacting of these models and the one which we employed. It requires 4 key assumptions to be met; unidimensionality, local independence, monotonicity, and nonintersection.[34]

The commands *aisp* (assessing unidimensionality), *monotonicity*, and *pmatrix* (assessing nonintersection) were used at each stage of the model-building process. For assessment of scalability, the following general cutoffs for values of H_j and H were applied: 0 to 0.3, *no scalability*; 0.3 to 0.4, *weak scalability*; 0.4 to 0.5, *moderate scalability*; and >0.5, *strong scalability*.[34]

Results

Screening Tool Development

Factor analysis was conducted on the phase I cohort ($n = 1198$). The questions involving drawing interlocking circles and pentagons were excluded from the analysis, thus 31 questions were included in the analysis. A number of different extraction and rotation methods were examined although the results were very similar regardless of the method used. The principal component extraction method yielded the model with the greatest amount of total variance explained by the 4 factors with eigenvalues greater than unity (57.3%). The result obtained after Varimax rotation is shown in Table 1.

Table 2. The 5-Item Regression Model.

	β	SE	Sig	Exp(β)	95% CI for Exp(β) Lower	Upper
Bridge	−0.728	0.480	0.129	0.483	0.188	1.237
Chief	−0.500	0.394	0.204	0.607	0.280	1.312
Day	−1.031	0.390	0.008	0.357	0.166	0.765
Animals categorized	−0.397	0.258	0.124	0.672	0.405	1.115
Recall	−0.449	0.118	<0.001	0.638	0.507	0.804
Constant	1.522	0.423	<0.001	4.580	–	–

Abbreviations: CI, confidence interval; SE, standard error; sig, significance.

Method I: regression analysis. The phase II development data set of 236 patients and 33 items (31 from the CSI-D and 2 from CERAD 10-word list) were used to develop a regression model with *DSM-IV* dementia diagnosis as the outcome variable. Using the methods described, a 5-item model (Table 2) was developed. The inclusion of interaction terms did not increase the performance of the model. The screening instrument developed from this model is shown in Table 3.

Method II: MSA. The development data set of 236 patients and 33 variables was used to construct the model; the drawing interlocking circles and pentagons items were excluded from the analysis. following 5 items, remember my name, story recall, animal naming, long-term memory, and 3-word list immediate recall were unscalable. Setting the lower limit for $H_j = 0.3$ and $\alpha = .05$, all other items were identified as belonging to the same scale. There were no violations of monotonicity (decrease of >0.1 in the probability of a positive response). The items naming the village, the chief and the month, folding paper, and the CERAD 10-word list items violated the assumptions of nonintersection. Thus, a 22-item model was identified ($H = 0.687$). Since this model contained too many items to be of use as a screening instrument, the item with the highest H_j value from each of the 7 subdomains still represented in the model were used. The final model is shown in Table 4. The model is very similar to that developed by Prince et al.[12]

Table 3. Development of the 5-Item Model Scoring System.

Predictor Variable	Category	Reference Value	Distance From Baseline Value in Regression Units	Points Allocated
Day	Incorrect	0	0	0
	Correct	1	1.031	2
Bridge	Incorrect	0	0	0
	Correct	1	0.728	2
Chief	Incorrect	0	0	0
	Correct	1	0.500	1
Recall	No words remembered	0	0	0
	1 word remembered	1	0.449	1
	2 words remembered	2	0.898	2
	3 words remembered	3	1.347	3
	4 words remembered	4	1.796	4
	5 or more words remembered	5	2.245	5
Animals categorized	0-3 animals named	0	0	0
	4-7 animals named	1	0.397	1
	8 or more animals named	2	0.794	2

Table 4. Scale Properties as Defined Using Mokken Scale Analysis.

Subdomain	Item	H_j (Standard Error)	Item Difficulty, π	Rank Order of Difficulty
Naming	Chair	0.850 (0.053)	0.081	22
Abstract thinking	Hammer	0.792 (0.065)	0.084	21
Spatial orientation	Store	0.675 (0.058)	0.132	13
Temporal orientation	Year	0.631 (0.050)	0.597	2
Language comprehension	Point	0.668 (0.052)	0.182	8
Short-term memory	Worddel	0.647 (0.067)	0.614	1
Language fluency	Repeat	0.637 (0.057)	0.167	10

Table 5. Performance of the Screening Instruments Developed.

	AUROC (95% CI)	Maximum Score	Dementia Cutoff	Sensitivity, %	Specificity, %
Validation data set (n = 60)					
5-Item instrument	0.871 (0.768-0.975)	12	≤7	91.7	61.7
7-Item instrument	0.786 (0.648-0.925)	9	≤6	91.7	38.3
CSI-D cognitive section	0.847 (0.714-0.980)	33	≤21	88.9	64.9
Brief CSI-D	0.792 (0.637-0.947)	9	≤6	91.7	42.6
Fieldwork testing data set (n = 60)					
5-Item instrument	0.867 (0.752-0.982)	12	≤7	81.8	71.4
Matchstick design item	0.842 (0.708-0.977)	3	≤1	90.9	77.8
6-Item IDEA study instrument	0.888 (0.766-1.000)	15	≤7	81.8	84.4
			≤10	90.9	62.2

Abbreviations: AUROC, area under the receiver–operating characteristic; CSI-D, community screening instrument for dementia; IDEA, Identification and Intervention for Dementia in Elderly Africans.

Validation

The performance of the 5-item and 7-item models developed using the 2 methods was assessed using the validation data set of 60 patients. The results are presented in Table 5, together with a comparison of the performance of the CSI-D cognitive section and the brief CSI-D developed by Prince et al.[10,12] The 5-item instrument is preferred.

Fieldwork Testing and Refinement

There were 4 missing values for the matchstick design item, none of these patients had dementia. Of the 60 people screened using the 5-item instrument, 11 (18.3%) were found to have *DSM-IV* dementia during subsequent clinical assessment. The instrument performed well with an AUROC of 0.867, see Table 5. The mean

time taken to administer the instrument was 9.4 minutes (standard deviation 2.90).

The matchstick design test also performed well (Table 5) on the 56 patients for whom data were available. The data from both the 5-item instrument and the matchstick design test were analyzed using regression modeling to try to refine the regression model and thus the instrument. Adding the matchstick design item to the screening instrument, without adjusting the scoring system, improved the performance of the instrument (Table 5), with an AUROC of 0.888 achieved with high specificity or sensitivity possible, depending on the cutoff used. The new 6-item screening instrument is preferred over the 5-item model. Using a cutoff, ≤ 7 instrument identified 9 (81.8% sensitivity) of the 11 people with dementia, while at a cutoff of ≤ 10, the instrument identified all but 1 (90.9% sensitivity) person with dementia.

Other diagnoses affecting cognition. Twenty-seven people screened positive for dementia using a cutoff of 10 or less for the 6-item instrument. Of these, 24 (88.9%) had either dementia (n = 10), MCI (n = 12), schizophrenia (n = 1), or a psychotic illness (n = 1). Therefore, only 3 (11.1%) people who screened positively did not have some form of mental illness affecting cognition.

Discussion

Performance of the IDEA Screening Instrument

We have developed and refined a dementia screening instrument which is culturally appropriate for our population. The instrument should be able to be administered in 10 to 15 minutes by nonspecialist health care workers. Further validation work is required on larger cohorts in community and hospital settings. Although our instrument was developed specifically for use in SSA, we recognize that it may be of use in other world regions where background levels of education are low. The performance of the final 6-item instrument compares well to that of short dementia screening instruments developed in high-income countries, a review of which has been published.[35]

Although the 5-item instrument performed less well in prospective fieldwork than it did using the retrospective validation data set, almost half of the prospective study population were people who had a diagnosis of MCI 2 years prior to fieldwork being carried out. Therefore, differential diagnosis in this group was particularly challenging. Nevertheless, the instrument had acceptable properties that were improved by the inclusion of an item assessing praxis. The instrument's lower specificity at the higher cutoff (≤ 10) was mainly due to the identification of people with MCI and other psychiatric conditions, which may be expected to affect cognition.

Data were collected from a single population in rural Northern Tanzania. We are unable to comment on the applicability of our results to other populations, although the forthcoming IDEA study, to be conducted in Tanzania and Nigeria, will provide some data in this regard. Dementia risk factor profiles are likely to vary across SSA. With regard to the differences in diet and lifestyle between cultures, there is a great deal of genetic diversity within SSA.[36] It is therefore likely that there will be significant variation in the presentation of dementia across SSA and this may impact on the performance of our screening instrument in other settings. However, data relating to the presentation of dementia across SSA are still limited.[37]

Screening Instrument Development Strategy

Regression modeling produced a superior instrument compared to that developed using MSA. In MSA, items are selected based on the item difficulty. Regression modeling and MSA are underpinned by different theoretical frameworks and the methods of item selection are quite distinct. Regression analysis is based on a statistical model that tries to explain the underlying population value of the mean of the outcome variable in relation to the predictor variables (or items). Using stepwise selection methods, a new variable is only added to the model if it accounts for a statistically significant amount of additional variability in the outcome variable not already explained by an existing variable. This approach helps to avoid the problem of multicollinearity and ensure that each parameter estimate is stable. The MSA aims to develop a hierarchical unidimensional scale that measures a latent underlying trait. If the assumptions of monotonicity and nonintersection are met, then, theoretically, items that measure the same part of the variability of the outcome can be included in the scale. Furthermore, items are ranked in the order of difficulty, with the items becoming increasingly difficult. Theoretically, this makes the identification of a cutoff value for the presence of the underlying trait easier than when a model is developed using regression modeling.

As such, MSA is an intuitively attractive method for developing a screening instrument.[38] The method is nonparametric and is designed for the analysis of discrete variables. However, since the model is constructed without reference to a specific outcome, the underlying predictive value of each item is not considered. Dementia is a multifactorial, clinically diagnosed condition, where a number of distinct cognitive deficits may contribute differing amounts to a positive diagnosis in any group of people. Thus, the identification of a single latent trait within the data may not be possible. Regression models are constructed with reference to an outcome variable and allow predictor variables to be weighted according to their influence on that outcome.

Mazzocco and Hussain[39] recently compared the performance of expert-led question selection, stepwise logistic regression, and a Bayesian belief network to develop models to predict the presence of clinical dementia, with regression modeling giving the best model based on AUROC analysis. The authors concluded that stepwise logistic regression is the preferred technique and outperformed the "state-of-the-art" Bayesian model.[40] They also note that using a statistically driven approach, it is possible to reduce down a large set of variables to a more manageable screening instrument. There was no overlap in the questions selected for inclusion in the 5-item regression model and the 7-item MSA-derived model. The differences between the MSA and the logistic

regression-derived instruments clearly reflect the different theoretical approach to model construction.

It is not clear why the model of Prince et al, and our 7-item model, did not perform as well as expected in our cohort.[12] Prince et al report much better performance generally and most notably in Nigeria. This is an area we intend to explore further during work in Nigeria and Tanzania, as part of the IDEA study.

Conclusions

We have developed and tested a 6-item screening instrument for dementia for use in elderly people living in SSA. The scoring system is easy to use and it should be possible to administer it in 10 to 15 minutes. After further validation work, it may also be of use in other world regions where background levels of education are low.

Appendix A

Coding Used for Questions

Domain	Question	Question Code
Community screening instrument for dementia (CSI-D) cognitive section		
Naming	What is this (shows pencil)?	Pencil
	What is this (shows watch)?	Watch
	What is this (points to chair)?	Chair
	What are these (points to shoes)?	Shoes
	What are these (points to knuckles)?	Knuckle
	What is this (points to elbow)?	Elbow
	What is this (points to shoulder)?	Shoulder
Abstract thinking	What is a bridge for?	Bridge
	What is a hammer for?	Hammer
	What do you do in a church/temple	Pray
	Where do you buy medicine?	Medicine
Spatial orientation	Who is the head of this village?	Chief
	Name of this town	Town
	Name two roads nearby	Street
	Where is the nearest store to here?	Store
	What is your address?	Address
Temporal orientation	What month is it?	Month
	What day of the week is it?	Day
	What year is it?	Year
	What season is it?	Season
Language fluency	Repeat common saying	Repeat
	Name as many animals as you can in one minute	Animals
Language comprehension	Nod your head	Nod
	Point to the window and then the door	Point
Short-term memory	Repeats interviewers name	Name
	Remembers interviewers name	Nrecall
	Remember the words boat, house, fish—immediate recall	Wordimm
	Remember the words boat, house, fish—delayed recall	Worddel
	East Boston story (recall six key events from the story)	Story
Long-term memory	When was Tanzanian independence?	Longmem
Praxis	Take paper in right hand, fold it with both hands and place on lap	Fold
	Draw interlocking circles	Circles
	Draw interlocking pentagons	Pentagons
CERAD 10-word list		
Immediate recall	Recall as many words from the list as possible	Learn1
Delayed recall	Recall as many words from the list as possible after 5-10 minutes delay	Recall

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Anna Longdon, Aloyce Kisoli, and Maria Samuel contributed to data collection. William K. Gray and Catherine Dotchin contributed to data analysis. Richard Walker, Catherine Dotchin, William Gray, and Stella-Maria Paddick contributed to interpretation of results. William K. Gray, Richard Walker, Catherine Dotchin, Stella-Maria Paddick, Maria Samuel, Anna Longdon, Aloyce Kisoli, Paul Chaote, and Ahmed Jusabani contributed to writing the article. The sponsors of this study had no role in designing the study; in the collection, analysis, and interpretation of data; in the writing of the report; or in the decision to submit the article for publication.

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