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Measures of Cognitive Functioning in the 1994–2000 Second Longitudinal Study of Aging

by Laura A. Pratt, Ph.D.; Julie D. Weeks, Ph.D.; and Margie R. Goulding, Ph.D.;
Office of Analysis and Epidemiology

Abstract

Objectives—This report describes in detail the measures of cognitive functioning administered in the Second Longitudinal Study of Aging (LSOA II) and proposes a three-category cognitive impairment variable for analysts' use that is derived from the individual measures.

Methods—LSOA II self-respondents completed an 11-question cognitive functioning measure based on the Telephone Interview of Cognitive Status (TICS) instrument. Proxy respondents answered nine questions drawn from the short Informant Questionnaire on Cognitive Decline in the Elderly (IQCODE). Using cut points provided in the literature as a guide, a single three-level categorical measure of cognitive impairment was created: probable, possible, and no cognitive impairment.

Results—The cognitive functioning measures administered in LSOA II retain many of the favorable psychometric properties of the original TICS and IQCODE. The constructed cognitive impairment (CI) variable demonstrates good construct validity, and prevalence rates are generally consistent with those from other published studies.

Conclusions—The categorical CI variable is easy to use and interpret and allows analysts the option of combining self- and proxy-respondent data in investigations of associations between CI and health outcomes, including continuing independence, progressive impairment, health care utilization patterns, and mortality.

Keywords: LSOA II • Second Longitudinal Study of Aging • cognitive functioning • cognitive impairment

Introduction

Cognitive impairment (CI) is an important risk factor for loss of independence, institutionalization, and death in the older population (1–3). Studies of factors related to outcomes including mortality, difficulties with daily activities, institutionalization, and health care utilization would be incomplete without a covariate describing cognitive functioning.

LSOA II was designed to describe the health trajectories of a nationally representative sample of persons 70 years of age and older from 1994–2000. LSOA II contains a wealth of data about physical and social functioning. The functioning measures include items concerning upper and lower body physical functioning and limitations in activities of daily living (ADL) and instrumental activities of daily living (IADL) as well as questions about engagement in social activities. Cognitive functioning is of key importance in maintaining independence

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in these activities (4,5). Measures of cognitive functioning were included in Waves 2 (1997–1998) and 3 (1999–2000) of LSOA II.

This report has three main goals. First, the cognitive functioning measures administered in Waves 2 and 3 of LSOA II are described. Because the self-reported and proxy-reported cognitive functioning questions used in the survey are subsets of the original TICS and IQCODE instruments, the questions are examined in some detail that includes discussion of scoring, reliability, and construct validity. Next, a method is described for constructing a succinct, three-category summary CI variable that is created from the self-respondent and proxy-respondent measures. Finally, the prevalence of CI as measured by the summary variable is described, and its construct validity is examined. This aggregate measure of CI allows researchers to use self-respondent and proxy-respondent cognitive data in the same analyses, thereby reducing selection bias, and to use the largest sample size possible in analyses where CI plays an important role.

Description of LSOA II

LSOA II comprises three interviews: the baseline contact and two follow-up telephone interviews, conducted approximately two years apart. The baseline interview, known as the Second Supplement on Aging (SOA II), was administered as part of the 1994 National Health Interview Survey (NHIS). NHIS is a continuous, nationally representative survey of the civilian noninstitutionalized population with more than 100,000 persons per year in approximately 40,000 households (6). In 1994, NHIS included a supplemental disability survey. Phase I of the National Health Interview Survey on Disability (NHIS-D) was conducted along with the core 1994 NHIS interviews, whereas Phase II of NHIS-D was conducted as a follow-up approximately 7 to 17 months later from 1994 through 1996. The SOA II interviews were administered to all consenting 1994 NHIS respondents who were 70 years of age and older (n = 9,447) at the time of the NHIS-D Phase II survey.

LSOA II contains a wealth of information from these other surveys—the 1994 NHIS core and NHIS-D Phases I and II. The SOA II instrument is extensive and covers a wide variety of topics, including questions about concentration, forgetfulness, and senility. More formal measures of cognitive functioning were added at the Wave 2 and 3 follow-up interviews.

Wave 2 interviews took place during 1997–1998. Interviews, including 938 conducted with a next of kin or caretaker of deceased respondents, were obtained for 7,998 respondents, which is 85% of eligible persons with an SOA II interview. Wave 3 was administered from 1999–2000. At Wave 3, 6,465 interviews were obtained, covering 76% of eligible respondents. Of these interviews, 906 were conducted with a decedent informant. The follow-up instruments administered at Waves 2 and 3 captured information about cognitive functioning from self- and proxy respondents. Cognitive functioning measures were not obtained from persons who completed self-administered mail questionnaires (n = 706) nor from persons who ended the interview prior to the cognitive functioning section (n = 148). After these exclusions, Wave 2 included 4,959 persons with self-reported cognitive functioning data and 1,830 persons with proxy-reported cognitive functioning measures, 799 of which were decedent interviews. Persons with proxy-provided cognitive measures in Wave 2 were older, were less educated, had more ADL and IADL limitations, and were more likely to be male than persons with self-reported cognitive functioning data (Table 1). Persons with proxy cognitive data in Wave 2 reported poorer self-rated health and more forgetfulness in their baseline interview than persons with self-reported cognitive data at Wave 2. Persons with no cognitive functioning data at Wave 2 were also more likely to be male, older, and less educated and to report poorer self-rated health than persons with self-reported cognitive functioning data, but these associations were not as strong as in the proxy- and self-respondent comparisons. Wave 3 had 3,960 self-respondents with cognitive functioning data and 1,619 proxy respondents, of which 805 were for deceased subjects. Baseline characteristics of persons in these three groups in Wave 3 were similar to those for Wave 2.

Methods

Cognitive functioning measures in LSOA II

Cognitive functioning measures for self-respondents

The cognitive functioning measure for self-respondents (CF-SR) used in LSOA II is an 11-question, 22-point measure based on TICS (7). Exact wording of the questions is provided in the ‘‘Technical Notes.’’ TICS and a modified version, TICS-m (8), are widely used in studies of cognitive functioning; both have been well validated in the United States (9–11) and in other countries (12–14). The main difference between the LSOA II measure and TICS is that LSOA II does not include the ‘‘serial 7s’’ subtraction item. In addition, the LSOA II CF-SR items are a subset of those used in the Health and Retirement Survey (HRS), first introduced in Wave 1 of the Asset and Health Dynamics Among the Oldest Old (AHEAD) study, thus providing an opportunity for crosswalk analyses between the two studies. Unlike the LSOA II measure, the HRS measure includes ‘‘serial 7’’ subtractions (similar to TICS) and, like TICS-m, a 10-word delayed recall (15). The LSOA II CF-SR measure tests memory, orientation, knowledge, and language and includes the following items:

1. A 10-word immediate recall (one question—10 points).
2. Naming the month, day, year, and day of the week (four questions—1 point each).
3. Two counting backwards items, first from 20 and then from 86 (two questions—2 points each).

4. Naming the ''prickly plant that grows in the desert'' and ''what people use to cut paper'' (two questions—1 point each).
5. Naming the President and Vice President (two questions—1 point each).

Cognitive functioning measures for sample persons with proxy respondents

The LSOA II cognitive functioning measure for sample persons with proxy respondents (CF-PR) consists of nine questions from the short IQCODE (16). The original IQCODE has 26 questions. The questions are asked of a proxy informant and measure cognitive change rather than cognitive functioning. Jorm and his colleagues created a short IQCODE of 16 questions by retaining only the questions that had the highest reliability and validity and were least influenced by premorbid cognitive functioning (17).

Validity studies of IQCODE have compared it with cognitive tests such as the Mini-Mental State Examination (MMSE) (18), with clinical diagnoses of dementia (19,20), with autopsy results (21), and with changes in scores on cognitive tests over a period of years (22). In studies that compared IQCODE and a cognitive test with a clinical diagnosis of dementia, IQCODE performed equally well or better at identifying persons with a clinical diagnosis of dementia, depending on the cut points selected (18,19,20).

The nine items in LSOA II were chosen from the short IQCODE. The exact wording is provided in the ''Technical Notes.'' Each item asks about change in a particular cognitive ability, such as the following: ''Compared with two years ago, how is (sample person) at: Remembering things about family and friends, such as occupations, birthdays, and addresses? Has this improved, not much changed, or gotten worse?'' A five-item Likert scale from 1 (much improved) to 5 (much worse) was used for each item, and the nine questions were summed and divided by nine resulting in a score ranging from 1 to 5. A higher score indicates that the sample person's cognitive abilities have worsened over time, capturing the progressive nature of dementia.

The original IQCODE asks proxy respondents about change in the sample person's cognitive abilities over the past 10 years. In LSOA II, the recall period was modified. Proxy respondents were asked about cognitive change in the 2-year period since the previous interview for live sample persons or change from the previous interview until approximately one month before death for deceased sample persons. The version of IQCODE used in HRS also asked about a 2-year recall period.

Methods for handling missing items

Imputation of missing items in the cognitive functioning measures for self-respondents

Out of the 4,959 respondents in Wave 2 with CF-SR data, 732 respondents answered ''I don't know'' to at least one question, and 169 respondents refused to answer one or more of the questions. ''Don't know'' answers were coded as incorrect answers. Of the 732 persons with ''don't know'' answers, 89% answered ''don't know'' to only one or two questions. Determining how to code refusals was more complicated. Following the lead of Herzog and Wallace using the AHEAD data (15), the characteristics of persons who had refused to answer a particular question were compared with the characteristics of persons who had answered that question (Table 2). The respondents who refused were more similar in all the characteristics examined in Table 2 to persons who had received low scores (i.e., performed poorly) than to persons with middle or high scores. Given the bias that would be introduced in the data by excluding persons who refused to answer, low scores were imputed to the refused questions and retained in the dataset. Researchers from HRS and AHEAD and from the earlier Epidemiologic Catchment Area Program, among others, handled refusals in a similar manner (15,23). Scores for refusals were imputed separately for the group that was 70–74 years of age at baseline and those who were 75 years of age and older at baseline. The refusals were assigned the score of the 10th percentile of all the persons who answered the particular item. The same process was followed to impute scores for refusals in Wave 3.

Missing items in cognitive functioning measures for sample persons with proxy respondents

Missing items were less common in the Wave 2 CF-PR data than in the Wave 2 CF-SR data. Among proxy respondents for live sample persons, 83 persons (8%) answered ''don't know'' to at least one question compared with 14% of self-respondents. Among proxy respondents for deceased sample persons, 108 persons (13%) answered ''don't know,'' a similar percentage to self-respondents. Refusals were rare among proxy respondents. Only 9 of the 1,830 proxy respondents refused to answer at least one of the IQCODE questions. The percentage of ''don't know'' answers in the Wave 3 proxy data was slightly smaller than in the Wave 2 proxy data, and refusals were equally rare.

''Don't know'' and refusals were scored as ''missing.'' Following the example of other users of IQCODE (24), when averaging the total score, the scores of the individual IQCODE questions were summed and the total was divided by the number of questions answered. When informants answered fewer than five of the nine IQCODE items, the total score was coded as ''missing.''

Evaluation of individual cognitive functioning measures

Cognitive functioning measures for self-respondents

In this section, mean scores on separate items and correlations between items are examined. Then, the psychometric properties of LSOA II CF-SR and its construct validity are

described. These explorations were conducted on the data from Waves 2 and 3, but the Wave 2 results are highlighted here. The mean score on the 10-word recall was 4.5, standard deviation 1.9. The proportion of the self-respondents knowing the full date correctly was 75%. The proportion that answered the common knowledge and language items correctly ranged from 79.5% for those who knew the Vice President's name to 98.3% for those who could name ''scissors.'' The product-moment correlations of the items making up the LSOA II's CF-SR measure were examined. Most items had product-moment correlations of 0.15–0.25 with the other items in the cognitive measure, and all correlations were significant at $p < 0.0001$. The most highly correlated items were 1) knowing the correct year and month ($r = 0.38$), 2) the ability to name the President's and Vice President's names ($r = 0.36$), and 3) counting backwards from 20 and counting backwards from 86 ($r = 0.35$). The lowest correlations were among naming scissors and all other items. The ''scissors'' item correlated poorly with other items in the HRS measures as well (15), likely because almost all respondents named ''scissors'' correctly.

Similar to TICS-m (8), the scores on the LSOA II's CF-SR measure exhibited a near-normal distribution with a tail on the left where the most impaired respondents' scores fell. The advantage to this distribution, as compared with one with a ceiling effect such as that associated with MMSE, is that TICS-m can distinguish between persons at both ends of the cognitive functioning spectrum (11). The unweighted mean total score for the Wave 2 measure (out of a total possible score of 22) was 14.95, with a standard deviation of 3.26. In Wave 3, the unweighted mean score was 14.82 and the standard deviation was 3.33. The weighted mean scores were 15.03 in Wave 2 and 14.92 in Wave 3.

To test the reliability or internal consistency of the measure, Cronbach's alpha was calculated, which was 0.71 in Waves 2 and 3. An alpha value of 0.70 or greater is generally considered reliable (25). Among the 3,499 persons who had CF-SR scores in Waves 2 and 3, the mean score was 15.57 in Wave 2 and 15.09 in Wave 3, which may measure an expected decline in cognitive functioning over the 2-year period.

To assess construct validity, *t*-tests and tests for trend were used to examine the differences in the mean cognitive score for subgroups based on characteristics known to be associated with cognitive function, including age, education, self-rated health, self-rated memory, and difficulty with IADL (Table 3). IADL difficulty was chosen because many IADL items have important cognitive content—for example, managing money and managing medication. The cognitive score was related to each variable in the expected direction. Mean CF-SR scores decreased with age, ranging from a mean of 15.8 among persons 72–74 years of age to a mean of 13.3 among persons 85 years of age and older. Mean scores increased with increasing years of education. Respondents with 8 or fewer years of education had mean cognitive functioning scores of 12.5, whereas the mean score of persons with more than a high school education was 16.1. Persons who rated their own health and memory as fair or poor were significantly more likely to have a lower cognitive functioning score than persons who rated their memory and health as good, very good, or excellent. Persons with IADL difficulties were also more likely to have low cognitive scores.

Cognitive functioning measures for sample persons with proxy respondents

Using weighted estimates, 44% of Wave 2 sample persons and 39% of Wave 3 sample persons with proxy interviews had an IQCODE score of 3 (''not much change'' in the sample persons' cognitive abilities in all nine areas). Only 2.8% in Wave 2 and 3.5% in Wave 3 had an average IQCODE score of less than 3, indicating improvement in memory. Proxy respondents reported that sample persons were ''much worse'' in all areas (an IQCODE score of 5) for 4.1% (Wave 2) and 5.1% (Wave 3) of sample persons with proxy interviews. The median score in Wave 2 was 3.1, whereas the mean was 3.5. In Wave 3, the median score was 3.2, and the mean was 3.5.

Cronbach's alpha for the LSOA II version of IQCODE was 0.91 or 0.92, depending on the wave and whether the sample person was alive or dead. This very high alpha coefficient is consistent with the 0.93–0.95 range found for the original IQCODE. In the 618 persons who had proxy measurements in Waves 2 and 3, the correlation between the scores was 0.63. The mean score in Wave 2 was 3.53, and in Wave 3 it was 3.60, meaning that greater cognitive decline was reported in Wave 3.

To assess construct validity, the differences in the mean IQCODE score were tested for subgroups based on characteristics known to be associated with cognitive function, including age, education, proxy-rated memory, and IADL difficulties (Table 3). Consistent with the TICS-derived CF-SR measure, older age was associated with more cognitive decline as measured by the proxy-reported IQCODE score. Unlike the results demonstrated with the CF-SR measure, however, no relationship existed between Wave 2 IQCODE score and education. This is consistent with other studies using IQCODE (17,26), which was designed specifically not to be affected by the study subject's educational level (16,17). Using the IQCODE score, greater cognitive decline was seen for the white population than for other races and for women than for men, the opposite of the findings for self-respondents. The relationship between proxy-rated memory at Wave 2 and IQCODE score was strong and was in the expected direction. The relationship between IADL difficulties and IQCODE score as reported by proxy respondents for live sample persons was also significant. Proxy respondents for deceased sample persons were not asked about IADL difficulties at Wave 2. Worse memory and fair or poor health were associated with greater cognitive decline reported by the Wave 2 proxy respondents.

The proxy interview for live sample persons contained an item capturing the reasons a proxy respondent was needed. The relationship between the reasons given and the IQCODE score was congruent. For example, sample persons who needed a proxy because of a hearing problem had a mean IQCODE score of 3.38, whereas those who needed a proxy because of poor memory had an IQCODE score of 3.93, indicating more cognitive decline in this group (data not shown).

Summary CI indicator

Background

The measure for self-respondents and the measure for sample persons with proxy respondents used in LSOA II assess two different concepts. The former is a test of cognitive functioning, whereas the latter measures cognitive change; however, as described above, IQCODE and TICS have been shown to identify cases of clinically-diagnosed dementia. Because of the importance of CI and the systematic bias that is introduced when analyses include only self- or only proxy respondents, a variable summarizing the two measures may be valuable.

A categorical variable with three levels is proposed: probable CI, possible CI, and no CI. This variable is a succinct, aggregate measure of CI, allowing analysts to use data from self-respondents and sample persons with proxy respondents and thereby the largest sample size possible in investigations related to CI.

Many studies have used TICS, TICS-m, or some modification of these, and many different cut points for CI have been suggested (7,11,27,28). Cut points for the CF-SR measure were chosen in this study on the basis of this literature: scores of 0–9 as probable CI (CI), scores of 10 or 11 as possible CI, and scores of 12 or more as no CI. The largest part of any misclassification is expected to have occurred in the middle, ''possible,'' group.

In a 2004 review of the IQCODE measure and its psychometric properties and validity, Jorm reported that cut points for dementia in persons living in community settings were generally in the range of 3.3–3.6, whereas, the range has been higher, 3.4–4.0, in patient samples (24). In a validity study in a community cohort of persons aged 70 years and older, Jorm and colleagues categorized participants into five groups based on the IQCODE score (22): improved, no change, slight decline, moderate decline, or severe decline. On the basis of this study, LSOA II CF-PR scores ranging from 1 to less than 3.5 were treated as no CI, 3.5 to less than 4 (Jorm et al.'s ''moderate decline'' group) as possible CI, and 4 to 5 (Jorm et al.'s ''severe decline'' group) as probable CI.

This three-level variable indicating CI is thus available for all sample persons who completed the cognitive functioning questions, all live sample persons with a proxy interview, which includes answers to the IQCODE questions, and all dead sample persons with a proxy interview including answers to the IQCODE questions. The number of respondents in Wave 2 with a value for the constructed CI variable is 6,789, or 72% of the persons with an SOA II interview and 85% of those interviewed in Wave 2. In Wave 3, 5,579 persons, 86% of those interviewed, have a combined CI variable.

Results

As a validity check on the combined CI variable, levels of CI in LSOA II were compared with the results from other studies. Table 4 compares probable CI from LSOA II with estimates of probable CI or dementia from two other general population surveys: the 1998 HRS and the 1994 National Long Term Care Survey (NLTCS) (29). The prevalence rates of probable CI are similar in LSOA II and HRS, both among sample persons who were self-respondents and among those with proxy respondents. The rates of probable CI by sex as well as the age-specific rates do not differ significantly between the two studies. Estimates of probable CI based on the self-reported LSOA II data appear slightly larger than estimates of dementia from NLTCS, but the 95% confidence limits around the rates overlap.

Table 5 compares estimates of possible and probable CI in LSOA II on the basis of self- and proxy-reported data, with rates of mild through severe dementia as measured in three population-based studies that used clinical examinations to diagnose dementia (30–32). Unlike the comparisons with other surveys' results, the LSOA II estimates are generally lower than those from the studies using clinical diagnoses, particularly in the older age groups 80–84 years and 85 years and older. Studies using clinical examinations to diagnose dementia are generally more sensitive and thus are more likely to identify milder cases than studies using survey-based indicators, particularly among high functioning persons.

Comparing the proportions in each LSOA II CI category with prevalence rates of CI from other studies does not indicate whether persons have been classified correctly, but it does allow comparisons with expected prevalence rates by characteristics such as age and sex. In order to examine the issue of classification or construct validity, the association of Wave 2 CI was examined as measured by the three-category variable with age, education, sex, race, self- or proxy-rated health status, self- or proxy-rated memory, and IADL difficulties (Table 6). Persons with probable CI were significantly different in expected ways from persons with no CI. Persons with probable and possible CI were more likely to be older, less educated, and black or another minority race and to report worse health and memory and more IADL difficulties than persons with no CI. Persons with probable CI were more likely to be women than persons with no CI, but persons with possible CI and persons with no CI did not differ by sex.

Discussion

The instruments used to measure cognitive functioning and cognitive change in LSOA II are based on frequently used and well-validated

measures—TICS and IQCODE. The subsets of questions used in LSOA II retain many of the good psychometric properties of the original instruments.

The TICS-based measure shows good content validity. As has been seen in other studies using brief cognitive tests (33,34), test scores decreased with age and increased with higher levels of education. As expected, those with lower scores also reported more difficulties with IADL and rated their general health and their memory worse than those with higher scores did.

The IQCODE-based measure shows good content validity as well. Cognitive decline (indicated by a higher score) was associated with age, lower proxy-rated health and memory, and more IADL difficulties. No relationship existed between education and IQCODE score, which replicates the findings of other studies using IQCODE (16,26).

Although informant questionnaires such as IQCODE and cognitive tests such as MMSE or TICS have been shown to identify clinically-diagnosed dementia with similar sensitivity and specificity (18), the two types of measures introduce different sources of bias. The key clinical element in dementia diagnosis is global deterioration in cognitive functioning (35). Well-educated persons may perform relatively well on a one-time cognitive test, such as TICS, despite having deteriorating cognitive functioning, and would thus be a source of false negatives. The IQCODE results may be affected by the relationship between the informant and the sample person. The shortened recall period of 2 years, used in LSOA II, may also be a source of bias, missing cases that have been stable over the last two years. However, given the progressive nature of most subtypes of dementia (35), this is unlikely to be a major cause of misclassification. Even pure vascular dementia, which represented only 9% of dementia cases in one community-based autopsy study (36), may be progressive because of multiple infarcts (37).

In epidemiologic studies, losses to follow-up and other sources of missing data create the possibility of bias. In LSOA II, persons with the self-reported cognitive measure are younger, healthier, and better educated than the rest of the sample. Persons with proxy measures are older, less healthy, and less educated than the rest of the sample. Sample persons with missing data for both cognitive measures are older than the persons with CF-SR measures, but younger than those with CF-PR measures; they are less healthy than persons with CF-SR measures but more healthy than those with CF-PR measures. Because the characteristics of persons with no cognitive measures form a middle ground between the CF-SR and CF-PR extremes, their absence is less likely to cause a systematic bias.

Researchers conducting analyses that use only self-respondents or only persons with proxy respondents will probably find using the continuous score for the TICS-based or IQCODE-based measure is the best choice. Many researchers, however, will want to take advantage of the full sample. For this reason, cutoffs have been proposed for each measure that will allow a combined cognitive status variable to be used.

Previous studies have compared the use of a brief cognitive test, usually MMSE (38), (on which TICS is based) with the use of an informant questionnaire, generally IQCODE (18,39). Despite the differences between them, the two instruments were generally equally effective at identifying dementia as measured by clinical examination. The results of these studies support the idea that these measures can be used in conjunction to identify CI.

Comparisons of LSOA II age-specific CI prevalence rates with rates from HRS and NLTCS found no statistically significant differences. A different pattern emerges when CI rates from LSOA II are compared with dementia rates from studies that used clinical examinations to reach a diagnosis. The rates of CI from LSOA II, probable and possible combined, are lower than those from studies with clinical examinations. One of the greatest challenges in using survey methods rather than clinical examinations may be in the identification of mild CI. Better identification of persons with mild CI may explain much of the difference in rates between studies that used clinical examinations to identify cases and those that relied solely on questionnaires.

A major limitation of this work is that the cut points chosen for the three-level categorical variable have not been validated for the subset of TICS and IQCODE items that was used in LSOA II. LSOA II does not have the clinical data that would be necessary to investigate thoroughly the validity of these cut points. Our results suggest, however, that using a shorter version of TICS and IQCODE did not compromise the ability of the instruments to identify persons with CI. Despite the exclusion of the ''serial 7'' subtractions and the delayed word recall (items associated with significant respondent burden), the prevalence rates from Wave 2 of LSOA II were similar to those found in the 1998 HRS. The prevalence rates of CI in sample persons with proxy respondents were also similar, although HRS used the full 16-item short IQCODE and LSOA II used a shorter 9-question version. Two Asian studies using even shorter versions of the IQCODE have also shown high screening accuracy for dementia (40,41).

This report demonstrates that the LSOA II self-respondent and proxy-respondent cognitive functioning measures, despite using subsets of the original instruments' questions, have good construct validity and produce similar prevalence rates to those found in other studies using survey methodology. Combining the two types of measures into a categorical indicator of CI has also been shown to be feasible, and the indicator demonstrates good construct validity. Using the categorical CI variable will improve future analyses by reducing selection bias and improving generalizability to the entire noninstitutionalized population with CI. As researchers make continued use of LSOA II measurements, particularly in examining the value of this cognitive status indicator as a predictor for known outcomes such as mortality and institutionalization, further evidence on its usefulness will accrue.

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Table 1. Baseline (SOA II) characteristics by source of cognitive measures at Wave 2 of LSOA II, 1997–1998

Baseline characteristics	Self-reported cognitive measures (*n* = 4,959) weighted percent	Proxy-reported cognitive measures (*n* = 1,830) weighted percent	No cognitive measures (*n* = 2,658) weighted percent
Age			
69–74 years	46.3	25.9	35.9
75–79 years	30.2	26.6	29.2
80–84 years	16.6	23.4	19.9
85 years and over	6.9	24.2	15.0
Sex			
Male	36.6	48.8	39.6
Female	63.4	51.2	60.4
Race			
White	91.3	88.4	88.2
Black and other	8.7	11.6	11.8
Education			
Less than 8 years	18.0	35.6	28.4
8–11 years	14.8	15.2	17.5
12 years	36.4	30.4	33.1
More than high school	30.8	18.8	21.0
Living arrangements			
Living alone	36.2	30.1	34.4
Living with spouse	53.1	51.8	51.0
Living with other	10.7	18.0	14.6
Self-reported health			
Fair or poor	21.8	39.6	31.0
Good, very good, or excellent	78.2	60.4	69.0
Trouble concentrating			
Yes	1.2	4.2	3.2
No	98.8	95.8	96.8
Frequently forgetful			
Yes	4.5	11.4	9.5
No	95.5	88.6	90.5
Physical functioning difficulties[1]			
0	44.2	26.9	40.2
1–2	26.0	19.6	19.5
3 or more	29.7	53.5	40.3
ADL difficulties[2]			
0	79.0	55.0	67.9
1–2	13.9	20.9	16.6
3 or more	7.2	24.1	15.5
IADL difficulties[3]			
0	75.7	51.2	65.3
1–2	17.6	20.6	16.6
3 or more	6.7	28.2	15.4

[1]Includes the following 10 difficulties: walking a quarter mile; walking up 10 steps; standing for 2 hours; sitting for 2 hours; stooping, crouching, or kneeling; reaching over head; reaching out as if to shake hands; using fingers to grasp or handle; lifting or carrying 25 pounds; and lifting or carrying 10 pounds.

[2]ADLs includes the following seven difficulties: bathing or showering, eating, dressing, getting in or out of beds or chairs, walking, using the toilet, and getting outside.

[3]IADLs includes the following eight difficulties: preparing meals, shopping for groceries, managing money, using the phone, doing heavy housework, doing light housework, getting outside, and managing medication.

NOTE: SOA II is Second Supplement on Aging; LSOA II is Second Longitudinal Study of Aging. ADL is activities of daily living. IADL is instrumental activities of daily living.

Table 2. LSOA II Wave 2 self-respondent cognitive tests: Comparisons of respondents who refused with those who provided an answer, 1997–1998

	Unweighted frequencies	Mean score on word recall[1] (0–10)	Score on counting backwards from 20[1] (0–2)	Score on dichotomous items[1,2] (0–8)	Mean self-rated memory in Wave 2[3]	Mean self-rated health in Wave 2[3]	Percent with self-respondent cognitive tests in Wave 3
Word recall							
Refused	72	. . .	1.7	6.9	3.0	2.9	58.3
Low score (0–3)	1,449	. . .	1.6	6.7	3.0	2.9	58.7
Medium score (4–5)	2,106	. . .	1.8	7.4	2.8	2.7	72.8
High score (6–10)	1,332	. . .	1.9	7.6	2.6	2.5	80.5
Counting backwards from 20							
Refused	69	2.6	. . .	6.0	3.0	3.0	52.2
Low score (0–1)	604	3.5	. . .	6.4	3.0	2.9	58.8
High score (2)	4,286	4.7	. . .	7.4	2.8	2.7	72.5
Counting backwards from 86							
Refused	114	2.5	1.2	6.2	3.0	3.0	51.8
Low score (0–1)	1,034	3.8	1.4	6.7	3.0	2.9	62.9
High score (2)	3,811	4.7	1.9	7.4	2.8	2.6	79.7
Dichotomous items[1]							
Refused any	36	*	*	. . .	3.0	2.9	49.5
Low score (0–5)	377	2.8	1.2	. . .	3.2	3.0	42.4
Medium score (6–7)	1,912	4.2	1.8	. . .	2.9	2.8	65.8
High score (8)	2,634	5.0	1.9	. . .	2.7	2.6	77.7

. . . Category not applicable.
* Figure does not meet standards of reliability or precision. Estimates based on fewer than 30 people are considered unreliable.
[1]A higher score represents better cognitive functioning.
[2]Dichotomous items include naming the day, month, year, day of week, scissors, cactus, the President, and the Vice President.
[3]For self-rated memory and health, lower numbers represent better memory and health.
NOTES: Results are weighted. LSOA II is Second Longitudinal Study of Aging.

Table 3. Mean (weighted means) cognitive functioning score (self-respondents) and mean cognitive change score (proxy respondents), by sociodemographic and health or functioning characteristics for LSOA II Wave 2, by respondent characteristics: 1997–1998

Characteristic	Mean (SE) scores for self-respondents[1]	Mean (SE) scores for proxy respondents[2,3]
Age		
72–74 years	†15.8 (0.08)	†3.27 (0.04)
75–79 years	15.5 (0.07)	3.40 (0.03)
80–84 years	14.4 (0.11)	3.49 (0.03)
85 years and over	13.3 (0.16)	3.58 (0.03)
Sex		
Male	†14.9 (0.07)	†3.36 (0.02)
Female	15.1 (0.07)	3.57 (0.02)
Education		
Less than 9 years	†12.5 (0.14)	3.45 (0.03)
9–11 years	14.6 (0.12)	3.44 (0.04)
High school graduate	15.6 (0.07)	3.46 (0.03)
More than high school	16.1 (0.07)	3.49 (0.04)
Race		
White	†15.2 (0.05)	†3.48 (0.02)
Black and other	13.1 (0.22)	3.37 (0.04)
Self- or proxy-rated health		
Fair or poor	†13.8 (0.12)	†3.57 (0.02)
Good, very good, or excellent	15.4 (0.05)	3.34 (0.02)
Self- or proxy-rated memory		
Fair or poor	†13.9 (0.11)	†3.90 (0.03)
Good, very good, or excellent	15.4 (0.05)	3.11 (0.01)
Number of IADL difficulties[4,5]		
0	†15.3 (0.06)	†3.16 (0.03)
1–2	14.7 (0.09)	3.32 (0.03)
3 or more	13.3 (0.21)	3.77 (0.04)

†*t*-tests (dichotomous variables) or trend tests (variables with three or more levels) are significant at $p < 0.05$.

[1]Scores range from 0–22. A higher score indicates better cognitive functioning.

[2]Scores from proxy respondents are for both living and deceased sample persons. Scores from proxy respondents for living and deceased sample persons were similar.

[3]Scores range from 1–5. A score of 3 means no change. A higher score means greater cognitive decline.

[4]Does not include data from proxy respondents for dead sample persons because data on IADLs at Wave 2 were not gathered in the next of kin interview.

[5]IADLs includes the following eight difficulties: preparing meals, shopping for groceries, managing money, using the phone, doing heavy housework, doing light housework, getting outside, and managing medication.

NOTES: LSOA II is Second Longitudinal Study of Aging. SE is standard error. IADL is instrumental activities of daily living.

Table 4. A comparison of estimates of probable cognitive impairment from LSOA II Wave 2, 1997–1998, with probable cognitive impairment (CI) or dementia from the 1998 Health and Retirement Survey (HRS) and the 1994 National Long-Term Care Survey (NLTCS), by respondent sex and age

Sex and age	Probable CI LSOA II percent (95 percent confidence interval)	Probable CI 1998 HRS[1] percent (95 percent confidence interval)	Dementia NLTCS[2] percent (95 percent confidence interval)
Self-respondents			
Male	5.1 (4.2, 6.2)	5.2 (4.4, 6.2)	. . .
Female	6.4 (5.5, 7.3)	6.1 (5.5, 6.8)	. . .
72–74 years	2.8 (2.0, 4.0)	3.0 (2.3, 4.0)	. . .
75–79 years	4.2 (3.4, 5.2)	3.8 (3.0, 4.8)	. . .
80–84 years	8.2 (6.8, 9.9)	6.4 (5.4, 7.5)	. . .
72–74 years	2.8 (2.0, 4.0)	. . .	[3]1.7 (1.6, 2.4)
75–84 years	5.7 (5.0, 6.5)	. . .	4.4 (3.5, 5.2)
85 years and over	13.2 (10.8, 16.1)	14.2 (12.4, 16.1)	9.4 (7.3, 11.5)
Proxy respondents[4]			
Male	15.8 (12.6, 19.0)	13.5 (10.1, 17.8)	. . .
Female	28.1 (24.7, 31.6)	33.6 (28.1, 39.6)	. . .
72–79 years	16.6 (12.8, 20.4)	17.1 (13.6, 21.3)	. . .
80–84 years	22.5 (17.3, 27.6)	26.8 (19.9, 35.1)	. . .
85 years and over	28.9 (23.9, 33.9)	31.2 (26.1, 36.9)	. . .

. . . Category not applicable.

[1]From Ofstedal, personal communication, December 15, 2006.

[2]See Pressley JC, Trott C, Tang M, Durkin M, Stern Y, ''Dementia in community-dwelling elderly patients: A comparison of survey data, Medicare claims, cognitive screening, reported symptoms and activity limitations,'' *Journal of Clinical Epidemiology* 56:896–905, 2003.

[3]The NLTCS prevalence rate is for persons 65–74 years of age, whereas the LSOA II and HRS rates are for persons aged 72–74 years only.

[4]Data from proxy respondents for deceased sample persons are excluded.

NOTE: LSOA II is Second Longitudinal Study of Aging.

Table 5. A comparison of the prevalence of possible and probable cognitive impairment combined from the LSOA II Wave 2 (1997–1998) with rates of any dementia or cognitive impairment from three studies that used clinical examinations to diagnose dementia, by sex and age

Sex and age	LSOA II[1] Wave 2 percent (95 percent confidence interval)	Canadian Study on Health and Aging[2] percent	Chicago Population Study[3] percent (95 percent confidence interval)	Cardiovascular Health Study[4] percent
Age				
75–84 years	14.6 (13.3, 15.9)	11.1	18.7 (13.2, 24.2)	. . .
85 years and over	30.9 (27.8, 34.0)	34.5	47.2 (37.0, 63.2)	. . .
Male				
70–74 years	9.0 (7.0, 11.1)	. . .	. . .	9.0
75–79 years	12.6 (10.3, 14.9)	. . .	. . .	15.4
80–84 years	18.3 (14.8, 21.9)	. . .	. . .	33.3
85 years and over	26.9 (22.0, 31.8)	. . .	. . .	42.9
Female				
70–74 years	8.6 (6.6, 10.6)	. . .	. . .	9.0
75–79 years	10.7 (8.9, 12.4)	. . .	. . .	20.6
80–84 years	20.2 (14.8, 21.9)	. . .	. . .	32.6
85 years and over	32.6 (29.0, 36.2)	. . .	. . .	50.9

. . . Category not applicable.

[1]Prevalence rates shown here include proxy-respondent data for live sample persons only. Data from proxy respondents of deceased sample persons are excluded.

[2]Canadian Study of Health and Aging Workgroup, ''Canadian Study of Health and Aging: Study methods and prevalence of dementia,'' *Canadian Medical Association Journal* 150:899–913, 1994.

[3]Evans DA, Funkenstein H, Albert MS, Scherr PA, Cook NR, Chown MJ, et al., ''Prevalence of Alzheimer's disease in a community population of older persons: Higher than previously reported,'' *Journal of the American Medical Association* 262:2551–6, 1989.

[4]Fitzpatrick AL, Kuller LH, Ives DG, Lopez OL, Jagust W, Breitner JCS, et al., ''Incidence and prevalence of dementia in the Cardiovascular Health Study,'' *Journal of the American Geriatric Society* 52:195–240, 2004.

NOTE: LSOA II is Second Longitudinal Study of Aging.

Table 6. Sociodemographic, health, and functioning characteristics and cognitive impairment, including self- and proxy respondents, in LSOA II Wave 2: 1997–1998

Characteristic	Probable cognitive impairment percent	Possible cognitive impairment percent	No cognitive impairment[1] percent
Age at Wave 2			
69–74 years	††9.1	††16.1	25.0
75–79 years	25.3	27.2	37.0
80–84 years	37.4	27.5	22.3
85 years and over	38.3	29.2	15.7
Sex			
Male	†34.2	41.5	40.4
Female	65.8	58.5	59.6
Education			
Less than 9 years	††44.0	††42.0	18.4
9–11 years	14.5	18.4	14.6
High school graduate	24.8	26.0	36.8
More than high school	16.8	13.6	30.2
Race			
White	††83.4	†85.3	91.9
Black and other	16.6	14.7	8.1
Self- or proxy-rated health			
Fair or poor	††56.7	††46.9	25.7
Good, very good, or excellent	43.3	53.1	74.3
Self- or proxy-rated memory			
Fair or poor	††69.4	††45.7	22.4
Good, very good, or excellent	30.6	54.3	77.6
Number of IADL difficulties[2,3]			
0	††36.9	††45.4	66.5
1–2	23.6	29.2	25.8
3 or more	39.5	25.4	7.7

†p value < 0.01.
††p value < 0.001.
[1]No cognitive impairment (CI) is the reference group. *P* values are for chi-square tests of the difference between probable CI and no CI and between possible CI and no CI .
[2]IADLs includes the following eight difficulties: preparing meals, shopping for groceries, managing money, using the phone, doing heavy housework, doing light housework, getting outside, and managing medication.
[3]Proxy respondents for deceased sample persons were not asked about IADLs in the Wave 2 interview; therefore, data from live sample persons only are included.

NOTES: LSOA II is Second Longitudinal Study of Aging. IADL is instrumental activities of daily living.

Technical Notes

Second Longitudinal Study of Aging cognitive functioning measures

Self-respondent measures

1. I'll read a set of 10 words and ask you to recall as many as you can. We have purposely made this list long so that it will be difficult for anyone to recall all the words—most people recall just a few. Please listen carefully as I read the set of words. When I finish, I will ask you to recall aloud as many words as you can, in any order.

   Read words (SP[sample person] is assigned randomly selected word list 1, 2, 3, or 4).

Now please tell me the words you can recall.

2. We're interested in how memory actually works. We find that even people with very good memories seem to forget some things from time to time. The next questions are a little different, but are often asked on studies about memory.

Please tell me today's date.
Probe month, day, year, day of week.

3. For this next question, please try to count backward as quickly as you can from the number I will give you. Please start with 20.

4. Now please try counting backward from a different number. Remember to count as quickly as you can from the number I mention. The number to start from is 86.

Now I'm going to ask you for the names of some people and things.

5. What do people usually use to cut paper?

6. What do you call the kind of prickly plant that grows IN the desert?

7. Who is the President of the United States right now?

8. Who is the Vice President?

Proxy-respondent measures (live sample persons)

Now we want you to remember what (SP) was like two years ago and to compare it with what (he/she) is like now. Two years ago was in (month/year). I will read situations where (SP) has to use (his/her) memory or intelligence, and we would like you to indicate whether this has improved, stayed the same, or gotten worse in that situation over the past two years. Note the importance of comparing (his/her) present performance with two years ago. So if two years ago (SP) always forgot where (he/she) had left things, and (he/she) still does, then this would be considered ''not much change.''

Compared with two years ago, how is (NAME) at:

1. Remembering things about family and friends, such as occupations, birthdays, and addresses.
   a. Has this improved, not much changed, or gotten worse?
   b. Is it much improved or a bit improved?
   c. Is it much worse or a bit worse?
2. Remembering things that have happened recently?
3. Recalling conversations a few days later?
4. Remembering (his/her) address and telephone number?
5. Remembering what day and month it is?
6. Remembering where things are usually kept?
7. Making decisions on everyday matters?
8. Handling money for shopping?
9. Handling financial matters, that is, the pension or dealing with the bank?

Proxy-respondent measures (deceased sample persons)

Now we want you to remember what (NAME) was like when we interviewed (him/her) in (MM/DD/YY of last interview) and to compare it with what (he/she) was like toward the end of (his/her) life, but leaving out the last month or so of (his/her) life. I will read situations where (NAME) had to use (his/her) memory or intelligence and, we would like you to indicate whether this had improved, stayed the same, or gotten worse in that situation over the past two years. Note the importance of comparing (his/her) performance toward the end of (his/her) life with when we interviewed (him/her) in (MM/DD/YY of last interview). So if in (MM/DD/YY of last interview) (NAME) always forgot where (he/she) had left things, and (he/she) still did a month or so prior to death, then this would be considered ''not much change.''

Compared with when we interviewed (him/her) in (MM/YY/DD), how was (NAME) at:

1. Remembering things about family and friends, such as occupations, birthdays, and addresses.
   a. Had this improved, not much changed, or gotten worse?
   b. Was it much improved or a bit improved?
   c. Was it much worse or a bit worse?
2. Remembering things that had happened recently?
3. Recalling conversations a few days later?
4. Remembering (his/her) address and telephone number?
5. Remembering what day and month it is?
6. Remembering where things were usually kept?
7. Making decisions on everyday matters?
8. Handling money for shopping?
9. Handling financial matters, that is, the pension or dealing with the bank?

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