Cognitive Functioning and Impairment Among Rural Elderly Hispanics and Non-Hispanic Whites as Assessed by the Mini-Mental State Examination

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We conducted a cross-sectional study to determine the distribution of cognitive functioning as measured by the Mini-Mental State Examination (MMSE) among a sample of Hispanic and non-Hispanic White (NHW) residents from two counties in rural, southern Colorado. Residents aged 60 years and older (N=1,360) were administered the full MMSE, a sociodemographic and medical interview. Protocols were developed to administer the MMSE equitably in both ethnic groups. Younger Hispanics tended to be categorized as severely impaired more than similarly aged NHWs (OR at age 70 = 4.14), however, older Hispanics and NHWs performed similarly after adjusting for education and gender (OR at age 90 = 1.00). The use of a modified MMSE scale that removed the ethnic bias demonstrated that NHWs and Hispanics had similar levels of severe impairment after full adjustment (OR = 0.93). Given the widespread use of the MMSE, these findings indicate the need for further validation of this instrument.

COMPETENT cognitive functioning is an integral component of good health. Recent work in this area has provided detailed descriptions of cognitive function, mostly for white elders (Bachman et al., 1992; Fratiglioni et al., 1991; Ganguli et al., 1991; Wiederholt et al., 1993). Relatively little is known about the distribution of cognitive functioning in other population subgroups. Of particular interest are Hispanic subgroups. The characterization of cognitive impairment among elderly (65 + years) Hispanics is important because their population size will double between 1990 and 2010, and Hispanics as a whole are the fastest growing minority population (Day, 1996; U.S. Bureau of the Census, 1996). Without knowledge of the distribution of cognitive impairment in this expanding population, it is difficult to plan for future health care needs.

The Mini-Mental State Examination (MMSE; Folstein, Folstein, & McHugh, 1975) has been used clinically as a screening instrument for dementia, and in research settings as a measure of cognitive impairment. It measures orientation, registration, attention/calculation, recall, and language, and is simple to administer, requiring only 5 to 10 minutes. Traditionally, a cutoff score of 23 points or fewer out of 30 has been used to discriminate between persons with cognitive impairment and those without. More recently, the MMSE has been used to categorize people into 3 groups: 1) no impairment, 24–30 points; 2) mild impairment, 18–23 points; and 3) severe impairment, 0–17 points (Tombaugh & Mcintyre, 1992).

Several authors have suggested that the MMSE produced biased results in persons who have less than 8 years of education, or who are members of an ethnic minority. Some authors (Anthony, LeResche, Niaz, Von Korff, & Folstein, 1982; Murden, McRae, Kaner, & Bucknam, 1991; Ylikoski et al., 1992) have suggested that the cutpoints of the MMSE score should be modified for these individuals so that they are not characterized as having cognitive impairment, when they are cognitively normal. Other authors have suggested that the biased items of the MMSE should be eliminated or differentially weighted (Escobar et al., 1986; Teresi et al., 1995). More recently, both longitudinal (Farmer, Kittner, Rae, Bartko, & Regier, 1995; Jackmin-Gadda, Fabrigoule, Commenges, & Dartigues, 1997) and cross-sectional (Crum, Anthony, Bassett, & Folstein, 1993; Fraser, Singh, & Bennett, 1996; Freidl et al., 1996; Launer, Dinkgreve, Jonker, Hooijer, & Lindeboom, 1993) studies suggest that associations of MMSE score with education reflect real associations with cognitive function, and no adjustment to the MMSE score is needed. However, studies across many ethnic populations and subpopulations have not been conducted to establish whether the ethnic associations are attributable to bias in the MMSE, are real, or are a combination of both.

A review of the current literature identified only one study where a comparison of the MMSE is available for Hispanics and non-Hispanic Whites (NHWs) concurrently from a population-based sample. The Epidemiologic Catchment Area Program (ECA) was a population-based study of psychiatric illnesses in persons aged 18 or older who lived in one of five United States communities. Interviews were administered in either Spanish or English. Two articles have been published about the MMSE which contrast Hispanics and NHWs from this sample, and these provide somewhat contradictory views of the differences that may exist between Hispanic and NHW persons (Escobar et al., 1986; George, Landerman, Blazer, & Anthony, 1991). Both defined severe cognitive impairment as scoring fewer than 18 points on the MMSE. Escobar and associates (1986) compared the MMSE in Hispanics and NHWs aged 18 years and older from the Los Angeles site. Although they found a significantly higher prevalence of severe cognitive impairment among Hispanics using all items, after removing ethnically biased items from the MMSE score, the Hispanic excess was eliminated. George and colleagues (1991) compared subjects from all five study sites, paying particu-
lar attention to subjects aged 55 and older. The Los Angeles site contributed 76% of the Hispanics in the whole ECA sample, and at least 63% of those aged 55 and older. The prevalence of severe cognitive impairment using all items was highest among Blacks, and approximately equal in Hispanics and NHWs among those aged 55 and older in education-stratified analyses. Multivariate statistical adjustment for confounders was not performed. Given this limited data, and the broad age range used by Escobar and associates (1986), further elaboration of this endpoint in a well defined and characterized biethnic, elderly population is warranted.

In this article, we describe the prevalence and distribution of cognitive impairment using the MMSE in Hispanic and NHW rural elderly adults in southern Colorado. To fully contrast these groups, the MMSE scores were analyzed continuously as a measure of cognitive functioning and categorically as a measure of severe and mild impairment. Additionally, modified MMSE scores were examined to investigate the possibility of an ethnic bias in this measurement.

METHODS

Population

The Study subjects were from the San Luis Valley Health and Aging study (SLVHAS), which was designed to understand the level of disability and functional limitation among elderly Hispanics and NHWs residing in a two-county rural region of southern Colorado. The San Luis Valley is comprised of five counties, with a combined land area the size of Connecticut. It is bordered by two mountain ranges, and it relies on agriculture and tourism as its major industries.

The Valley was settled in the 1800s by Hispanics who were descendants from Spanish settlers of the Americas, and by NHWs from the United States, who migrated into Colorado after the Louisiana Purchase. Many residents from both ethnic groups can trace their lineage to these early settlers. Our data from a different cohort in the San Luis Valley indicate that 98.1% were born in the United States (Hamman et al., 1989). Because of the long duration of residence in the Valley, this Hispanic population represents a subgroup distinct from other urban Hispanic and Latino populations (Devor, 1980; Lantis, 1950; Swadesh, 1974). They are, however, similar to other rural Hispanics who live in central southwestern states who identify themselves as “other Spanish or Hispanic,” and not as predominantly “Mexican American” or from another Latin national origin. In fact, 60.3% of Hispanics who live in the Valley report their ethnicity as “other Spanish or Hispanic,” and 39.5% report it as “Mexican American.” This is in contrast to the rate of Hispanics who report their identity as “Mexican American” in Colorado (59.8%) and in the United States (58.9%; Bean & Tienda, 1987).

Alamosa and Conejos counties were chosen to represent the five county area. All households were identified and enumerated between 1992 and 1993. The eligibility criteria were: (a) current residency in either county, (b) aged 60 years or older and, (c) Hispanic or NHW ethnicity. Six long-term care facilities in the five county region were also enumerated. Persons whose prior address was in the two county study area and who lived in one of these facilities were considered county residents.

Subjects were invited to participate based upon stratified sampling by age and ethnicity. The sampling percentages were as follows: Hispanics: 60–64 years, 48.8%; 65+, 100%; non-Hispanic Whites: 60–64 years, 36.6%; 65–79, 58.5%; 80+, 100%. Of the 2,067 persons who were invited, 310 became ineligible for several reasons: 171 died before the initial visit, 125 moved out of the study area, and 14 had an inaccurately recorded age or ethnicity. An additional 324 persons refused to participate, which resulted in a response rate of 81.6% and a sample size of 1,433.

Numbers of Participants

Of these 1,433 subjects, 48 were excluded because they had a proxy interview without the MMSE, 2 subjects were excluded due to a missing MMSE, and 23 were excluded because of missing education level (which we thought to be strongly related to the MMSE score). This left 1,360 persons for this analysis.

Data Collection

All protocols were approved by the University of Colorado Health Sciences Center Institutional Review Board, and informed consent was obtained from all subjects who participated. Bilingual interviewers administered the interviews in the subject’s language of preference, either in the community research clinic or the subject’s residence. Subjects first had a vision and hearing assessment, followed by the full (30 point) MMSE. The MMSE was scored as indicated by Folstein and colleagues (1975). Refusals and nonresponses to each MMSE item were considered errors.

Those who scored 18 points or above on the 30-point scale continued with the standard protocol (n = 1,195), whereas those who scored below 18 points or who could not complete the interview were administered an abbreviated protocol (n = 165). A proxy respondent was sought to answer additional selected questions.

The full protocol included a medical history, the Center for Epidemiological Studies Depression Scale (CES–D) (Radloff, 1977), an acculturation scale, and other measures. The medical history ascertained self-reported physician diagnoses of 17 major chronic diseases, including diabetes, cancer, high blood pressure, heart attack, stroke, transient ischemic attack, arthritis, migraine, depression, angina, Parkinson’s disease, emphysema, cirrhosis, kidney failure, osteoporosis, seizure disorder, and vascular surgery. The count of these chronic diseases was used as an adjustment variable. The acculturation scale measured self-identified frequency and proficiency of Spanish and English language, and orientation and identification with traditional Hispanic values. Subjects were also asked to bring any medications that they had taken during the previous month so that the names and dosages could be recorded. Some subjects did not have complete information regarding either the medical history, CES-D, or acculturation scale (n = 63).

Questionnaire Development

Our Spanish version of the MMSE was adapted from the Spanish version of the National Institute of Mental Health Diagnostic Interview Schedule (Karno, Burnam, Escobar, Hough, & Eaton, 1983). The exact wording of several questions was modified to account for the local dialect. The phrase to be repeated was changed to “Más vale tarde que nunca,” which means “Better late than never” instead of “No hay pero que valga”, the direct translation of “No ifs, ands, or buts” used by Karno. The remaining interview schedules were translated from English into Spanish by a local, bilingual, educated translator. They were subsequently translated back by bilingual staff members, and changes were
made to ensure that the meaning of the questions was the same for both versions. In most cases a direct translation was used; however, the interviewers often supplemented the questions with words from the alternative language (code switching). For example, when administering the question "¿Cuál es la estación del año?" ("What season of the year is it?"), the interviewers may have also said "Season" in English, as a probe. Because 47% of the participants regularly use both Spanish and English in their daily living, this method may have helped to reduce the barriers posed by the translation and cultural differences and was used throughout the entire interview.

Statistical Analysis
Exploratory data analysis was conducted to determine whether the MMSE differed between Hispanics and NHWs. Potential confounders that were examined included age, sex, and years of school. For those subjects who completed the full protocol, self-reported diagnosis of diabetes, number of medications, number of chronic diseases, acculturation, language use, and CES-D score were also examined as potential confounders and predictors of the MMSE score.

The association between the MMSE scores and covariates was calculated by linear regression model, using Statistical Analysis System (SAS) version 6.12 for Windows (SAS Institute, Cary, NC). The distribution of MMSE scores was normalized by taking the square root of the number of errors. Because the expectation of the MMSE scores was not linear, the following back-transformations were used (Jaquimn-Gadda et al., 1997):

\[
E[\text{MMSE}] = 30 - \{X\beta\} - \text{Var}(Y).
\]

\[
\text{Var}(\text{MMSE}) = 2\{\sigma^2\}^2 + 4\sigma^2(X)^2.
\]

The estimates of \(X\beta\) and \(\sigma^2\) were obtained from the estimate option of the GLM (General Linear Models) procedure.

We also calculated a reduced-item, 21 point MMSE scale, removing the 5 items found to be culturally biased by Escobar and colleagues (1986). The items removed were orientation to state (1 point), season (1 point), county (1 point), repetition of a phrase (1 point), and either spelling backwards or calculation (5 points). Individuals were categorized as having normal (21–24), mild (17–20), and severe impairment (12–0) based on this 21-point scale.

Individuals were also put into three categories as defined by traditional cutpoints for the 30-point MMSE scale: normal (24–30), mild (21–23), and severe impairment (17–0). For further exploration, unconditional logistic regression was used to adjust for confounders using both the 30- and 21-point scales. Two models were examined for each scale: mildly impaired versus not impaired, and severely impaired versus not impaired. We investigated all potential covariates identified from the linear regression analysis. Covariates which were not statistically significant or confounders (change in Beta coefficient by 10%) were eliminated. Odds ratios and 95% confidence intervals were calculated to determine the ethnic contrast for mild and severe cognitive impairment.

RESULTS
A description of the analysis sample (\(N=1360\)) is presented in Table 1. This consisted of 1,304 community-dwelling and 56 long-term care residents. Hispanic persons were significantly younger, had fewer years of education, had a lower income, and were less likely to reside in a long-term care facility than NHW persons. Hispanic and NHW persons were similar with respect to gender and limitation in any activity of daily living. The education level differences can also be expressed by age-adjusted mean years completed, which were 8.36 years among Hispanics and 12.25 among NHWs (\(T = 21.1, p < .0001\)).

The distribution of MMSE scores in Hispanics and NHWs is presented in Figure 1, which shows that it is not distributed normally. This is particularly evident in the NHW persons, where 41% scored either 29 or 30 points. This distribution is in contrast to that of the Hispanic persons, where the mode was 26 points. The median score for NHWs was significantly higher than the median score for Hispanic persons (NHW: 28; H: 24; Wilcoxon Rank Sums \(p = .0001\)).

Quantitative Analysis
Linear regression was performed on the transformed MMSE score to determine whether an ethnic difference existed after adjusting for the covariates. A lower mean MMSE score was observed in Hispanic persons compared with NHW persons after adjusting for age, years of education, and gender. Interactions between ethnicity and the significant covariates were also examined. Statistically significant interactions between ethnicity and gender, and ethnicity and age were found.

### Table 1. Description of Study Population (\(N=1360\)) The San Luis Valley Health and Aging Study 1993–1995

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Non-Hispanic White ((n=591))</th>
<th>Hispanic ((n=769))</th>
<th>Chi-Square p value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gender</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>41.3</td>
<td>42.3</td>
<td>0.72</td>
</tr>
<tr>
<td>Female</td>
<td>58.7</td>
<td>57.7</td>
<td></td>
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<tr>
<td><strong>Age group</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>60–64</td>
<td>12.7</td>
<td>10.7</td>
<td>(&lt; .0001)</td>
</tr>
<tr>
<td>65–69</td>
<td>20.5</td>
<td>25.6</td>
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</tr>
<tr>
<td>70–74</td>
<td>21.0</td>
<td>23.0</td>
<td></td>
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<tr>
<td>75–79</td>
<td>15.4</td>
<td>19.4</td>
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<tr>
<td>80–84</td>
<td>16.6</td>
<td>11.7</td>
<td></td>
</tr>
<tr>
<td>85–99</td>
<td>13.9</td>
<td>9.4</td>
<td></td>
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<tr>
<td><strong>Education</strong></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>0–4 years</td>
<td>0.8</td>
<td>16.5</td>
<td>(&lt; .0001)</td>
</tr>
<tr>
<td>5–8 years</td>
<td>12.9</td>
<td>40.7</td>
<td></td>
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<tr>
<td>9–12 years</td>
<td>49.4</td>
<td>33.2</td>
<td></td>
</tr>
<tr>
<td>13+ years</td>
<td>36.9</td>
<td>9.6</td>
<td></td>
</tr>
<tr>
<td><strong>Income</strong></td>
<td></td>
<td></td>
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<tr>
<td>(&lt; $10,000)</td>
<td>32.3</td>
<td>56.9</td>
<td>(&lt; .001)</td>
</tr>
<tr>
<td>($10,000–$24,999)</td>
<td>40.0</td>
<td>36.9</td>
<td></td>
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<tr>
<td>($25,000 +)</td>
<td>27.7</td>
<td>6.2</td>
<td></td>
</tr>
<tr>
<td><strong>Activities of Daily Living</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No difficulty</td>
<td>66.4</td>
<td>66.6</td>
<td>0.93</td>
</tr>
<tr>
<td>Difficulty on 1+</td>
<td>15.8</td>
<td>15.2</td>
<td></td>
</tr>
<tr>
<td>Needs assist. 1+</td>
<td>17.2</td>
<td>18.2</td>
<td></td>
</tr>
<tr>
<td><strong>Residence</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Home</td>
<td>93.9</td>
<td>97.4</td>
<td>(&lt; .0001)</td>
</tr>
<tr>
<td>Long Term Care Facility</td>
<td>6.1</td>
<td>2.6</td>
<td></td>
</tr>
</tbody>
</table>
Although a three-way interaction between ethnicity, gender, and age was not tested, it appears as if NHW women are driving the ethnicity by gender interaction. These interactions remained after adjustment for education. The final predictive model is presented in Table 2 (Model 1), and a plot of the estimated MMSE scores for subjects in gender and ethnicity subgroups between the ages of 60 and 95 is in Figure 2. In this sample, NHW women scored approximately one to two points higher than men or Hispanics, and Hispanics of both genders had the lowest score over nearly all ages. Interestingly, the scores of NHW men overlapped with those of Hispanic men and women at older ages.

Additional potential confounders to Model 1 were also examined in the subjects who had complete information (n=1,297, Model 2, Table 2). Acculturation, number of medications, language preference, and CES-D were associated with MMSE scores univariately. Because acculturation and language preference, and number of medications and CES-D were correlated, both could not be entered into the same regression model. Number of medications and language preference each explained more variance than their counterpart measure and were used to fully adjust the analysis. These attributes were independent predictors of MMSE score such that they were lower among those with increasing medication use and among persons who preferred to speak Spanish. The MMSE was not associated with the number of chronic diseases (excluding diabetes) or presence of diabetes.

Severe, Mild, and No Cognitive Impairment
When the 30-point MMSE scores were categorized to stratify subjects as having severe, mild, or no impairment, a modest proportion of the population had severe impairment. The prevalence of severe cognitive impairment was 8.6% (95% CI: 6.5–11.2%) in NHWs and 18.3% (95% CI: 15.7–21.3%) in Hispanics. Table 3 presents the prevalence of severe cognitive impairment in Hispanics and NHWs by education and age strata. Two distinct patterns can be seen in these results. First,
The prevalence estimates of severe cognitive impairment were higher among Hispanics than NHWs, among subjects with 0–8 and 9–12 years of schooling. The prevalence estimate in those with 13 or more years of school was unstable and very low. Second, prevalence estimates were generally higher among the poorly educated when compared with those more educated in both ethnic groups.

To determine whether the prevalence estimates were different after accounting for the confounding effects of age and education, logistic regression was used. Table 4 presents the unadjusted and adjusted ORs for mild and severe cognitive impairment in both ethnic groups on the 30- and 21-point scale. In the unadjusted analysis of the 30-point MMSE scale among the whole sample (n=1,360), Hispanic persons were more likely to have mild (OR=4.65, 95%; CI, 3.4–6.3) and severe (OR=3.50, 95%; CI, 1.5–4.6) cognitive impairment than NHW persons. After adjustment for education, the same interaction between ethnicity and age was found as in the linear regression model; however, the ethnicity by gender interaction and gender effect were not statistically significant and are not shown (Model 1). The Hispanic excess of cognitive impairment was highest among the young, and decreased at older ages, a similar pattern to that shown in Figure 2. When the additional covariates were added and persons with missing data were removed (Model 2), the Hispanic excess was larger with the same age-related pattern.

Logistic regression analyses of the categories from the 21-point MMSE scale are also presented in Table 4. The crude OR of Hispanic excess of mild (OR=3.01, 95%; CI, 2.3–4.0) and severe (OR=2.44, 95%; CI, 1.7–3.5) impairment was diminished compared with the 30-point scale. Further adjustment for education, gender, and age (Model 1) also decreased the Hispanic excess; however, it was still statistically significant (ORMild=2.08, 95%; CI, 1.5–3.0; ORSevere=1.69, 95%; CI, 1.0–2.9). The adjustment for additional covariates (Model 2) reduced the OR such that the ethnic OR was close to one, and not statistically significant. This change in ORs appeared to be attributable to the additional adjustment for language and medication use because the ORs for mild and severe impairment were similar to those obtained in Model 1, when only subjects who completed the full protocol were included (n=1,297) and those covariates were not included.

### DISCUSSION

These results demonstrate that when using the conventional scoring of all items in the MMSE, Hispanic persons score lower than NHW persons when examined both as a continuous and categorical outcome. This study also confirms the work of others, showing that individuals at older ages or with less education, tend to have lower MMSE scores when compared with those who are younger or more educated. (Crum et al., 1993; Escobar et al., 1986; Freidl et al., 1996; George et al., 1991; Jacqmin-Gadda et al., 1997; Zhang et al., 1990). We detected an interaction between ethnicity and age, indicating that the Hispanic performance on the MMSE was worse than that of NHWs among younger subjects, and was similar among the oldest of our subjects. Given the persistent concern that the MMSE is ethnically biased, we attempted to examine the ethnic differences after accounting for this. The increased prevalence of cognitive impairment among Hispanics was eliminated when the unbiased MMSE score (Escobar et al., 1986) was fully adjusted for all covariates.

The age and education strata prevalence estimates of severe cognitive impairment (Table 3) as defined by the MMSE are interesting because they display the effects of age and education seen in other populations. The mean MMSE among older Colombians display the same decline in MMSE scores with advanced age and fewer years of schooling as our data (Ardila, Roselli, & Puente, 1994). They are also similar to those obtained...
in other Hispanic populations that did not use the MMSE (Alonso Serra, Conde, De Andino, & Mendoza, 1995; Lopez-Aqueres, Kemp, Plopper, Staples, & Brummel-Smith, 1984). In Alonso's study of Puerto Ricans aged 60 years and older, the prevalence of cognitive impairment as defined by the Short Portable Mental Status Questionnaire (SPMSQ, Pfeiffer, 1975) was 9.5% in ages 60–69, 17.1% ages 70–79, and 40.5% in those aged 80 and older. The mean age of their population was 72 years, and 80.6% had 6 years or less of education. Lopez-Aqueres conducted a population-based study of Hispanic elderly who lived in Los Angeles to determine the prevalence of cognitive impairment. As measured by CARE (Gurland et al., 1977–1978) the prevalence was 10% in ages 60–64, 10.7% in ages 65–69, 8.6% in ages 70–74, and 26.3% in ages 75 years and older. Prevalence estimates from Alonso, Lopez-Aqueres, and us are much higher than those in the full ECA study (George et al., 1991), where the MMSE was used. The prevalence of severe cognitive impairment among persons aged 74–84 years in the ECA study was 6.28% in those with less than 9 years of education, 1.58% in those with 9–11 years of education, and 0.41% in those with more than 12 years of education. The other age-specific prevalence estimates were also comparably lower in their ECA sample, despite the fact that institutionalized persons were also sampled in the ECA study. These prevalence estimates were for all racial groups combined, although prevalence estimates among Blacks were statistically higher than those of Hispanics and NHWs.

Given that Alzheimer's disease (AD) is a common form of dementia, it is expected that the prevalence of severe cognitive impairment is at least as prevalent as AD. To assess the accuracy of some screening questionnaires, such as the MMSE and SPMSQ, examining the prevalence of AD may prove fruitful. The only estimates of AD among Hispanic persons come from Cuban Americans who live in Dade County, Florida (Prineas et al., 1995). Prineas and colleagues measured the male and female prevalence of AD at 4.2% and 4.6% among those aged 65–74 years, 8.3% and 17.1% among those aged 75–84 years, and 32.0% and 24.6% among those aged 85 years and older. These prevalence estimates were similar to those from Black and NHW persons living in the same community. The rate of AD has also been examined in the Framingham study population (Bachman et al., 1992), Shanghai, China (Zhang et al., 1990), East Boston (Evans et al., 1989), and Stockholm, Sweden (Fratiglioni et al., 1991). The prevalence of AD in these populations ranged from 0.5%–4.6% in persons aged 65–74, 3.4%–18.7% in persons aged 75–84, and 11.8%–47.2% in persons aged 85 and older. Estimates from East Boston tended to be the highest, whereas those from Sweden were the lowest. Our prevalence estimates for severe cognitive impairment are within these ranges, as expected, though the wide ranges would encompass many estimates.

We were unable to demonstrate that lower MMSE scores occur more frequently among subjects with self-reported diabetes. This finding is in contrast to a summary of the literature which suggests that non-insulin-dependent diabetes is associated with risk of cognitive dysfunction (Strachan, Deary, Ewing, & Frier, 1997). Although our measure of diabetes was not determined by a current diagnostic blood glucose test, a considerable portion of our population (50%) has had an oral glucose tolerance test administered by the staff at previous visits and was aware of their diabetes status.

The finding that young, elderly Hispanics have more cognitive impairment than NHWs has not been described in any other population and appears to be robust because the results were consistent using both continuous and categorical methods. The interpretation of this interaction is not obvious. One possibility is that young NHWs with cognitive impairment are more likely to have died or moved out of the study area than young Hispanics with cognitive impairment. Alternatively, this may have arisen from a higher participation rate among young, cognitively impaired Hispanic persons compared with similarly aged NHW persons. Review of our data does not support these scenarios. The interaction may be attributable to an earlier age of onset of cognitive impairment among Hispanic persons compared with NHWs. Although we cannot examine this issue now, we hope to after reassessing this population.

The interaction between ethnicity and age and main ethnic effect was not significantly statistically associated with cognitive impairment when the 21-point MMSE scale was used after covariate adjustment. This suggests that the young Hispanic excess of cognitive impairment was attributable to the items which Escobar and colleagues (1986) identified as being ethnically biased. Although replication of this result seems to strengthen the hypothesis that the 30-point MMSE questionnaire is ethnically biased, two concerns should be addressed. First, because the two study populations were different in age, residence, and culture, their definition of "ethnic bias" may not apply to our population. Additionally, the method to determine ethnically biased items was not based on a gold standard of cognitive impairment. Bias can only be identified when the MMSE is compared to a neurological assessment. Since neither our work nor that of Escobar (1986) used a gold standard, neither should be used to determine whether the MMSE is ethnically biased. Several other studies have performed the analyses necessary to detect bias and evaluate the validity of the Spanish MMSE.

Three methods have been used to compare the MMSE with standardized dementia diagnoses among Spanish-speaking subjects. These include: (a) comparison of Spanish- and English-speaking subjects, (b) validity analysis of the Spanish MMSE, and (c) prediction of dementia by MMSE items. Two groups have evaluated the MMSE scores of Spanish- and English-speaking persons to look for differences attributable to cultural bias. Loewenstein, Arguelles, Barker, and Duara (1993) found no mean difference in MMSE scores between Spanish- and English-speaking AD patients matched for memory impairment. They did, however, identify a cultural bias in three of the other eight neuropsychological tests that were administered. Lopez and Taussig (1991) also found no difference in MMSE score between English- and Spanish-speaking AD patients, as well as nonimpaired subjects. However, they found a difference in the Spanish and English versions of the Wechsler Adult Intelligence Scale. In addition, Taussig, Henderson, and Mack (1992) demonstrated that Spanish- and English-speaking subjects performed equally well on several of their respective neuropsychological questionnaires, including the MMSE. Later, they also showed the MMSE to have concurrent validity with three other neuropsychological questionnaires (Taussig, Mack, & Henderson, 1996).

Further support of the validity of the Spanish MMSE comes from sensitivity and specificity analyses. These measures were good among a Puerto Rican population (Canino et al., 1987), a predominantly Cuban, Spanish-speaking population from Florida (Loewenstein, Duara, Arguelles, & Arguelles, 1995), a popula-
tion from Leganes, Spain (Del-Ser, Morales, Barquero, Canton, & Bermejo, 1997), and a population from Madrid, Spain (Morales, Bermejo, Romero, & Del-Ser, 1997). In a different sample of subjects from Madrid, the MMSE had lower sensitivity, but comparable specificity and accuracy to the earlier study (Morales, Gonzalez-Montalvo, Bermejo, & Del-Ser, 1995).

Methods that identify the MMSE items associated with incident dementia can also indicate the usefulness of the MMSE. Through the use of discriminant analysis, Klein and colleagues (1985) showed that serial 7s or spelling of world backwards was one of five items that discriminated between demented and normal subjects. Likewise, Braekhus, Laake, and Engedal (1995) found that subjects who could not spell world backwards at baseline had three times the rate of dementia of those that could. Although both of those studies were done on NHWs, it is interesting that some of the items Escobar (1986) found to be ethnically biased were important in predicting future dementia.

One study has found similar results to Escobar (1986) among Hispanic, African American, and NHW elders from New York. Using Item-Response theory, Teresi and colleagues (1995) demonstrated that serial 7s, repetition of “no ifs, ands, or buts,” closing eyes, and sentence writing were educationally and ethnically biased. Orientation to state was also ethnically biased. This method did not specify the ethnic group that the MMSE was biased against; however, it accounted for presence of dementia.

In summary, the studies that compared the MMSE and a standardized dementia evaluation consistently found the MMSE to be a valid measure of cognitive functioning among English- and Spanish-speaking subjects. This is in contrast to studies of other neuropsychological assessments. Although bias may explain the lower MMSE scores in Hispanics, the literature suggests that the MMSE is not biased. Thus, the cross-sectional differences in MMSE scores appear to be real, despite replication of the Escobar (1986) findings.

The present article and brief literature review highlight the need to make a valid MMSE specifically designed for the variety of United States’ Hispanic populations, yet comparable to the English version. This would require a large sample of representative Hispanic persons with diagnosed dementia and a similar group of non-demented individuals. Only after this vital step is completed can cross-ethnic comparisons of cognitive function be conducted in large groups of research subjects. Our data indicate that an excess prevalence of cognitive impairment may exist in elder Hispanic compared with NHW persons and may be particularly pronounced in 60- and 70-year-old Hispanic persons. That this result can be due to bias can be neither concluded nor dismissed. We expect that the analysis of our two-year incidence data will demonstrate the changes in cognitive functioning that occur among Hispanic and NHW persons and may clarify whether Hispanic persons are more or as likely as NHWs to become cognitively impaired.

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