Journal of the International Neuropsychological Society (1999), **5**, 301–307.

Mini-Mental State Examination and Mattis Dementia Rating Scale performance differs in Hispanic and non-Hispanic Alzheimer's disease patients

URSULA HOHL,[1,2] MICHAEL GRUNDMAN,[1,2] DAVID P. SALMON,[1]
RONALD G. THOMAS,[1,3] AND LEON J. THAL[1,2]

Departments of Neurosciences,[1] Neurology,[2] and Family and Preventive Medicine,[3]
University of California, San Diego, School of Medicine and VA San Diego Healthcare System

(RECEIVED February 6, 1997; REVISED May 21, 1998; ACCEPTED June 25, 1998)

Abstract

Little information exists regarding the performance of Spanish-speaking *versus* English-speaking patients with Alzheimer's disease (AD) on the Mini-Mental State Examination and the Mattis Dementia Rating Scale. In an attempt to identify culturally biased MMSE items or DRS subscales, we matched Spanish-speaking Hispanic and English-speaking non-Hispanic White community-dwelling AD patients by their MMSE scores and examined specific items within each scale. Our findings indicate that Hispanic AD patients perform significantly worse than non-Hispanics in terms of total DRS score, scores on the DRS subscales for Conceptualization and Memory, and on serial subtraction (or backward spelling item) of the MMSE. While mildly to moderately demented Hispanic and non-Hispanic patients obtained comparable scores on the DRS, severely impaired Spanish-speaking participants obtained considerably lower DRS scores than their English-speaking counterparts. The discrepancy in the DRS scores of the severely impaired Hispanic and non-Hispanic examinees might reflect a cultural bias in the test or educational differences between the groups. Alternatively, the DRS may be more sensitive than the MMSE for detecting severe cognitive impairment in Hispanic patients. (*JINS*, 1999, *5*, 301–307.)

Keywords: Spanish-Speaking, Alzheimer, Mini-Mental State Examination, Mattis Dementia Rating Scale

INTRODUCTION

Although Alzheimer's disease (AD) affects individuals of all races and cultures, the instruments used to assess its clinical features have been mainly developed with members of the English-speaking White middle class. It is well known, however, that neuropsychological assessment—on which the clinical diagnosis of Alzheimer's disease critically depends—is sensitive to confounding factors such as education and cultural background (Ardila et al., 1989; Heaton et al., 1986; Rosselli & Ardila, 1990; Stern et al., 1994; Zhang et al., 1990). For example, individuals with low education tend to obtain lower scores on neuropsychological testing than those with a higher level of educational attainment and risk being placed in the impaired range (Anthony et al., 1982). Similarly, cultural factors such as unfamiliarity with test taking, little previous exposure to test materials, and differences in the emphasis placed upon particular cognitive abilities during development can adversely affect neuropsychological test performance (Ardila et al., 1989; Cole et al., 1971; Pick, 1980; Segall, 1986).

The Spanish-speaking Hispanic population represents the largest and fastest growing cultural and linguistic minority in the U.S. (U.S. Bureau of the Census, 1992). Thus, development and validation of cognitive screening instruments in Spanish, that are also culturally fair, has become a clinical necessity. Recent data suggest, however, that even carefully translated psychometric instruments administered in Spanish may be susceptible to cultural biases. It has been shown, for example, that nondemented Spanish-speaking elderly perform worse than their English-speaking counterparts on several selected subtests of the Wechsler Adult Intelligence Scale (Lopez & Taussig, 1991), on tests of delayed recognition memory (Loewenstein et al., 1992) and on verbal fluency tasks (e.g., the FAS test; Loewenstein & Rubert, 1992).

Reprint requests to: Ursula Hohl, Geriatric University Clinic, Kantonsspital Basel, CH-4031 Basel, Switzerland.

There is evidence that cultural bias also exists in less sophisticated mental status tests such as the Mini-Mental State Examination (MMSE; Folstein et al., 1975) which is probably the best-known and most widely used cognitive screening instrument. For example, Bird et al. (1987) showed that in a community sample in Puerto Rico the prevalence of severe cognitive impairment, defined by the MMSE, was significantly higher than that of U.S. communities. Similarly, Gurland et al. (1992) reported that Hispanics were more likely than non-Hispanic white or black individuals to receive a false-positive classification of "demented" when examined with cognitive screening tests (including the MMSE) in a community study of healthy and demented elderly. However, after adjusting for education, mean differences in the MMSE scores in a community sample of Hispanics and non-Hispanics no longer existed across ethnic groups (Mungas et al., 1996).

Although the cognitive functioning of healthy Hispanic persons appears to be underestimated by the MMSE, little information exists regarding MMSE performance in Hispanic demented patients. In one of the few studies addressing this issue, no cultural bias was found in the MMSE scores of a sample that included Spanish-speaking and English-speaking AD patients and normal controls (Taussig et al., 1992). Furthermore, it was recently shown that scores on a Spanish version of the MMSE were highly correlated with performance on the Mental Status Questionnaire, the Information–Memory–Concentration test, and the Orientation–Memory–Concentration test, and that the MMSE reliably distinguished between Hispanic AD patients and normal controls (Taussig et al., 1996). In contrast, Bohnstedt et al. (1994) recently compared the MMSE scores and clinical diagnosis of White, Black, and Hispanic dementia patients and found that MMSE scores for Black and Hispanic patients underestimated their cognitive capabilities relative to White patients.

In 1990 the Alzheimer's Disease Research Center (ADRC) at the University of California at San Diego began cross-cultural research examining AD in the Hispanic population. Preliminary analyses revealed that Hispanic AD patients had a much lower average MMSE score for their 1st year in study (12.56 ± 7.99) than non-Hispanic White AD patients (19.29 ± 5.64), even though the two groups reported approximately the same duration of illness (3.75 ± 3.14 *vs.* 4.09 ± 3.08). As it seemed rather unlikely that dementia progresses faster in Hispanic than in non-Hispanic individuals, we examined the possibility that the MMSE was underestimating the cognitive abilities of the Hispanic AD patients due to their lower education or to potential cultural bias in the test. In the present study we compared the performance of Spanish-speaking Hispanic and English-speaking non-Hispanic AD patients with similar age and education levels on individual MMSE items in an attempt to identify culturally biased items. We also compared their performance on the Dementia Rating Scale (DRS), another widely used global cognitive screening instrument (Mattis, 1976, 1988). The MMSE and the DRS are both used to confirm the presence of cognitive deficits, quantify the severity of the dementia, and document the decline of cognitive capacities over time; however, the DRS assesses cognitive status more extensively than the MMSE and allows a more detailed documentation of deteriorating cognitive capacities. The MMSE and the DRS are highly correlated in non-Hispanic, White middle-class AD patient samples (Salmon et al., 1990), and both tests are strongly related to loss of neocortical synapses in AD patients (Terry et al., 1991).

Because performance on the individual MMSE items and on the subtests of the DRS depends on the level of dementia of the individual being tested, as well as on possible effects of education or culture, we adopted the strategy of comparing Hispanic and non-Hispanic AD patients who were similar in terms of education, estimated duration of disease, and functional impairment, and were matched for overall MMSE score. In this way we could be relatively confident, that any observed differences on individual MMSE items were due primarily to cultural factors rather than to differences in education or stage of dementia. Furthermore, matching the groups on overall MMSE performance allowed us to examine any differential effects of culture on DRS performance and on the relationship between the two cognitive screening instruments. The analyses were restricted to patients with AD because it has been shown that patients with different dementing disorders display unique patterns of impairment on the MMSE (Brandt et al., 1988) and the DRS (Salmon et al., 1989).

METHODS

Research Participants

Participants were 21 Spanish-speaking Hispanic and 21 English-speaking non-Hispanic White patients who were enrolled in the ongoing ADRC evaluation program. All patients met the NINCDS–ADRDA criteria for probable or possible Alzheimer's disease (McKhann et al., 1984). The diagnosis of AD was based on a comprehensive medical, neurological, and neuropsychological examination and, if indicated, psychiatric evaluation. History, functional status, and demographic data were obtained from an informed caregiver. Functional impairment reported by the caregivers was assessed using the Lawton-Powell Physical Self-Maintenance Scale (PSMS; Lawton & Brody, 1969). Possible other causes of dementia were ruled out by laboratory tests and neuroimaging (CT or MRI). The final diagnosis was reached after two senior neurologists independently reviewed all data. The Hispanic sample consisted of 16 probable and 5 possible AD patients; the non-Hispanic group consisted of 19 probable and 2 possible AD patients ($p = .22$; Fisher's Exact Test).

Patients were recruited through community presentations in senior citizen centers and support groups of the Alzheimer Association, or were referred by medical practitioners. Only community residing individuals were included. The

https://doi.org/10.1017/S1355617799544019 Published online by Cambridge University Press

non-Hispanic patients were evaluated at the ADRC in La Jolla, while the Hispanic patients were evaluated at two satellite sites of the ADRC. One site is located in El Centro, a mainly agricultural area approximately 100 miles east of San Diego, and the other site is located in Chula Vista, a community in South San Diego County. Both areas have large Hispanic populations. Eighty-five percent of the Hispanic patients were Mexican-American or of Mexican descent, the remainder were each from Peru, Guatemala, and Puerto Rico.

Inclusion criteria for Hispanic participants in this study were (1) Spanish as their primary language and used either exclusively or dominantly; (2) cognitive testing was conducted in Spanish; (3) MMSE score was greater than 0; and (4) both the MMSE and DRS were completed. Because we were interested in the effects of language and culture on psychometric measures, and not level of dementia, non-Hispanic participants were individually matched to Hispanic participants based on their MMSE scores (scores were individually matched within ± 1 point).

Instruments

The MMSE is a 30-item screening instrument that assesses orientation in time and place, attention/concentration, immediate and delayed recall, constructional abilities, and the use of language. The following MMSE items were scored for the present analyses: orientation to time (5 points), orientation to place (5 points), immediate registration of three items (3 points), delayed recall of three items (3 points), serial subtraction of 7 from 100 or spelling "world" backwards (5 points), following a three-step verbal command (3 points), repeating a phrase (1 point), confrontation naming (2 points), reading and following a command (1 point), writing a sentence (1 point), and copying a pentagon (1 point). The English and the Spanish version of the MMSE were administered according to the procedures described by Folstein et al. (1975), in which the serial subtraction and the reverse spelling items are interchangeable. Participants failing the serial subtraction item were asked to perform the alternative of spelling "world" or "*mundo*" respectively backward. The task with the fewer number of errors was counted towards the MMSE total score. As a slight modification of the original instrument, the question "What is the name of this hospital?" was replaced with the question "What is the name of this place?"

The Spanish MMSE was developed by a research team at San Diego State University (Valle et al., 1991) who used the recommended translation and instrument revision process (Brislin, 1980; Brislin et al., 1973). A bilingual and bicultural staff translated the instruments which were then backtranslated by a collaborator who did not know the original English version. The two versions were compared and discrepancies were reconciled by the first translation team. Modifications of the English version were made as follows: The question "On which floor are we?" was replaced by "What is the address of this place?", and the literal translation of the sentence for the repetition task "No ifs, ands, or buts" does not make sense in Spanish and was replaced by "Si no bajo, entonces usted suba." Illiterate Hispanic patients were allowed to say a sentence instead of writing one, and were allowed to imitate the gesture of closing the eyes rather than following the written command "Close your eyes."

The DRS is a cognitive screening instrument that consists of five subscales that assess attention, initiation and perseveration, construction, conceptualization, and memory. The DRS was administered to all patients according to the standard procedure (Mattis, 1976) with the exception that all items were administered to all patients. The maximum possible total score on the DRS is 144 points, the total subscale scores are 37 for attention, 37 for initiation and perseveration, 6 for construction, 39 for conceptualization, and 25 for memory. The DRS was translated directly into Spanish with only one modification. The repetition of the English syllables "bee-key-gee" and "be-ba-bo" was changed to repetition of the more common Spanish syllables "si-ti-mi," and "si-sa-su," respectively.

Procedure

Patients were tested individually in a quiet, well-lit room. The MMSE and DRS were administered as part of a larger neurological and neuropsychological evaluation by a trained nurse or psychometrist. Spanish-speaking patients were assessed by a bilingual and bicultural staff who also carried out a proportion of the evaluations of the English-speaking non-Hispanic AD patients.

Statistics

Continuous MMSE item scores and the DRS total score and subscores were compared using paired *t* tests. Dichotomous MMSE item scores were compared using McNemar tests. To describe the relationship between the MMSE and the DRS, correlational analyses were performed and described by Pearson's *r*. The level of a (two-tailed) test was set at .05. Due to the exploratory nature of this study, we did not attempt to correct for multiple comparisons.

RESULTS

Demographic data, PSMS and the mean MMSE and DRS scores for the Hispanic and non-Hispanic groups are presented in Table 1. The groups did not differ significantly in age, education, duration of illness, or functional impairment, and had similar sex distributions. The range for education was from zero to 17 years in the Hispanic group and from zero to 13 years for the non-Hispanic group. As expected with the matching procedure, the two groups did not differ with regard to total MMSE score. The entire sample included a range from severely impaired to mildly impaired patients with MMSE scores ranging from 5 to 26.

The performances of the Hispanic and non-Hispanic AD patients on the individual components of the MMSE are

https://doi.org/10.1017/S1355617799544019 Published online by Cambridge University Press

Table 1. Demographic characteristics and MMSE and DRS scores of Hispanic and non-Hispanic AD patients

Variable	Hispanic AD patients (N = 21) M (SD)	non-Hispanic AD patients (N = 21) M (SD)	p
Age (years)	71.48 ± 7.89	74.38 ± 8.97	.27
Education (years)	6.38 ± 4.61	7.60 ± 2.85	.31
Sex	15 F:6 M	14 F:7 M	.74
Duration (years)	3.52 ± 2.39	4.09 ± 2.01	.47
PSMS*	8.21 ± 2.25	8.63 ± 3.88	.68
MMSE	14.95 ± 6.85	15.00 ± 6.75	.66
DRS	80.67 ± 36.60	94.62 ± 19.61	.02

Note. Comparisons were made using unpaired t test (age, education, duration, PSMS), paired t test (MMSE, DRS), and chi-square (sex).
*N for the PSMS in each group = 19.

shown in Figure 1. The mean percentage of the total possible number of points obtained for each component is presented so that the individual items can be compared on the same scale. As Figure 1 shows, the Hispanic and non-Hispanic AD patients performed similarly on most MMSE items. However, the Hispanic patients scored lower than their English-speaking counterparts on the serial subtraction or spelling "world" backward item [$t(20) = 2.54$, $p < .05$]. In contrast, Hispanics tended to perform better than the non-Hispanics on the recall, registration and 3-step command items, but these differences did not reach statistical significance.

Despite equivalent performance on the MMSE, the Hispanic AD patients achieved significantly lower total DRS scores than the non-Hispanic patients [$t(20) = 2.60$, $p < .05$; see Table 1] and, in particular, scored lower on the Conceptualization [$t(20) = 2.55$, $p < .05$] and Memory [$t(20) = 2.14$, $p < .05$] subscales (Figure 2). The Hispanic AD patients also tended to perform more poorly than the non-Hispanic patients on the Attention and Construction subscales, but these differences did not reach statistical significance. The Hispanic and non-Hispanic AD patients performed comparably on the Initiation subscale. The mean percentage of the total possible score obtained on each DRS subscale is presented in Figure 2.

To examine the relationship between the MMSE and DRS in the Hispanic and non-Hispanic AD patients, total MMSE scores are plotted as a function of total DRS scores for each of the two groups (Figure 3). The MMSE and the DRS were highly correlated for both Hispanic ($r = .83$, $p < .001$) and non-Hispanic patients ($r = .91$, $p < .001$), although the correlation was slightly weaker for Hispanic patients. On a descriptive level, the MMSE and the DRS scores of the non-Hispanic AD patients were linearly related across the entire range of scores. In contrast, the MMSE and DRS scores of the Hispanic patients appeared to be linearly related for the relatively mildly impaired patients (i.e., MMSE scores of 15–26), but to have a curvilinear relationship in the more advanced patients (i.e., MMSE score less than 15). Indeed, a number of Hispanic patients with MMSE scores in the 5- to 10-point range were scoring at near floor levels on the DRS.

DISCUSSION

Our findings indicate that Spanish-speaking Hispanic AD patients and English-speaking non-Hispanic AD patients perform similarly on most items of the MMSE when the groups are comparable with regard to age, education, and overall

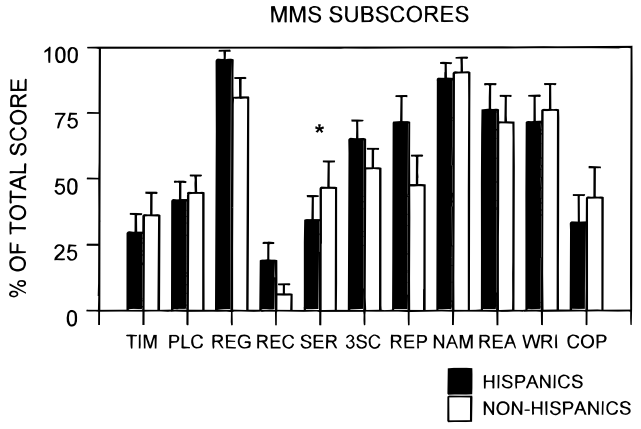

Fig. 1. Mean proportion of the total possible score for each MMSE item achieved by the Hispanic and non-Hispanic AD patients. TIM: orientation for time; PLC: orientation for place; REG: registration; REC: recall; SER: serial subtraction; 3SC: three-step command; REP: repetition; NAM: naming; REA: written command; WRI: writing; COP: construction. Asterisk indicates a significant group difference [$p < .05$ (paired t test)].

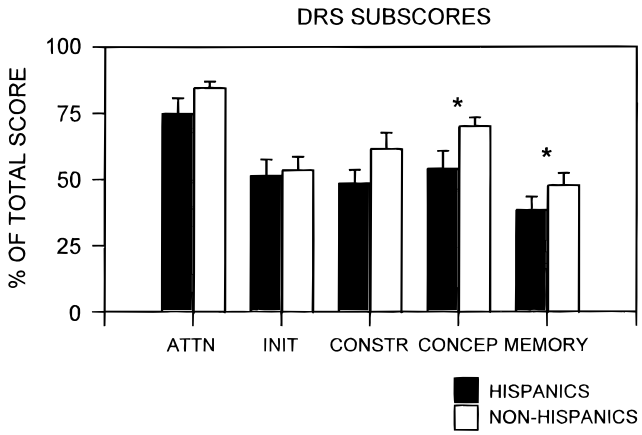

Fig. 2. The mean proportion of the total possible score for each DRS subtest achieved by the Hispanic and non-Hispanic AD patients. ATTN: Attention; INIT: Initiation and Perseveration; CONSTR: Construction; CONCEP: Conceptualization; MEM: Memory. Asterisk indicates a significant group difference [$p < .05$ (paired t test)].

https://doi.org/10.1017/S1355617799544019 Published online by Cambridge University Press

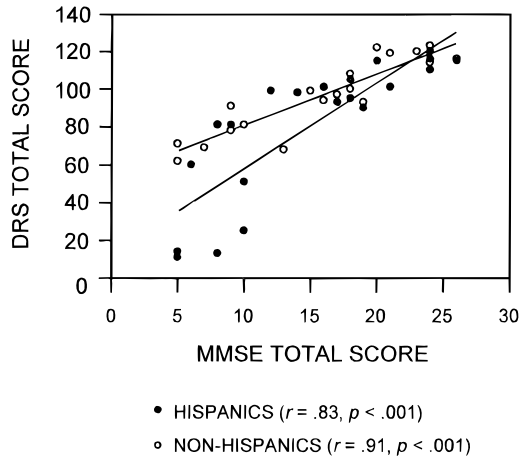

Fig. 3. The MMSE scores of Hispanic and non-Hispanic AD patients plotted as a function of their scores on the DRS.

level of dementia. However, even in these carefully matched groups, the Hispanic AD patients performed significantly worse than the non-Hispanic patients on the serial subtraction MMSE item (or on its alternate, spelling "world" backwards). This finding is consistent with the results of Teresi and colleagues (Teresi et al., 1995) who found the serial subtraction item to be more difficult for Hispanics than for non-Hispanics in a sample of nondemented and demented participants, and with those of Escobar et al. (1986) who found poorer serial subtraction and backwards spelling in Spanish-speaking than in English-speaking participants in a Los Angeles community sample. Although these previous studies suggested that less education in the Hispanic patients may have led to their poorer performance on this item, the present results suggest that this difference may have a cultural basis since the Hispanic and non-Hispanic groups had similar levels of formal education.

The results of the present study did not replicate the previous finding that Spanish-speaking Hispanic individuals perform worse than English-speaking non-Hispanics on the orientation item of the MMSE, but better on the repetition item (Escobar et al., 1986). The failure to observe this pattern may be due to comparable levels of education in the Hispanic and non-Hispanic groups, or due to an artifact produced by matching the groups in terms of total MMSE score. In the present study, Hispanic patients tended to perform better than non-Hispanic patients on the delayed recall, registration, and three-step command items, which might indicate that the Hispanic group tend to have a better memory, have fewer attention deficits, and might be less apractic. However, the results of the DRS, which tests memory and attention more extensively than the MMSE, does not support this assumption. It must be kept in mind that a significantly lower score by one group on one MMSE item (i.e., serial subtraction) requires that their scores on the remaining items be higher than those of the other group.

Despite being matched for overall level of dementia as measured by total MMSE score, the Hispanic AD patients performed significantly worse than the non-Hispanic AD patients on the DRS. This difference was accounted for primarily by the significantly poorer performance of the Hispanic patients, relative to the non-Hispanic patients, on the Memory and Conceptualization subtests. The Memory subtest of the DRS is particularly sensitive to the effects of dementia (Monsch et al., 1995; Paulsen et al., 1995) and it may be the case that the Hispanic AD patients are more demented than their MMSE scores suggest. That is, there may be components of the DRS that are sensitive to deficits in the Hispanic group that are not effectively measured by the MMSE.

However, the groups were comparable in terms of their functional impairment; thus the Memory and Conceptualization items of the DRS may be biased against Spanish-speaking Hispanic AD patients, either through educational or cultural factors. The Conceptualization subtest of the DRS (Monsch et al., 1995) and the serial subtraction item or its alternative backwards spelling of the MMSE are particularly susceptible to the effects of education, and these were two of the items that were performed worse by the Hispanic AD patients than by the non-Hispanic AD patients.

The Hispanic and non-Hispanic AD patients in the present study were comparable with regard to years of formal education. This variable, however, might not be equated across different cultures or school systems as different emphasis is put on certain scholastic achievements. For example spelling is highly overlearned in English-speaking participants and is usually not taught in Latin-American countries where the emphasis is to write a word correctly instead of spelling it aloud. Thus the Hispanic AD patients were at a disadvantage while performing this task. Unfortunately our sample size was too small so we could not meaningfully break down the score and differentiate whether the poorer performance was mainly driven by the serial subtraction task or the backward spelling task.

The differential sensitivity of the DRS to cognitive deficits in Hispanic and non-Hispanic AD patients was also reflected by differences in the relationship between the DRS and MMSE in the two groups. Although performance on the scales was highly correlated in both patient groups, the correlation was greater in non-Hispanic than in Hispanic patients. Furthermore, the relationship between the scales was linear throughout the range of severity in the non-Hispanic patients, but was nonlinear in the Hispanic patients. Hispanic AD patients scoring below 12 on the MMSE tended to perform extremely poorly on the DRS. Indeed, the overall difference in DRS scores between the two patient groups appears to be driven primarily by Hispanic patients scoring below 12 on the MMSE. This suggests that any cultural or educational bias present in the DRS does not become apparent until a patient reaches a stage of severe dementia.

In summary, the present findings indicate that our linguistically and culturally adapted version of the MMSE is relatively free of cultural and educational biases, with the exception of the serial subtraction item or backward spelling. As in previous studies, the serial subtraction item or its

https://doi.org/10.1017/S1355617799544019 Published online by Cambridge University Press

alternate was performed worse by Hispanic AD patients than by non-Hispanic AD patients, even though the groups were comparable on all major demographic features. This result might be mainly driven by poorer performance of the Hispanic AD patients on the backward spelling item as spelling out loud is usually not taught in Latin-American countries. Our linguistically adapted version of the DRS, in contrast, appears to be susceptible to some cultural or educational factors that become particularly salient in the severe stages of dementia. Alternatively the DRS might be more effective in detecting cognitive deficits in Hispanic patients than the MMSE.

ACKNOWLEDGMENTS

Supported in part by funds from the Swiss National Science Foundation, the Ciba-Geigy Jubilaeums Stiftung, the M.&W. Lichtenstein Stiftung (U.H.), National Institute on Aging Grant AG-05131 to the University of California, San Diego (UCSD), and a grant from the State of California (ADDTC). We gratefully acknowledge the assistance of the staff members of the UCSD Alzheimer's Disease Research Center.

REFERENCE

Anthony, J.C., LeResche, L., Niaz, U., von Korff, M.R., & Folstein, M.F. (1982). Limits of the "Mini-Mental State" as a screening test for dementia and delirium among hospital patients. *Psychological Medicine*, *12*, 397–408.

Ardila, A., Rosselli M., & Rosas, P. (1989). Neuropsychological assessment in illiterates: Visuospatial and memory abilities. *Brain and Cognition*, *11*, 147–166.

Bird, H.R., Canino, G., Stipec, M.R., & Shrout, P. (1987). Use of the Mini-Mental State Examination in a probability sample of a Hispanic population. *Journal of Nervous and Mental Disease*, *175*, 731–737.

Bohnstedt, M., Fox, P.J., & Kohatsu, N.D. (1994). Correlates of Mini-Mental Status Examination scores among elderly demented patients: The influence of race–ethnicity. *Journal of Clinical Epidemiology*, *47*, 1381–1387.

Brandt, J., Folstein, S.E., & Folstein, M.F. (1988). Differential cognitive impairment in Alzheimer's disease and Huntington's disease. *Annals of Neurology*, *23*, 555–561.

Brislin, R.W. (1980). Translation and content analysis of oral and written materials. In H.C. Triandis & J.W. Berry (Eds.), Handbook of cross-cultural psychology—Methodology (Vol. 2, pp. 389–444). Boston: Allyn and Bacon Inc.

Brislin, R.W., Lonner, W.J., & Thorndyke, R.M. (1973). *Cross cultural research methods*. New York: Wiley and Sons.

Cole, M., Gay, J., Glick, J., & Sharp D. (1971). *The cultural context of learning and thinking*. New York: Basic Books.

Escobar, J.I., Burnam, A., Karno, M., Forsythe, A., Landsverk, J., & Golding, J.M. (1986). Use of the Mini-Mental State Examination (MMSE) in a community of mixed ethnicity. *Journal of Nervous and Mental Disease*, *174*, 607–614.

Folstein, M.F., Folstein, S.E., & McHugh, P.R. (1975). "Mini-Mental State": A practical method for grading the cognitive state of patients for the clinician. *Journal of Psychiatric Research*, *12*, 189–198.

Gurland, B.J., Wilder, D.E., Cross, P., Teresi, J., & Barrett, V.W. (1992). Screening scales for dementia: Towards reconciliation of conflicting cross-cultural findings. *International Journal of Geriatric Psychiatry*, *7*, 105–113.

Heaton, R.K., Grant, I., & Matthews, C.G. (1986). Differences in neuropsychological test performance associated with age, education, and sex. In I. Grant & K. Adams (Eds.), *Neuropsychological assessment of neuropsychiatric disorders* (pp. 100–120). New York: Oxford University Press.

Lawton, M.P. & Brody, E.M. (1969). Assessment of older people: Self-maintaining and instrumental activities of daily living. *Gerontologist*, *9*, 179–186.

Loewenstein, D.A., Ardila, A., Rosselli, M., Hayden, S., Duara, R., Berkowitz, M., Linn-Fuentes, P., Mintzer, J., Norville, M., & Eisdorfer, C. (1992). A comparative analysis of functional status among Spanish- and English-speaking patients with dementia. *Journal of Gerontology: Psychological Sciences*, *47*, 389–394.

Loewenstein, D.A. & Rubert, M.P. (1992). The NINCDS–ADRDA neuropsychological criteria for the assessment of dementia: Limitations of current diagnostic guidelines. *Behavior, Health and Aging*, *2*, 113–121.

Lopez, S.R. & Taussig, I.M. (1991). Cognitive-intellectual functioning of Spanish-speaking impaired and nonimpaired elderly: Implications for culturally sensitive assessment. *Psychological Assessment*, *3*, 448–454.

Mattis, S. (1976). Mental status examination for organic mental syndrome in the elderly patient. In L. Bellack & T.B. Karasu (Eds.), *Geriatric psychiatry: A handbook for psychiatrists and primary care physicians* (pp. 77–121). New York: Grune & Stratton.

Mattis, S. (1988). *Dementia Rating Scale: Professional manual*. Odessa, FL: Psychological Assessment Resources Inc.

McKhann, G., Drachman, D., Folstein, M., Katzman, R., Price, D., & Stadlan, E.M. (1984). Clinical diagnosis of Alzheimer's disease: Report of the NINCDS–ADRDA work group under the auspices of Department of Health and Human Services task force on Alzheimer's disease. *Neurology*, *35*, 453–461.

Monsch, A.U., Bondi, M.W., Salmon, D.P., Butters, N., Thal, L.J., Hansen, L.A., Wiederholt, W.C., Cahn, D.A., & Klauber, M.R. (1995). Clinical validity of the Mattis Dementia Rating Scale in detecting dementia of the Alzheimer type. *Archives of Neurology*, *52*, 899–905.

Mungas, D., Marshall, S.C., Weldon, M., Haan, M., & Reed, B.R. (1996). Age and education correction for Mini-Mental State Examination for English-speaking and Spanish-speaking elderly. *Neurology*, *46*, 700–706.

Paulsen, J.S., Butters, N., Sadek, J.R., Johnson, S.A., Salmon, D.P., Swerdlow, N.R., & Swenson, M.R. (1995). Distinct cognitive profiles of cortical and subcortical dementia in advanced illness. *Neurology*, *45*, 951–956.

Pick, A.D. (1980). Cognition: Psychological perspectives. In H. Triandis & W. Lonner (Eds.), *Handbook of cross-cultural psychology* (pp. 117–153). Boston: Allyn & Bacon.

Rosselli, M. & Ardila, A. (1990). Neuropsychological assessment in illiterates: II. Language and praxic abilities. *Brain and Cognition*, *12*, 281–296.

Salmon, D.P., Kwo-on-Yuen, P.F., Heindel, W.C., Butters, N., & Thal, L.J. (1989). Differentiation of Alzheimer's disease and Huntington's disease with the Dementia Rating Scale. *Archives of Neurology*, *46*, 1204–1208.

Salmon, D.P., Thal, L.J., Butters, N., & Heindel, W.C. (1990). Longitudinal evaluation of dementia of the Alzheimer type: A com-

parison of three standardized mental status examinations. *Neurology*, *40*, 1225–1230.

Segall, M.H. (1986). Culture and behavior: Psychology in global perspective. *Annual Review of Psychology*, *37*, 523–564.

Stern, Y., Gurland, B., Tatemichi, T.K., Tang, M.X., Wilder, D., & Mayeux, R. (1994). Influence of education and occupation on the incidence of Alzheimer's disease. *Journal of the American Medical Association*, *271*, 1004–1010.

Taussig, I.M., Henderson, V.W., & Mack, W. (1992). Spanish translation and validation of a neuropsychological battery: Performance of Spanish- and English-speaking Alzheimer's disease patients and normal comparison subjects. *Clinical Gerontologist*, *11*, 95–108.

Taussig, M., Mack, W.J., & Henderson, V.W. (1996). Concurrent validity of Spanish-language versions of the Mini-Mental State Examination, Mental Status Questionnaire, Information–Memory–Concentration Test, and Orientation–Memory–Concentration Test: Alzheimer's disease patients and nondemented elderly comparison subjects. *Journal of the International Neuropsychological Society*, *2*, 286–298.

Teresi, A.J., Golden, R.R., Cross, P., Gurland, B., Kleinman, M., & Wilder, D. (1995). Item bias in cognitive screening measures: Comparisons of elderly white, Afro-American, Hispanic and high and low education subgroups. *Journal of Clinical Epidemiology*, *48*, 473–483.

Terry, R.D., Masliah, E., Salmon, D.P., Butters, N., DeTeresa, R., Hill, R., Hansen, L.A., & Katzman, R. (1991). Physical basis of cognitive alterations in Alzheimer's disease: Synapse loss is the major correlate of cognitive impairment. *Annals of Neurology*, *30*, 572–580.

U.S. Bureau of the Census. (1992). *1992 census of population and housing data paper listing (CPH-L74)*. Washington, DC: Government Printing Office.

Valle, R., Hough, R., Kolody, B., Cook-Gait, H., Velazquez, G.F., Jimenez, R., Aktinson, J.H., Jex, N., Nees, D., Mendivil, L., Sanchez, C., Lopez, S., Lujan, G., Ballon, E., & Ganger, W. (Eds.) (1991). *Final report to the National Institute of Mental Health. The Hispanic Alzheimer's Research Project (HARP)*. San Diego, CA: San Diego State University.

Zhang, M., Katzman, R., Salmon, D., Jin, H., Cai, G., Wang, Z., Qu, G., Grant, I., Yu, E., Levy, P., & Klauber, M.R. (1990). The prevalence of dementia and Alzheimer's disease in Shanghai, China: Impact of age, gender, and education. *Annals of Neurology*, *27*, 428–437.

https://doi.org/10.1017/S1355617799544019 Published online by Cambridge University Press