Published in final edited form as:

Int J Geriatr Psychiatry. 2006 July ; 21(7): 618–625. doi:10.1002/gps.1536.

Validation analysis of informant's ratings of cognitive function in African Americans and Nigerians

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SUMMARY

Objectives—To examine informant validity using the Community Screening Interview for Dementia (CSI ‘D’) both cross-sectionally and longitudinally in two very different cultures and to explore the effects of informants and study participants’ characteristics on the validity of informants’ reports.

Methods—Elderly African Americans age 65 years and older residing in Indianapolis, USA and elderly Yoruba Nigerians age 65 years and older residing in Ibadan, Nigeria were assessed on cognitive functioning using the CSI ‘D’ at baseline (1992–1993) and five-year follow-up (1997–1998). At baseline, the informant validity in both samples was evaluated against participants’ cognitive tests using Pearson correlation and regular regression models. At follow-up, informants ratings on cognitive decline were assessed against participants’ cognitive decline scores from baseline to follow-up using biserial correlation and logistic regressions.

Results—At baseline, informants’ reports on cognitive functioning significantly correlated with cognitive scores in both samples (Indianapolis: $r = -0.43$, $p < 0.001$; Ibadan: $r = -0.47$, $p < 0.001$). The participant–informant relationships significantly affected the informants’ reports in the two samples with different patterns ($p = 0.005$ for Indianapolis and $p < 0.001$ for Ibadan) at a given level of cognitive functioning. African Americans spouses reported more cognitive problems, while siblings reported more problems for the Yoruba Nigerians. At follow-up, informants’ ratings on cognitive decline significantly correlated with the cognitive decline scores (Indianapolis $r = 0.38$, $p < 0.001$; Ibadan $r = 0.32$, $p < 0.001$). The characteristics of study participants and informants had little impact on the informants’ ratings on cognitive decline.

Conclusions—Informant reports are valid in assessing the cognitive functioning of study participants both cross-sectionally and longitudinally in two very different cultures, languages and environments.

Keywords

informants’ reports; validity; cognitive function; dementia; Community Screening Interview for Dementia (CSI ‘D’); cross-cultural studies

INTRODUCTION

Comparative cross-cultural studies provide unique opportunities for exploration of environmental and genetic risk factors for Alzheimer's disease and dementia (Hendrie, 2001). One of the keys to such studies is having a cognitive screening instrument that is valid in a variety of education levels and cultures. However, many studies showed that participant-based direct cognitive tests are often susceptible to education and culture biases (Folstein *et al.*, 1975; Teng *et al.*, 1994; Glosser *et al.*, 1993).

An alternative to the participant-based cognitive tests is to obtain information from an informant such as a spouse, sibling, child and other close relative. Informants' reports are intended to measure cognitive functioning in a longitudinal perspective by reporting direct changes in cognitive performance using their knowledge of the participant's functioning earlier in life. Thus, education and culture biases are greatly reduced (Jorm, 1996). O'Connor *et al.* (1989) reported informants' reports concurred with cognitive test scores in the CAMDEX instrument. Jorm *et al.* (1994) showed that informants' reports were correlated with the subjects' cognitive test performance and age, indicating their good validity. In community-based dementia studies, researchers often combine the two approaches to augment the discriminating ability of dementia although a previous study showed that informant reports performed as well as the cognitive tests in assessing cognition (Law and Wolfson, 1995; Hall *et al.*, 1996; Mackinnon and Mulligan, 1998; Cacchione *et al.*, 2003; Knafelc *et al.*, 2003; Mackinnon *et al.*, 2003; Tierney *et al.*, 2003).

Informants' reports are likely to be affected by participants' and informants' characteristics. To explore how the characteristics influence the validity of informants' reports is of great importance because it would provide a basis for selecting more appropriate informants and obtaining more accurate information. However, little information is known about informant characteristics that affect validity (Jorm, 2003). A study showed that a spouse who lived with a patient with Alzheimer's Disease was most likely to provide optimal report regarding participant performance (Cacchione *et al.*, 2003). However, other studies showed that informant ratings using IQCODE had no significant association with either the length of the relationship or the type of the relationship (O'Connor *et al.*, 1989; Fuh *et al.*, 1995). Inconsistent findings about the effect of informants' characteristics on reports of performance of study participants are perhaps not surprising because the informant measures in different studies are quite diverse in terms of content domain, assessment period, data collection method and the purpose of assessment. The characteristics of participants appear also to influence the informant reports although again there are inconsistent results. One study showed informants tended to report more cognitive decline with older male subjects, with no correlation with education of the subject (Jorm *et al.*, 1994). However, another study suggested that a more accurate appraisal of functioning was more likely if the participant was younger, male and better educated (Cacchione *et al.*, 2003).

Research teams at Indiana University School of Medicine, Indiana, USA, and the University of Ibadan College of Medicine, Ibadan, Nigeria have been conducting a longitudinal comparative epidemiological community-based study of age associated dementias since 1992. The Community Screening Interview for Dementia (CSI'D') developed by these teams includes a direct cognitive assessment, and an interview with an informant of the participants asking about whether they have observed change in cognitive function over time (Hall *et al.*, 1993). The CSI'D' instrument has been successfully used as a screening tool for dementia in many sites with different cultures, languages and environments (Hall *et al.*, 2000; Prince *et al.*, 2003). The main aim of the study was to examine the validity of informant reports using the CSI'D' both cross-sectionally, reflecting informants' impression of current cognitive function, and long-itudinally, reflecting the informants' assessment of

cognitive decline, in two very different cultures. As a secondary analysis, we also explored the effects of informants and study participants' characteristics on the validity of informants' reports.

METHODS

Study populations

As part of the Indianapolis-Ibadan Dementia Project (IIDP), elderly African Americans age 65 years and older residing in Indianapolis, USA ($n = 2212$) and elderly Yoruba Nigerians age 65 and older residing in Ibadan, Nigeria ($n = 2487$) were screened with the CSI'D' at baseline between 1992–1993. Of those, 1253 and 1228 individuals from Indianapolis and Ibadan were screened again at five year follow-up. Details of the study have been published previously (Hendrie *et al.*, 1995; Hall *et al.*, 1996).

Community Screening Interview for Dementia (CSI'D')

The cognitive test of the CSI'D' includes 33 items measuring multiple cognitive domains including language, memory, recall, orientation, judgment, comprehension and constructional praxis. A cognitive score which represents general cognitive functioning was created by summing the 33 items. Lower scores indicate more cognitive impairment. The scoring details have been published previously (Hall *et al.*, 1993).

The informant interview assesses the daily functioning of the study participants. The questions are based upon the Cambridge Examination for Mental Disorders (CAMDEX) (Roth *et al.*, 1986; Hendrie *et al.*, 1988) and the Blessed Dementia Scale (Morris *et al.*, 1993). The informant is asked about possible changes in language, memory, judgment and activities of daily living of the study participants. The informant was first asked to evaluate whether or not there has been a general decline in the mental functioning of the study participants. The responses are coded as 'yes' or 'no'. In the following 13 questions informants were asked to evaluate specific cognitive activities of the study participants. These items measure a continuum of cognitive impairment. The items are listed in Appendix 1. The responses are 'no', 'sometimes' and 'yes' which were scored as 0, 0.5 and 1, respectively. For the purpose of validity evaluation, the 13 items were summed to create an informant-based cognitive score, which will be called informant score thereafter. Higher informant scores indicate worse cognitive function.

Characteristics of participants and informants

Several characteristics that potentially influence the quality of informant reports included participant's age, gender, and education, types of informant-participant relationships, co-residence with participant and frequency of informant seeing the participant. The informant-participant relationships were categorized as spouse, sibling, child, and others including grandchild. The frequency of informant seeing the participant ranged from everyday, every other day, once a week, once a month to less than once a month.

Statistical analysis

We separately performed two kinds of analyses to evaluate the validity of informants' reports on cognitive functioning of the study participants: a baseline evaluation in which only baseline data were used and a follow-up evaluation in which both the baseline and the five-year follow-up data were used. Separate analyses were conducted for the Indianapolis and Ibadan samples. All analyses were done in SAS software version 8.2.

The baseline analysis—The cognitive scores were used as an objective measure of cognitive functioning. We focused linear relationship between informant scores and cognitive scores because scatter plots of our data did not indicate a non-linear trend. Furthermore a linear relationship has been commonly applied in the literature (Jorm *et al.*, 1996, 2000). The informant scores were first compared with cognitive scores using Pearson correlation coefficients. Linear regression models were carried out with the informant scores as dependent variables and cognitive scores as independent variables controlling for the characteristic factors. We regarded informant scores as random variables which are dependent on participants' cognitive scores if the informant reports are valid. Using informant scores as dependent variables and cognitive scores as independent variables would also allow us to investigate how informant characteristics influence their reports given a certain level of cognitive functioning. In contrast to the continuous education levels for Indianapolis participants, we dichotomized the Ibadan participants into having any education vs no education since the majority had no education at all. Tukey-Kramer adjusted pairwise comparisons were used for further exploration of the characteristic effects. As post hoc analyses, Pearson partial correlations adjusting for the characteristics were conducted between informant scores and cognitive scores within each informant-participant relationship group. Histograms were used to facilitate the interpretation of results with grouped cognitive scores by tertiles (the highest third, the intermediate third and the lowest third) and the means of informant scores. We realized that the informant scores are positively skewed. Therefore Spearman nonparametric rank correlation and rank regression models were also conducted along with Pearson correlation and regular regression models for comparisons (Conover and Iman, 1981).

The follow up analysis—At five-year follow-up, informants were asked to evaluate whether or not study participants had general mental decline in the past five years. To assess the validity of this informant's rating, we first compared it with cognitive decline scores using biserial correlation, which aims to measure the adjusted correlation of a continuous variable with a binary variable (Kraemer, 1982). The cognitive decline scores are defined as baseline cognitive scores minus follow-up cognitive scores with positive change scores reflecting cognitive decline for ease of interpretation. The association between informant reported decline at five year follow-up and cognitive decline scores was further explored using logistic regression controlling for the characteristic factors. Histograms were used to facilitate the interpretation of relationships. Scatter plots were generated between changes in informant scores defined as follow-up minus baseline and cognitive decline scores.

RESULTS

The baseline analysis

Of the 2212 African Americans at baseline, 1493 (67%) had informants who were interviewed, and in Ibadan, 2459 (99%) of 2487 Yoruba Nigerians had informants. The characteristics of participants at baseline were summarized in Table 1.

Pearson correlation coefficients showed significantly negative associations between the cognitive scores and the informant scores in both samples (Indianapolis: $r = -0.43$, $p < 0.001$; Ibadan: $r = -0.47$ $p < 0.001$). Histograms showed a clearly decreasing trend in both samples with the lowest third cognitive group having the worst informant scores (Figure 1). Table 2 showed the results of the regression models with informant scores as the dependent variable. Individuals with low cognitive scores were more likely to have higher informant scores ($p < 0.001$ for both sites).

The regression models demonstrated that the types of informant-participant relationships significantly affected the informant scores ($p = 0.005$ for Indianapolis and $p < 0.001$ for

Ibadan) controlling for cognitive functioning. In the Indianapolis sample, Tukey-Kramer adjusted pair-wise comparisons among types of relationships showed informant scores reported from spouses were significantly higher than those reported from others including grandchildren ($p = 0.004$). In Ibadan, informant scores reported from siblings were significantly higher than those reported from any other types (spouse, $p = 0.026$; child, $p = 0.028$; others, $p < 0.001$).

Post hoc analyses showed that Pearson partial correlations between informant scores and cognitive scores were all significant within each informant-participant relationship group in both sites. In Indianapolis, the highest association was for child informants ($r = -0.51$), followed by siblings ($r = -0.37$), spouses ($r = -0.28$) and others ($r = -0.28$). In Ibadan, the highest association was for spousal informants ($r = -0.43$), followed by children, siblings and others with similar correlation coefficients ($r = -0.40$, -0.38 and -0.41 respectively).

The study participant's gender significantly influenced informant scores in the Indianapolis sample ($p = 0.018$), in which informants tended to report more cognitive problems for males than females. The effect was not found in the Ibadan sample ($p = 0.675$). The participants' age significantly influenced informant scores in Ibadan but not in Indianapolis with older individuals being reported as having worse cognition ($p < 0.001$). In the Ibadan sample, we found that study participants with any education had more memory problems reported by informants compared to those with no education ($p < 0.001$). However, this effect was not identified in the Indianapolis study ($p = 0.674$). Non-parametric analyses using Spearman rank correlation and rank regression produced similar results as Pearson correlation and regular regression and are hence not presented here.

The follow-up analysis

At the five-year follow-up, 1253 out of 2212 (57%) African Americans and 1228 out of 2487 Nigerians (50%) were screened again using CSI'D'. Among the participants who had CSI'D' at both time points, 1027 Indianapolis participants (82%) and 1226 Ibadan participants (99.8%) had an informant who was interviewed (Table 1). The characteristics of the samples were summarized in Table 1.

High magnitude of biserial correlation coefficients were reported in both Indianapolis ($r = 0.38$, $p < 0.001$) and Ibadan ($r = 0.32$, $p < 0.001$), indicating informants' reported cognitive decline is consistent with cognitive decline scores. The trend is seen in the histograms (Figure 2). In both samples, mean cognitive decline scores in participants whose informants reported cognitive decline appear to be about 2 points larger than the ones in those without reported decline. It is of interest, however, that the mean cognitive decline scores in Ibadan are much larger than the ones in Indianapolis (4.13 vs 2.39 for informant reported cognitive decline group; 2.11 vs 0.62 for the no-reported decline group).

Logistic regression further demonstrated a significant association between informants' reported cognitive decline and cognitive decline scores in both samples (Table 3, Odds Ratio = 1.23 for Indianapolis, 1.16 for Ibadan; $p < 0.001$ for both). For each 1 unit decline in the cognitive score, the odds of reported cognitive decline by informants increase 23% in Indianapolis and 16% in Ibadan. None of the characteristics, except for the age of the participants in the Ibadan sample, were found to be associated with informant's reported cognitive decline controlling for cognitive decline scores. Informants tended to report cognitive decline for older elderly Yoruba (OR = 1.07, $p < 0.001$). Scatter plots showed that informant score change over time are consistent with cognitive score decline over time in both samples (Figure 3).

DISCUSSION

Our analysis demonstrated the validity of informants' reports on the cognitive functioning of study participants in two very different cultures, languages, and environments. The validation process included using baseline cognitive tests in a cross-sectional analysis as well as using cognitive change in longitudinal analysis. The correlation coefficients between informant scores and cognitive scores in our data were -0.43 for African Americans and -0.47 for Nigerians, which fell in the range of correlation coefficients (0.37 – 0.78) reported in the literature (Jorm, 1996). The results supported the CSI 'D' as a culturally adaptable screening instrument in this epidemiological study.

Few previous studies had validated informants' reports on cognitive decline although such reports were routinely utilized in the screening and diagnosis of dementia. Jorm *et al.* (1996) assessed informant validity in a community sample of elderly people aged 70 and older using IQCODE scores against changes on cognitive tests over the past 3.5 years and against changes over the previous 7–8 years (2000). Our study assessed the informant validity in two different community samples using the CSI 'D' informant scores against cognitive decline scores over the previous five years. Both results from the IQCODE and the CSI 'D' reached the same conclusion that informant's reports on cognitive decline are valid, assuring the assessment can be carried out only at one point of time. In addition, we showed that the characteristics have little effect on informant's assessment of cognitive decline. This is because informant reports evaluate the individuals based upon a comparison between past and current cognitive function and, therefore, covariates' biases are greatly reduced (Jorm, 1996, 2003).

Our analyses showed that participant–informant relationship was significantly associated with informants' reports in two different cultures though with different patterns. Our results are consistent with a previous study (Cacchione *et al.*, 2003).

The data in Figure 2 and Table 3 seem to suggest that Ibadan informants tended to be more conservative in reporting cognitive decline compared to the Indianapolis informants. This may reflect an interesting cultural effect. An earlier study showed that marked regional variations were reported on care-givers' reports of behavioral symptoms of dementia in developing countries (Ferri *et al.*, 2004). There may be a threshold effect in informants reporting as cognitive decline becomes more apparent.

Older individuals in the Ibadan sample were reported by their informants to have worse cognitive function compared to younger ones even after adjusting for cognitive function/decline. However, this was not supported in the Indianapolis sample. Earlier studies showed that greater inaccuracy of informant reports was related to older individuals with fewer years of education (McLoughlin *et al.*, 1996; Ross *et al.*, 1997; Cacchione *et al.*, 2003). We speculate that this finding might be due to the informants' overestimation of the performance for older elderly Yoruba Nigerian given their lower level of education.

One limitation to note is that one-third of study participants in the Indianapolis sample did not identify an available informant. However, the individuals with an identifiable informant have similar demographic characteristics to those without informants, and the distribution of cognitive scores is comparable for the two groups. Therefore, possible biases resulting from lack of informants may be minimal.

Acknowledgments

This research was supported by NIA grant R01 AG09956-13. We would like to thank all individuals who participated in this study in Indianapolis, USA and in Ibadan, Nigeria. We also appreciate the dedication of the

interviewers who made home visits to conduct the interviews. We thank the council of elderly in Ibadan and the community advisory board in Indianapolis for providing community support for this project. We gratefully acknowledge Dr Mary Austrom and Dr Tamilyn Bakas for their literature enrichment. We specially thank Ms Kathleen A. Lane for her careful proofreading of the manuscript.

Contract/grant sponsor: NIA; contract/grant number: R01AGO995613.

APPENDIX

Informant interview items which measure a continuum of cognitive impairment are listed below:

1. Does he/she forget where he/she has put things?
2. Does he/she forget where things are usually kept?
3. Does he/she forget the names of friends?
4. Does he/she forget members of the family?
5. Does he/she forget what he/she wanted to say in the middle of a conversation?
6. When speaking does he/she have difficulty finding the right words?
7. Does he/she use the wrong words?
8. Does he/she tend to talk about what happened long ago rather than the present?
9. Does he/she forget when he/she last saw you?
10. Does he/she forget what happened the day before?
11. Does he/she forget where he/she is?
12. Does he/she get lost in the community?
13. Does he/she get lost in his/her own home, e.g. finding the toilet?

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Figure 1.
Mean informant scores at baseline broken down by percentile grouped cognitive scores at two different samples

Figure 2.
Mean cognitive decline scores broken down by informants' reported mental decline at 5-year follow-up at two different samples

Figure 3.

Scatter plots with embedded regression lines and correlation coefficients of informant change scores with cognitive decline scores at the Indianapolis (upper panel) and Ibadan (lower panel) samples. The cognitive decline scores are meant from baseline to 5-year follow-up. The informant change scores, however, are defined as the follow-up scores minus the baseline scores

Table 1

Demographic characteristics for the two samples in the baseline and follow-up analyses

	Baseline data		Follow-up data	
	Indianapolis (<i>n</i> = 1493)	Ibadan (<i>n</i> = 2459)	Indianapolis (<i>n</i> = 1027)	Ibadan (<i>n</i> = 1226)
% Female	63	65	69	64
Mean age (SD)	74 (7)	72 (8)	77 (6)	76 (7)
Mean education (year)/% education *	10 (3)	15%	10 (3)	17%
Informant-subject relationship (%)				
Child	25	33	34	29
Sibling	14	16	9	9
Spouse	36	17	26	22
Others (including grandchild)	25	34	31	40
Co-residence with subjects (%)	58	88	45	85
Frequency informants seeing subject (%)				
Every day	70	93	62	93
Every other day	13	2.7	17	4
Once a week	10	2.6	13	2
Once a month	4	1.2	3	1
Others	2	0.5	5	0.5
Mean cognitive scores (SD)	30 (3)	28 (4)	—	—
Mean informant scores (SD)	1.5 (1.8)	1.1 (1.5)	—	—
% Informant reported mental decline at five-year follow-up	—	—	16	11
Mean cognitive decline scores	—	—	0.9 (2.6)	2.3 (3.4)
Mean informant change scores [†]			0.32 (1.9)	−0.07 (1.4)

Notes:

* The percentage of any formal education was reported in Ibadan.

[†] The informant change scores were defined as changes from baseline to five-year follow-up.

Table 2

Multivariate regression models for informant scores with cognitive scores and covariates at baseline for the two samples

	Indianapolis			Ibadan		
	Parameter Estimate	SE	p-value	Parameter Estimate	SE	p-value
Female participant	-0.234	0.099	0.018	-0.026	0.061	0.675
Participant's age	0.007	0.007	0.352	0.041	0.004	<0.001
Participant's education(years) *	-0.006	0.015	0.674	-0.304	0.077	<0.001
Informant-Participant relationship			0.005			<0.001
Child	0.234	0.126	0.065	0.199	0.064	0.002
Sibling	0.358	0.146	0.014	0.419	0.080	<0.001
Spouse	0.492	0.145	0.001	0.160	0.081	0.047
Others(Reference)						
Co-residence with participant	-0.006	0.140	0.969	0.063	0.109	0.565
Frequency of informants seeing participant	-0.044	0.059	0.457	0.060	0.064	0.351
Cognitive score	-0.261	0.018	<0.001	-0.181	0.001	<0.001

* Education in Ibadan was dichotomized as any formal education vs no education.

Multivariate logistic regression of informants' reported cognitive decline (yes vs no) at 5-year follow up against cognitive decline scores and covariates at the two samples

Table 3

	Indianapolis			Ibadan		
	Odds Ratio	95% CI	p-value	Odds Ratio	95% CI	p-value
Female participant	0.91	0.60–1.38	0.652	1.12	0.71–1.77	0.634
Participant's age	1.02	0.99–1.05	0.195	1.07	1.04–1.09	<0.001
Participant's education(years) *	0.96	0.90–1.02	0.144	0.67	0.37–1.21	0.180
Informant-participant relationship			0.190			0.795
Child	1.37	0.85–2.21	0.196	1.13	0.71–1.80	0.597
Sibling	1.24	0.59–2.58	0.574	1.19	0.60–2.37	0.624
Spouse	1.99	1.07–3.68	0.030	1.32	0.76–2.32	0.328
Others(Reference)						
Co-residence with participant	1.08	0.63–1.85	0.786	1.28	0.63–2.60	0.494
Frequency of informants seeing participant	0.89	0.72–1.11	0.298	1.08	0.67–1.72	0.761
Cognitive decline score	1.23	1.16–1.32	<0.001	1.16	1.09–1.22	<0.001

CI = Confidence Intervals.

* Education in Ibadan was dichotomized as any formal education vs no education.