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A CROSS-CULTURAL COMMUNITY BASED STUDY OF DEMENTIAS: METHODS AND PERFORMANCE OF THE SURVEY INSTRUMENT INDIANAPOLIS, U.S.A., AND IBADAN, NIGERIA

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SUMMARY

Research teams of Indiana University School of Medicine and University of Ibadan College of Medicine have established a collaborative study to determine the prevalence and incidence rates of Alzheimer's disease (AD) and other dementing disorders in elderly community-dwelling African Americans in Indianapolis and Yoruba in Ibadan, Nigeria. The purpose of this paper is to describe the design, the samples, and field work, and to report on the performance of the Community Screening Interview for Dementia (CSI"D") in the first phase of the prevalence study. Screening interviews were conducted with a random sample of 2212 African Americans age 65 years old and older in Indianapolis, and a sample of 2494 Yoruba age 65 years and older living in Ibadan. The CSI"D" contains a cognitive assessment with the subject and information about activities of daily living from a relative. When logistic regression models were used to predict dementia at both sites with age, sex, education, and cognitive score as predictors, the addition of relative score as a predictor in the models significantly improved the fit of the models ($\chi^2 = 36.67$, $p < 0.0001$ for Indianapolis and $\chi^2 = 13.81$, $p = 0.0002$ for Ibadan). Sensitivity and specificity of the CSI"D" for both sites combined were 87.02% and 83.12% respectively (standard error 6.76%, 0.57%).

KEY WORDS—epidemiology; cross-cultural; Alzheimer's disease; prevalence

INTRODUCTION

Research teams of Indiana University School of Medicine and University of Ibadan College of Medicine have established a collaborative study to determine the prevalence and incidence rates of Alzheimer's disease (AD) and other dementing disorders in elderly community-dwelling African Americans in Indianapolis and Yoruba in Ibadan, Nigeria. The purpose of this paper is to describe the design, the sampling methods, and field work, and to report on the performance of the Community Screening Interview for Dementia (CSI"D") in these community samples.

The dementias of the elderly, of which AD is the most common type, represent a major public health problem worldwide with prevalence rates estimated at 5% to 11% for individuals age 65 years old and over in the developed countries (Rocca *et al.*, 1986; Jorm *et al.*, 1987; Evans *et al.*, 1989). The prevalence rates of dementia in the non-developed countries are less well known (Osuntokun *et al.*, 1992). AD is likely to be caused by a complex interaction of genetic, environmental and aging factors. While the discovery of genetic mechanisms is proceeding rapidly, the search for environmental risk factors so far has been less rewarding (Brayne, 1991). Comparative cross-cultural, transnational epidemiological studies offer one mechanism for elucidating these factors, particularly if these studies involve populations from similar genetic heritage now living in different countries at different stages of development with varying environments and culture (Osuntokun *et al.*, 1992). They are also useful in

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confirming the biological significance of posited association between genetic factors of AD (e.g. *APOE*) if it can be demonstrated that the association holds true across populations (Hendrie *et al.*, 1995).

Cross cultural studies, however, pose many methodological problems. These include issues of sampling in very different types of communities, some lacking accurate census data. Two types of sampling techniques have been traditionally employed. When accurate population census data is available, attempts are made to derive a representative sample of that population by various means. However in countries where there is a lack of reliable census data, particularly when the rates of the illness to be studied are likely to be low, a total population survey of a geographically defined area is employed. This was the technique employed by Schoenberg *et al.* in their Copiah County study (1985), and it had been previously employed by Osuntokun *et al.* in Nigeria (1987). As pointed out in the WHO protocol for the Program on Research on Aging (1984), sampling an entire village or well-defined area offers advantages in terms of a clear structure, low refusal rate, and homogeneity. This latter technique however has the disadvantage of lack of generalizability.

A major challenge is the development of screening and clinical instruments without cultural bias. This is particularly difficult in studies of the dementing disorders, where the diagnosis is based upon identifying a decline in cognitive function. Since 1988, beginning with our studies of the elderly Cree population in Manitoba, we have been developing both survey and clinical methods to detect dementia that can be used in populations with very different cultural and linguistic identities (Hall *et al.*, 1993). Most epidemiological studies of dementia have relied upon cognitive tests such as the MMSE screening instrument, but this has well known educational and possibly cultural biases (Jorm, 1990; Murden *et al.*, 1991). Jorm and Jacomb (1989) have suggested that a promising way to avoid educational bias inherent in cognitive testing would be to use informant data about the individual's daily functioning. In our previous study we decided to combine cognitive testing of the subject and informant data about performance in activities of daily living, in the development of our survey instrument the Community Screening Instrument for Dementia (CSI"D"). The principle of combining information from two sources like this for diagnosing dementia is of course standard practice in clinical assessment, but had not previously been utilized for community based studies. The CSI"D" was developed from items of widely used dementia assessment instruments, harmonized and standardized for use in Cree and English speaking populations and tested in a pilot study and subsequent community-based prevalence study in samples of Cree 65 years and over and elderly English speaking residents of Winnipeg Canada (Hall *et al.*, 1993). For the study being reported here, the CSI"D" has been harmonized for use in Yoruba speaking population of Nigeria and in the African Americans in Indianapolis.

METHODS

Design

The community prevalence study followed a two-stage design (Figure 1) in which there was an initial interview CSI"D" with a community-based sample of eligible individuals and their close relatives, followed in the second stage by full clinical diagnostic work up of selected subjects based on scores on the CSI"D". Scores on the initial interview were grouped as follows: the "poor performance" group, 100% of whom were invited to have a clinical assessment; the "intermediate performance" group, 50% of whom were given a clinical assessment; and the "good performance" group, of whom a 5% age stratified sample (75% age >75 years) were given the clinical assessment. A follow up two-year incidence study is now being conducted.

Construction of the Instrument

We previously developed and validated the CSI"D" in a study comparing the Cree Indians in Manitoba and Manitobans of European extraction (Hall *et al.*, 1993). Although the Cree language can be written in syllabics and phonetically, it is considered to be a spoken language. Yoruba is also considered to be a spoken language, although it too has a written version. In this sample in Ibadan, 84.8% were not able to read or write. The CSI"D" was modified with emphasis upon making each item harmonious with the Yoruba and African-American language and cultures.

The CSI"D" has two parts: a cognitive and risk factor section for the subject and an interview with

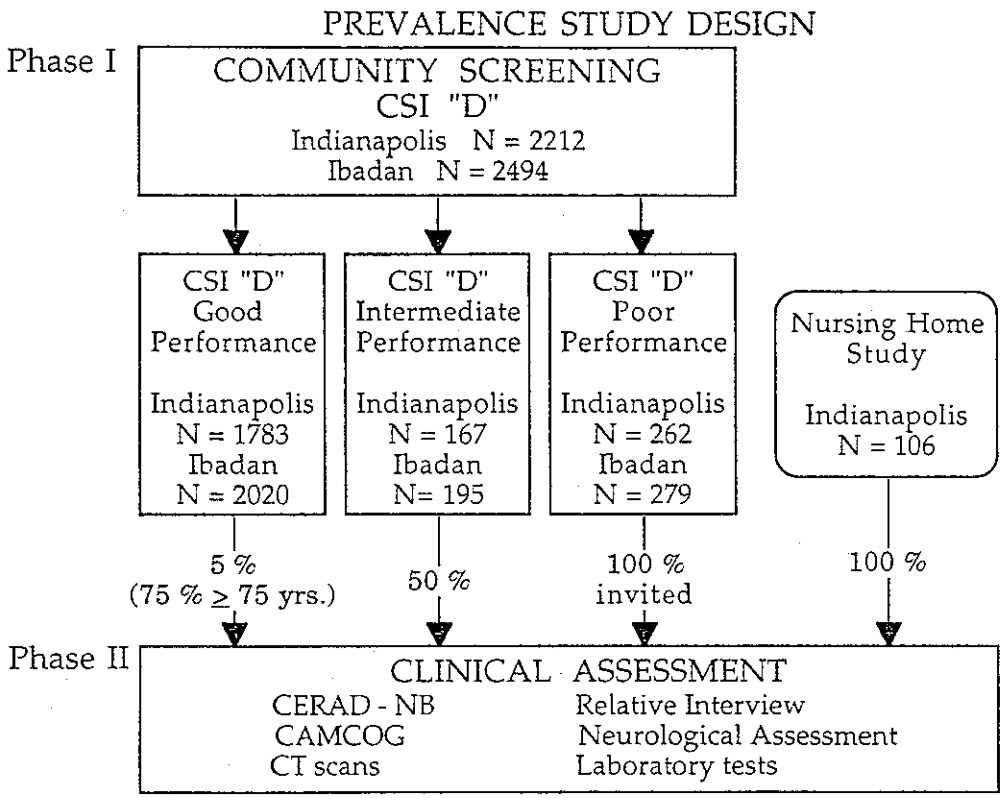

Fig. 1.

a relative about daily functioning and general health of the subject. As the purpose of the instrument is to identify possible dementia, items were selected for both the subject and informant sections which would be consistent with the DSM–III–R criteria for dementia (American Psychiatric Association, 1987). Thus items were selected which would measure, as far as was possible in a short interview: memory, abstract thinking, judgement, other disturbances of higher cortical function (aphasia, apraxia, agnosia, constructional difficulty), personality changes, and functioning at work and in social relationships. Items from the most widely used dementia instruments were then reviewed for their suitability for measuring each of these criteria. These included the CAMDEX (Roth *et al.*, 1986), MMSE (Folstein *et al.*, 1975), Dementia Rating Scale (Blessed *et al.*, 1968), Comprehensive Assessment and Referral Evaluation (CARE) (Gurland *et al.*, 1977) and the East Boston Memory Test (Evans *et al.*, 1989). Each item was evaluated for usefulness with elderly with little skill in reading and writing as well as with those who are literate. The items were adapted, tested and sometimes further modified to be meaningful in the local language and culture. A full description of the several steps followed in the original development of the instrument has been published elsewhere (Hall *et al.*, 1993). Briefly, the process involved item selection, adaptation, two independent translations, consensus translations, audio tape back-translation, revision, small pilot test, revision, large pilot test, determination of cut-off scores for classification of screening performance. Each version of the instrument must be developed this way on site by a team involving indigenous members. The interview as harmonized for the Indianapolis/Ibadan study contains many items that might be suitable to almost any site, items such as language comprehension, motor response, naming, and the East Boston story. A few of the items are site specific, including items to test long-term memory (Indianapolis: assassination of Martin Luther King, Ibadan: the Nigerian

Civil War). The interview consists of 45 cognitive items (33 used in the cognitive score, perfect score = 33) and takes about twenty minutes to administer. The interview with the relative has 24 items on problems in daily functioning (perfect score = 0) and lasts approximately fifteen minutes.

From the Canadian study, a discriminant function score was derived using the combination of cognitive and relative scores. This was the score which discriminated best between demented and non demented subjects. The analysis was conducted on pilot study data and revised after completion of the community survey and clinical assessments. The resulting discriminant score [0.564 + 0.0449 (relative score) − 0.0150 (cognitive score)] was first tested in pilot studies in Indianapolis and Ibadan and then applied to the screening results in the Indianapolis/Ibadan study.

Pilot studies

Two pilot studies were conducted in Indianapolis and Ibadan with the CSI"D" prior to the community survey. In the first study, the CSI"D" was administered to a sample of 10 elderly African-American subjects and 10 elderly Yoruba speaking residents of Ibadan to determine the acceptability of the instrument. After these interviews, minor revisions were made to the instrument. The second study was conducted to determine the appropriate cut-off scores from the CSI"D" to be used in sampling subjects to be seen for full clinical work up. The most common method to determine cut-off scores is to administer the instrument to a sample of known normal and known demented subjects to obtain the score which yields the best senstivity and specificity for dementia. The problem with this method for a pilot study of dementia is that mild dementia is rarely diagnosed, so most diagnosed cases will be moderate to severely demented. Interviewing only not-demented subjects and severely demented subjects will result in a bimodal distribution of scores. Demented subjects living in the community who may not yet have been diagnosed would most often be of mild to moderate severity, with test scores falling somewhere between the two mode points. Thus this type of pilot study will not yield data needed to identify mild dementia. In order to avoid this problem in the Indianapolis/Ibadan study, it was decided to test the instrument on samples of community dwelling subjects in both sites and compare the distribution of their scores to the data for similar subjects from the community prevalence study data in Canada. If the distribution of scores in these 3 samples were all similar, we would feel justified in using the cut-off scores derived from the Canadian study.

For this pilot phase the CSI"D" was administered to 50 subjects aged 65 years and over living independently and without difficulty in the community of Ibadan and in Indianapolis, who were identified by community social workers in Indianapolis and by trained health workers in Ibadan. There were no statistically significant differences in age and gender between the two sites (Indianapolis mean age 72.2 years ±5.7, 46% men and 54% women; Ibadan mean age 73.5 years ±8.1, 28% men and 72% women). As anticipated, there were highly significant differences in levels of education between the two sites. In Indianapolis all subjects had at least some schooling (40%: 1–8 years, 50%: 9–12 years, 10%: > 12 years), whereas in Ibadan 80% of the subjects had no formal schooling. Table 1 shows the mean discriminant scores from the Canadian study of Cree and English speaking samples and from the pilot phase of the current study for Indianapolis and Ibadan subjects. A one way analysis of variance indicated no significant differences of discriminant score means among any of these samples ($F = 1.35$, $p = 0.258$).

Based upon these analyses, we felt justified in using the cut-off scores derived from the Canadian study for the Indianapolis and Ibadan samples. In the Canadian study the cut-off score selected for 100% sensitivity had had a specificity of 89% for dementia (Hall *et al.*, 1993).

Pilot studies of clinical assessment instruments were conducted in the general population in

Table 1. Comparisons of discriminant scores from the Canadian study and Indianapolis/Ibadan pilot study (not demented subjects)

	Discriminant Score (possible range −0.1 to +1.4)		
Sample	Mean	SD	N
Cree	0.0445	0.099	164
Canadian	0.0287	0.092	200
Cree/Canadian (combined)	0.0303	0.096	364
Ibadan	0.0423	0.088	50
Indianapolis	0.0211	0.081	50

Indianapolis and in Ibadan to aid the clinicians in their interpretation of the results. Samples of elderly individuals living independently and reported to be well-functioning by key informants were tested in Indianapolis (N = 83) and in Ibadan (N = 100). The demographic characteristics of the samples were similar to the demographic characteristics of the study populations. The results of these studies are discussed in other papers (Unverzagt *et al.*, 1996; Gureje *et al.*, 1995).

Study populations and sampling

Indianapolis. The geographic area of the study covers 29 contiguous census tracts in the northern half of central Indianapolis, selected on the basis of demographic and economic factors. The 1990 census reported an average of 80% African Americans living in these tracts. The selected tracts include some with a growing proportion of African Americans as well as the tracts that have a long established African-American majority, ensuring that the sampled area has similar demographic composition as the city of Indianapolis. The distributions of age, sex and per capita income of the residents of these tracts are similar to those of African Americans in the entire city of Indianapolis and the state of Indiana. The 29 census tracts contain the residences of over two thirds of Marion County's African-American population.

The Indianapolis Mapping and Geographic Infrastructure System (IMAGIS) was employed in constructing a simple random sample of addresses. IMAGIS is the result of a consortium agreement of city agencies, public utilities and Indiana University. It is a digitized database map of the 492 square mile area of Marion County including Indianapolis. The map was constructed from aerial photographs, digitized and stored in the mainframe computer at the Indiana University Medical Center campus. Because there was no comprehensive list of city residents aged 65 years and older, we began with a random sample of addresses. Using IMAGIS, the Indianapolis Water Company, provider of water to this part of Indianapolis, constructed the sampling frame using all residential addresses in the target area. The Water Company constructed a simple random sample of 60% of the residential addresses in each census tract. Computer generated maps showing the "footprint" of each residence and each sampled address were used to plan the routes of the interviewers. After introductory letters were sent, interviewers visited each address to determine if there were any eligible residents. Eligibility criteria are as follows: 1. African American, 2. Age 65 years or older, 3. Resident in the designated area. All eligible individuals residing at a sampled address were recruited for the study; homeless and transients were excluded. Permanent residents who were temporarily away were included upon their return. The eligible subjects who were willing to participate signed informed consent statements and were given cash incentives at the completion of the interview.

The study was carried out in one census tract at a time, and field work continued in each tract until the required number of interviews were completed. Each census tract contributed subjects in proportion to the distribution for the entire 29 tracts. Interviewers approached 7590 households and completed 2212 interviews (282 households had two interviews and 4 households had three interviews), 121 (4.6%) eligible subjects were too ill to participate, 249 (9.6%) eligible subjects refused, 4915 households were ineligible because there were no residents age 65 years or older, and 383 households had no African Americans. Apart from the fact that they were aged 65 or older and African American, we were not able to get additional information about those who refused or were too ill. It is possible that some of these individuals may have had dementia but this cannot be documented.

Ibadan

The study was carried out in the Idikan area and adjacent wards (population about 50,000) within the municipality of Ibadan. The Idikan wards are political and administrative units of the more ancient parts of Ibadan, a city founded by itinerant warriors at the end of the eighteenth century. The population is fairly stable and is comprised mainly of Yoruba, a negroid town-dwelling people numbering about 35 million in all who are domiciled in South Western parts of Nigeria and the contiguous eastern region of Benin.

A census was carried out enumerating all households and identifying those with residents age 65 years or older. A total of 3489 households were listed. Because of the expected low prevalence of dementia in Nigerians and because missing a few cases would seriously influence the assessment

of prevalence, it was desirable to carry out a total population survey by door to door screening in a geographically defined population, as had been done in the Copiah County Study. Interviewers went door to door interviewing individuals aged 65 years or older concurrently with the listing of demographic data for residents of each house. Eligible subjects initialled or signed verbally administered informed consent statements and were usually interviewed immediately. Subjects were also given cash incentives at the completion of the interview. Two thousand five hundred and thirty-five (2535) individuals age 65 years and older were enumerated, of whom 2494 were interviewed and 41 (1.6%) were too sick or refused. In Ibadan interviewers were able to get some information about the individuals who refused from family members living nearby, and by their reports all were functioning adequately. There remains the possibility that some may have had dementia. Few eligible subjects declined participation due to illness. In Ibadan, participation in the study provided access to additional general medical services; this may have motivated quite ill individuals to participate in the study.

The issue of determining the age of subjects with no recorded dates of birth was handled by use of historical landmark events. In a previous study Ogunniyi and Osuntokun (1993) estimated the ages of 59 elderly subjects using this method. When the estimates were then compared to accurate birth records the estimates proved to be accurate to within 3 years of the correct age from birth records in 94% of the subjects.

Field work

Interviewers were recruited in Indianapolis by newspaper advertisement and letters to the ministers of the 71 churches in the area. All of the interviewers in Indianapolis were lifetime residents of the community. Four of six interviewers had retired from successful careers in the community and their stature was a very positive factor in the recruitment of eligible subjects. Preparations in the community were essential for this door-to-door, in-home interview study. In Indianapolis an advisory committee of seven leaders of the African-American community gave invaluable advice throughout study. The African-American newspaper, the mainstream newspaper, and local television programmes carried stories about the project. Before entering a census tract, meetings were held at the local police precinct and with the head of the local Crime Watch programme, letters were sent to ministers of churches in the area, and investigators and interviewers attended neighbourhood association meetings to enlist formal support for the study. Letters were then sent to sampled addresses. Interviewers wore photo identification badges while in the field.

In the Idikan wards of Ibadan the residents were familiar with medical research projects because the community clinic is staffed and operated by the University of Ibadan Department of Preventative Medicine. The clinic is located in the geographic centre of the wards. In addition, meetings were held with the Community Elders and Health Committee members to enlist their endorsement of the project. An important factor in getting their endorsement hinged upon the fact that the investigators had reported results of previous community studies back to the community. In Ibadan, interviewers were recruited by advertisement and word of mouth through community leaders of Idikan and neighbouring wards. All of the interviewers were well respected lifetime residents of the area. Some had had previous experience in studies in Idikan. As in Indianapolis, interviewers wore photo identification badges while in the field.

Selection for clinical assessments

The scores on the CSI"D" were separated into the following performance groups: "poor" performance, "intermediate" performance and "good" performance. The cut-off points for the discriminant score (combining the cognitive scores and the informant score) were those originally derived in the Cree study and then tested in Indianapolis and Ibadan in pilot studies. For subjects with no key informant and thus no discriminant function score, selection for clinical assessment was based solely on the cognitive score. Cut-off points based on the cognitive score were chosen to classify the same proportions of subjects into the three performance groups as observed using the discriminant function score. One hundred per cent of the "poor" performance group were offered clinical assessments. Subjects were randomly sampled from the "intermediate" group until 50% were assessed. As a check for false negatives, subjects were randomly sampled from the "good" performance group (weighted for 75% age 75 years and older) until 5% were assessed.

The clinical assessment

The clinical assessments were conducted by senior neurologists and psychiatrists at the University of Indiana and the University of Ibadan using DSM–III–R and ICD–10 criteria for dementia and the Clinical Dementia Rating (CDR) for severity (Hughes *et al.*, 1989). The diagnoses were made by consensus following independent evaluation of the data by both groups of investigators from each site. During the clinical evaluation procedure, information was obtained from a close relative using a structured interview, neuropsychological tests including the CERAD-NB (Morris *et al.*, 1989) and the CAMCOG (Hendrie *et al.*, 1988) were administered to the subjects; a physical and neurological examination was conducted; appropriate laboratory tests and CT scans were ordered when clinically necessary.

Quality control and reliability

Test-retest reliability of the CSI"D" was estimated in 17 randomly selected subjects, each of whom was interviewed twice about two weeks apart. The intraclass correlation from the test–retest was 0.79 for the cognitive score, 0.92 for the relative score and 0.93 for the discriminant score, all in the logarithmic scale for normality. (The reliability was slightly lower for the cognitive score because of a small, though statistically significant, upward shift of 0.4 in the mean score; the Pearson's correlation was 0.9.) Prior to the actual field work, interviewers attended a two week training course to ensure consistency in administering the CSI"D". High inter-rater reliability was obtained with kappa = 1 for 94% of the items. In the actual study subjects to be screened were randomly assigned among interviewers. Upon completion of each questionnaire, the questionnaire was inspected by a key staff member for completeness and accuracy before the data were sent to be entered into the data base. Within each site and between sites, CSI"D" data were monitored to check for trends owing to possible interviewer effects. Periodically over the course of the screening phase, an analysis of covariance, adjusting for age and education of each subject, was used to test for any differences in mean screening scores among the interviewers, as well as to test for any trends in screening scores over time. Any observed differences were addressed with the interviewer and re-checked in the next monitoring period.

Statistical evaluation of the CSI"D"

We estimated the sensitivity and specificity produced by the two cut-off points based upon the results of the clinical assessments of the CSI"D", as shown in Table 3. The cut-off points are the scores that separate the "poor" performance group from the "intermediate" performance group, and the "intermediate" from the "good" performance group. To assess the instrument with variable cut-off points, we also estimated the receiver operating characteristic (ROC) curves for the cognitive score alone and for the discriminant function score (Hanley and McNeil, 1982). Since only subsamples of subjects had their true disease (dementia) status assessed, standard estimation procedures had to be modified to take into account the different sampling weights in the four strata based on screening scores: 1) the "poor" performance group, 2) the "intermediate" performance group, 3) the "good" performance groups who were under age 74, and 4) the remaining older "good" performance group.

To obtain unbiased estimates of sensitivity and specificity, we first estimated the expected number of demented subjects in each of the four strata by applying the sampling weight to the prevalence of dementia among the clinically assessed subjects. The desired estimates were then obtained from the full sample cross-classified by the screening performance level and the expected dementia status. The variance of these estimates were based on the linear delta method, which takes into account the within stratum binomial variability and between strata multinomial variability (Little and Rubin, 1987).

Empirical ROC curves were computed separately for the discriminant score and for the cognitive score alone. As the cut-off point for a score was varied, the sensitivity and specificity were estimated for each cut off point, using appropriate sampling weights as described above. The estimate of sensitivity was then plotted against 1-specificity to give an ROC curve for the particular screening score. The trapezoidal rule was used to estimate the area under the ROC curve, which reflects the discriminatory power of the instrument. (An area of one reflects perfect discrimination whereas an area $\leqslant 50\%$ corresponds to discrimination no better than chance.)

RESULTS

Demographics and CSI"D" scores

The demographic characteristics of the samples for the two sites are shown in Table 2. There was no significant difference in the sex ratio between the two sites. The Indianapolis subjects were slightly but significantly older (Indianapolis subjects mean age 74.0 years ±7.0, Ibadan subjects 72.3 ±7.5, $p<0.0001$). There were marked differences between the sites for education and literacy levels with, as expected, the Indianapolis subjects having more education (mean of 9.6 years) as opposed to the Ibadan subjects (mean of 0.8 years) and much higher literacy rates (Indianapolis 97.9% of the sample, Ibadan 15.2% of the sample). This study employed the WHO criteria for literacy, the ability to read a newspaper and write a letter.

The cognitive scores and relative scores for the two sites are shown in Table 2. The mean cognitive score is significantly higher for Indianapolis than for Ibadan ($p<0.0001$), but when these scores are adjusted for education the mean cognitive scores become much closer. In fact the mean adjusted score for Ibadan is slightly but significantly higher than for Indianapolis ($p=0.001$). The mean relative score for Indianapolis is slightly but significantly higher than the mean relative scores for Ibadan ($p=0.001$). However, distributions of these scores across sites were similar, for example, the 25th, 50th and 75th percentile scores were 0.5, 2, 3.5 in Indianapolis, and in Ibadan, 1, 2, 3.5. The attainment of a significant difference between the mean relative scores was due to the large number of subjects in each site. The chance of detecting as small a difference in relative scores as half a point was almost 100% (99.850%).

Table 2. Descriptive statistics

Category	Indianapolis N=2212	Ibadan N=2494
% Male	35.0%	35.0%
% Female	65.0%	65.0%
Mean age	74.0 (±7.0)	72.3 (±7.5)
Literacy	97.9%	15.2%
Mean # years education	9.6 (±3.1)	0.8 (±2.3)
Mean cognitive score (Perfect score=33)	30.4 (±2.8)	28.0 (±3.8)
Mean cognitive score adjusted for education	29.9	30.3
Mean relative score (Perfect score=0)	2.9 (±3.4)	2.5 (±2.5)
Mean discriminant score (Range −0.106 to +1.086)	0.030 (±0.113)	0.062 (±0.118)

With the exception of gender, all comparisons were statistically significant at the 0.0001 level.

Selection for clinical assessment

"Good", "intermediate" and "poor" performance on the CSI"D" was determined using the discriminant score or, if a relative interview was not available, using the cognitive score alone. The percentages in each group were similar in the two sites (chi square=0.573, $p=0.751$). The groupings and cut-off scores are shown in Table 3.

Clinical assessments were offered to 100% of the subjects in the "poor" performance group. In Indianapolis 262 subjects were invited and assessments were completed on 174 (66.4%) subjects, 27 (10.3%) subjects were too sick or had died, 51 (19.5%) subjects refused, and 10 (3.8%) were not evaluated for other reasons. In Ibadan there were 279 subjects in the "poor" performance group of whom 214 (76.7%) were clinically assessed, 50 (17.9%) subjects were too sick or had died and 15 (5.4%) subjects had moved away. The subjects not clinically assessed in the "poor" performance group in Indianapolis did not differ significantly from the subjects who were clinically assessed in gender, age, cognitive score, or relative score. In Ibadan, those not assessed did not differ significantly from those subjects assessed in gender, cognitive score, or relative score. However in Ibadan, those not clinically assessed were significantly older than the clinically assessed subjects

Table 3. Distribution of scores by group

Category	Indianapolis N=2212	Ibadan N=2494
Good performance		
(D.S. – <0.120)	n=1783	n=2020
(Cog. only – >29.5)	80.6%	80.9%
Intermediate performance		
(D.S. – 0.120–0.183)	n=167	n=195
(Cog. only – >28.5≤29.5)	7.6%	7.8%
Poor performance		
(D.S. – ≥0.184)	n=262	n=279
(Cog. only – ≤28.5)	11.8%	11.2%

(not assessed subjects mean age = 82.32, assessed subjects mean age = 79.28, $p = 0.032$).

In the "intermediate" and "good" performance groups in Indianapolis, the sampled subjects who were not seen were not significantly different from those who were seen in age, gender or screening scores. Significant differences between those seen and not seen were found for gender and relative score in Ibadan's "good" performance group, 75 years of age and older (not assessed subjects: 47.1% male, assessed subjects: 62.3% male, $p = 0.017$; not assessed subjects: mean relative score 2.03, assessed subjects: mean relative score 2.19, $p = 0.031$). Aside from this group, for both the "intermediate" and "good" performance groups, those subjects clinically assessed did not differ significantly from those not clinically assessed in age, gender, and screening scores.

Analyses of discriminatory capability of CSI"D"

Analysis to estimate the sensitivity and specificity used the cut-off point dividing the "good" from the "intermediate" and "poor" performance groups that yielded sensitivity and specificity of the CSI"D" for both sites combined of 87.02% and 83.12% respectively (standard errors 6.76%, 0.57%). If applied to screen a population age 65 and over with a typical prevalence of 8% dementia, the CSI"D" gives a positive predictive value of 0.31 and a negative predictive value of 0.99.

In order to assess the ability of the discriminant score and the cognitive score alone to separate demented from not-demented subjects using various cut-off points, an empirical receiver operating characteristics (ROC) curve was computed for each site, as described above. As expected, the

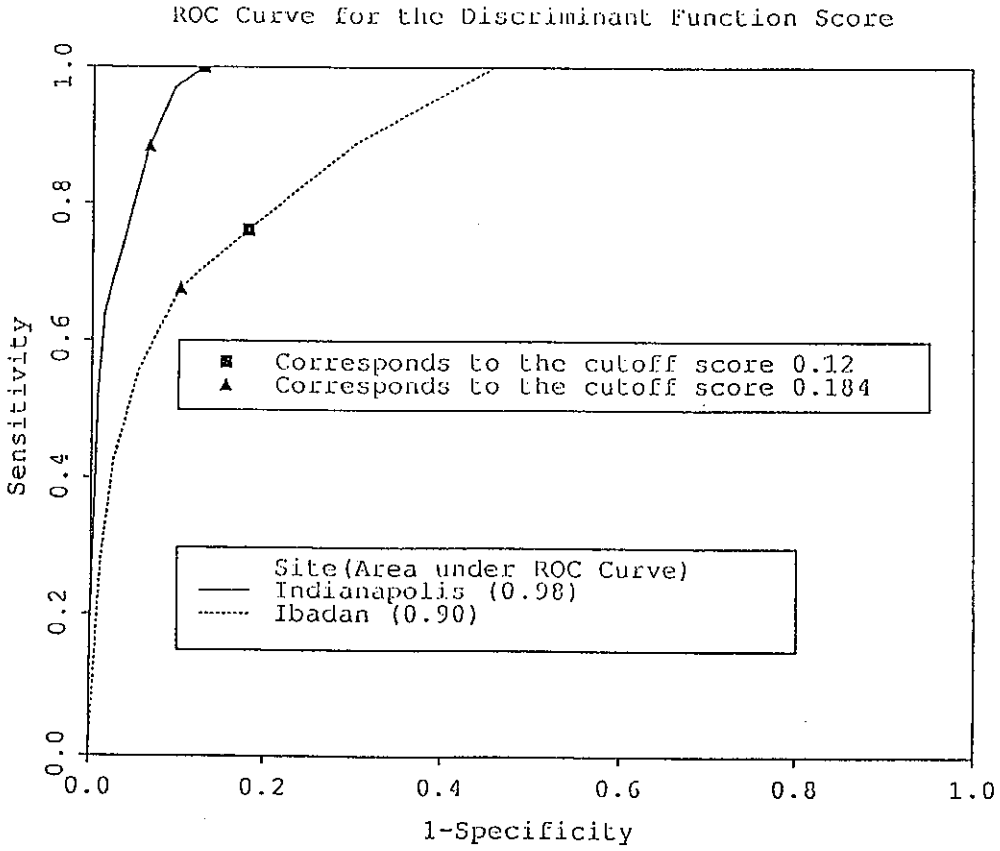

Fig. 2

Table 4. CSI"D" cognitive item comparisons by site. Per cent correct

DSM–III–R dimensions		Subjects who had clinical assessments: Ibadan Normal N=395	Ibadan Demented N=28	Indianapolis Normal N=286	Indianapolis Demented N=65	Entire community sample: Indianapolis N=2212	Ibadan N=2494
Memory							
Remember my name		77.7	57.1*	85.7	49.2‡	93.5	91.2‡
Remember 3 words (Boat, House, Fish)		40.8	21.4*	47.7	11.3‡	60.9	61.1
ML King's Assassination/Nigerian Civil War		45.2	21.4‡	87.7	43.5‡	94.1	71.2‡
East Boston Story (t-test)	mean	0.5622	0.3750‡	0.7453	0.4139‡	0.8156	0.6604‡
	s.d.	±0.273	±0.286	±0.261	±0.352	±0.230	±0.235
Subscore comparison	mean	2.4201	1.5417‡	3.1366	1.6344‡	3.4654	3.0888‡
	s.d.	±1.141	±1.146	±0.865	±1.261	±0.729	±0.910
Abstract thinking							
What is a bridge?		73.7	64.3	97.2	88.9‡	98.6	91.2‡
What do you do with a hammer?		85.1	75.0	100.0	90.5‡	99.7	95.7‡
What do people do in church?		96.7	92.9	100.0	96.8*	99.8	99.0‡
Where do we go to buy medicine?		69.4	60.7	99.3	93.5‡	99.6	89.6‡
Subscore comparison	mean	3.2481	2.9286	3.9650	3.7258‡	3.9783	3.7547‡
	s.d.	±1.037	±1.245	±0.184	±0.772	±0.179	±0.649
Higher cortical function							
Name these items as I point to them:							
Pencil		69.4	71.4	100.0	93.7‡	99.8	89.2‡
Watch		90.6	85.7	99.6	92.0‡	99.6	97.2‡
Chair		89.9	82.1	99.6	93.7‡	99.7	97.0‡
Shoes		89.9	85.7	99.3	95.2*	99.6	96.7‡
Knuckles		58.0	60.7	93.6	81.0‡	97.9	84.4‡
Elbow		86.8	92.9	98.9	90.5‡	99.5	96.2‡
Shoulder		88.1	88.9	98.6	95.2	99.4	96.4‡
Repeat: no ifs, ands or buts oke gb oke g'obe		82.3	75.0	71.9	53.2‡	82.0	93.7‡
Name animals (1 minute)	mean	9.8759	6.3571‡	12.8275	8.0323‡	14.3143	10.9711‡
	s.d.	±4.143	±3.664	±4.771	±4.349	±4.803	±3.956
Repeat: "Boat, House, Fish"		93.9	96.4	100.0	96.8*	99.7	96.4‡
Subscore comparison	mean	7.9458	7.6334	9.1940	8.3654‡	9.4009	8.9692‡
	s.d.	±2.147	±2.368	±0.685	±1.414	±0.600	±1.330
Praxis: language comprehension motor response							
Nod head		83.0	64.3*	97.6	93.5	98.8	95.0‡
Point to window then door		94.7	89.3	98.2	88.7‡	99.1	98.4*
Take paper in right hand, fold in half, put in lap		73.0	50.0‡	72.8	54.1‡	82.7	89.3‡
Constructional ability							
Overlapping circles		26.3	7.1*	86.6	64.4‡	91.6	41.5‡
Interlocking pentagons		2.3	0.0	37.2	18.6‡	54.1	7.8‡
Subscore comparison	mean	2.9465	2.3810‡	4.0956	3.3785‡	4.3716	3.3834‡
	s.d.	±0.843	±0.735	±0.775	±1.096	±0.723	±0.771
Orientation: place							
Name of city		95.4	82.1*	96.5	79.0‡	98.1	97.8
Name of major street		93.4	78.6*	93.0	66.1‡	96.6	96.6
Where is the local market?		95.4	82.1*	89.5	78.3*	94.6	98.0‡
Your address		87.6	78.6	82.5	56.5‡	91.9	94.4‡
Name of your mayor		67.1	42.9‡	57.4	19.4‡	74.6	83.8‡
Subscore comparison	mean	4.3899	3.6429‡	4.1866	3.000‡	4.5599	4.7060‡
	s.d.	±0.907	±1.521	±0.964	±1.496	±0.788	±0.652
Orientation: time							
Month		63.8	35.7‡	91.9	45.2‡	95.7	83.7‡
Day		83.8	35.7‡	92.3	46.8‡	95.4	92.8‡
Season		96.0	78.6‡	83.6	66.1‡	92.9	97.6‡
Year		26.1	0.0‡	90.6	37.1‡	94.9	43.2‡
Did it rain yesterday?		94.2	75.0‡	91.9	75.0‡	95.6	97.7‡
Subscore comparison	mean	3.6380	2.2500‡	4.5053	2.7167‡	4.7483	4.1499‡
	s.d.	±1.094	±1.236	±0.901	±1.530	±0.695	±0.931

*Significant at the 0.05 level, ‡Signif at the 0.01 level.
Comparisons are between columns 1 vs. 2, 3 vs. 4 and 5 vs. 6 only.

discriminant function score discriminated demented from not-demented subjects better than did the cognitive score alone. The areas under the ROC curve for the discriminant function were 98% for Indianapolis and 90% for Ibadan. Using the cognitive score alone, areas under the ROC curve were 94% for Indianapolis and 84% for Ibadan. Figure 2 shows the ROC curve for both sites corresponding to the discriminant score. Because cut points and sampling scheme used in the prevalence study captures most of the demented subjects and brings to clinical assessment a manageable number of false positives, the same cut points are being used in our current incidence studies. The ROC analysis of the screening scores of the baseline prevalence study provides the opportunity of modifying cut-off scores in subsequent incidence studies of the same samples in accordance with the needs and resources available to the study.

When logistic regression models were used to predict dementia at both sites with age, gender, education and cognitive score as predictors, the addition of relative score as a predictor in the models significantly improved the fit of the models ($\chi^2 = 36.67$, $p < 0.0001$ for Indianapolis and $\chi^2 = 13.81$, $p = 0.0002$ for Ibadan). Similar conclusions were reached when weighted logistic models were used for the analysis taking the sampling scheme into account. Hence, the use of additional information obtained from relative interviews contributes to better predictions of a clinician's diagnosis of dementia.

CSI"D" item comparisons between sites

Table 4 shows the comparison of individual items from the cognitive test between the two sites (entire sample), and between the clinically assessed demented and not demented for each site. The large number of comparisons requires that the *p*-values be interpreted as guidelines only. While many items in the cognitive test showed statistically significant differences between sites, this was mostly a reflection of differences in education and were reduced when adjusted for education (educationally adjusted comparisons are available upon request). Items well known to be highly dependent upon level of education such as constructional ability show great differences between sites while those less dependent upon education such as orientation to place show small differences. Individual items in the relative section also showed a difference between sites but both the memory and cognitive subscores and the activities of daily living subscores were similar between sites. Table 5 shows individual item comparisons for the relative interview for the entire sample in each site. Table 6 shows item comparisons of the demented and not-demented subjects who were clinically assessed in both sites.

DISCUSSION

There are many problems involved in designing and conducting cross-cultural studies. In this

Table 5. CSI"D" relative items by site. Per cent reporting problem

	Indianapolis N = 1499	Ibadan N = 2494
Memory & cognition		
Remembering is a problem	22.6	27.4‡
Forgets where he puts things	19.8	12.8‡
Forgets where things are usually kept	8.6	4.4‡
Forgets names of friends	6.0	1.6‡
Forgets names of members of the family	3.0	1.4‡
Forgets what wanted to say midsentence	7.2	2.3‡
Forgets when last saw you	1.1	1.5
Forgets what happened the day before	4.4	2.3‡
Forgets where he/she is	1.4	1.6
Gets lost in the community	2.2	2.1
Gets lost in own home	0.8	1.2
Subscore mean comparison	1.2200 ±1.660	0.9092 ±1.414
Activities of daily living (ADL)		
Difficulty with:		
Household tasks	2.2	0.5‡
Adjusting to change	4.9	9.8‡
Feeds self	0.3	0.4
Dressing	1.5	0.2‡
Using toilet	1.6	0.1‡
Change in ability to handle money	2.9	0.9‡
Loss of skill or hobby	6.9	2.7‡
Change in ability to think and reason	14.8	7.7‡
Subscore mean comparison	0.4629 ±1.090	0.3085‡ ±0.672
Miscellaneous problems		
Change in activities	53.4	79.6‡
Decline in mental functioning	15.7	5.5‡
Difficulty finding the right word	5.5	2.5‡
Uses wrong words	5.2	1.9‡
Does he/she talk about long ago	17.1	27.3‡

*Signif. at the 0.05 level.
‡Signif. at the 0.01 level.

Table 6. Relative item comparisons by site. Per cent reporting problem

	Ibadan Normal N=395	Ibadan Demented N=28	Indianapolis Normal N=178	Indianapolis Demented N=50
Memory & cognition				
Remembering is a problem	49.6	67.9*	54.8	81.6‡
Forgets where he puts things	38.0	63.0‡	39.8	73.5‡
Forgets where things are usually kept	14.7	50.0‡	19.3	61.2‡
Forgets names of friends	6.1	17.9*	14.2	40.8‡
Forgets names of members of the family	4.6	17.9*	8.5	22.0*
Forgets what wanted to say midsentence	6.6	32.1‡	18.6	31.3*
Forgets when last saw you	4.3	21.4‡	3.4	16.0‡
Forgets what happened the day before	8.1	39.3‡	12.1	49.0‡
Forgets where he/she is	4.6	25.0‡	2.8	22.5‡
Gets lost in the community	5.8	14.3‡	7.5	25.0*
Gets lost in own home	3.3	14.3*	1.1	12.2‡
Subscore mean comparison	2.0662 ±1.946	4.2963 ±2.665‡	2.5419 ±1.993	5.262 ±2.533‡
Activities of daily living (ADL)				
Difficulty with:	1.8	7.1	4.5	28.0‡
Household tasks				
Adjusting to change	25.6	57.1‡	11.3	33.3‡
Feeds self	1.3	3.6	0.0	4.0*
Dressing	0.3	3.6	2.8	22.0‡
Using toilet	0.3	3.6	2.8	22.4‡
Change in ability to handle money	2.5	18.5‡	4.6	52.2‡
Loss of skill or hobby	6.8	14.3	13.8	46.8‡
Change in ability to think and reason	22.4	57.1‡	38.6	76.0‡
Subscore mean comparison	0.7950 ±0.917	1.9815 ±1.695‡	0.9485 ±1.111	3.670 ±2.995‡
Miscellaneous problems				
Change in activities	90.8	96.4	72.3	96.0‡
Decline in mental functioning	18.0	64.3‡	36.2	77.6‡
Difficulty finding the right word	7.8	28.6‡	15.2	30.0*
Uses wrong words	5.3	17.9*	14.8	32.0‡
Does he/she talk about long ago	45.0	42.9	37.9	65.3‡

*Signif. at the 0.05 level.
‡Signif. at the 0.01 level.

paper we attempt to show how our research teams at the two sites addressed these issues.

The sampling techniques differed between the two sites reflecting the different concerns and conditions prevailing within the sites. In Indianapolis the emphasis was placed on constructing a sample of African Americans age 65 years old and older who would be representative demographically of the elderly African Americans in the city of Indianapolis so that the results obtained could be generalizable to this urban population. In Ibadan, because of the expected low prevalence of dementia and the absence of reliable census data, a total population survey of a geographically defined population was conducted in order to minimize the possibility of missing even a few cases of dementia. This sample is representative of Yoruba living in similar urban conditions but not necessarily of Yoruba in general or Nigerians at a national level. Nigeria is a nation of diverse cultures and levels of technological development, a representative national sample would not be possible for such a study. However as the primary purpose in this study was to identify and study different populations for prevalence patterns of dementia and to identify

potential risk factors, this loss of generalizability does not affect our primary aim.

A major effort was made in both sites to ensure community acceptance of the project and low individual refusal rates. This was accomplished in a variety of ways, but particularly useful was identifying and enlisting the help of community leaders and employing interviewers who were residents of the geographical area and familiar with the culture and mores of the community. Our refusal rates were 1.6% in Ibadan and 9.6% in Indianapolis. In Indianapolis this refusal rate in a population of African Americans considered to be sceptical of and possibly hostile to research endeavours was encouraging and compares very favourably with refusal rates in other studies involving African-American subjects.

The screening instrument performed well in both cultures despite their different educational backgrounds. Although there were statistically significant differences in both individuals cognitive items and mean total cognitive scores between the two sites, attributable to the influence of education, when the scores were adjusted for education, the subjects from Ibadan scored slightly but significantly higher than the subjects from Indianapolis. The distribution of scores in the two sites were similar (although statistically significant because of the large number of subjects). Similarly mean informant scores were statistically significant but differences did not appear clinically meaningful. In identifying cut-off points for "good", "intermediate" and "poor" performance using the discriminant score, we decided not to adjust for education because education has been reported to be a significant risk factor for AD. Nonetheless, almost equal percentages of "good", "intermediate" and "poor" performances were identified in the two samples.

The addition of information about activities of daily living to the screening process significantly improves the prediction of dementia in the screening phase. In Ibadan the traditional extended family residence pattern provided relatively direct access to close family members who had daily contact with the subject, and 100% had a relative interview. In Indianapolis, 46.0% of the subjects lived alone and only 67.8% had a relative interview. The close proximity of relatives observed in Ibadan is a pattern common in developing countries. The inclusion of informant information in such settings can help to attenuate the possible confounding of dementia with lack of education, in cognitive scores. In Indianapolis, the Pearson Correlation Coefficient was $r=0.3765$ between cognitive score and education, but only $r=-0.1738$ between the relative score and education. In Ibadan, the Correlation Coefficient for cognitive score and education was $r=0.1772$ and between relative score and education only $r=0.0099$. Informant data not only improves the discriminatory capability of the screening instrument, but it adds an additional dimension to the baseline data for follow-up incidence studies. It therefore seems worth the considerable effort it may require.

In summary, cross-cultural studies involving populations at different levels of development and with different educational and psycho-social backgrounds offer considerable advantages in distinguishing risk factors for AD that are uniform across cultures from those that are culture-specific. This distinction is not apparent in studies confined to one country. However, these studies pose formidable methodological challenges, not least of which is constructing assessment instruments with minimal cultural bias. We have demonstrated that these instruments can be developed by a process of translation, harmonization and pilot testing and can be used in a comparable manner in different populations. The process followed by our teams we think could be followed in a variety of study sites or combination of sites. In addition the comparative prevalence studies establish the framework within which to carry out future follow-up incidence studies, and for explorations of possible genetic and enironmental risk factors and their possible interactions.

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