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Neuropsychological and Neuropsychiatric Prediction of Global Cognitive Status Among Older Spanish-Speaking Hispanics and English-Speaking Whites

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Abstract

Background—Neuropsychological and depression measures have been found to predict cognitive functioning. We compared these associations among whites and Spanish-speaking Hispanics.

Methods—Fifty-two pairs of whites and Hispanics were matched demographically and clinically in a cross-sectional study. Hierarchical regression analyses predicted Global Deterioration Scale (GDS) rating by baseline neuropsychological tests and depression symptoms.

Results—Neuropsychological tests predicted GDS better in whites; depression symptoms—specifically retardation—predicted well in Hispanics but not whites. Immediate recall of the New York University (NYU)-Paragraph Test and the Retardation item of the Hamilton Depression Rating Scale were associated with GDS in Hispanics and delayed recall of the NYU-Paragraph Test and Wechsler Adult Intelligence Scale-Digit Symbol in whites. Neuropsychological tests and depression symptoms predicted GDS differently in Hispanics and whites.

Discussion—These results suggest that other measures should be considered to increase the predictive accuracy of neuropsychological tests when assessing cognitive status in Spanish-speaking Hispanics. Additional studies of specific ethnic/racial and sociodemographic subgroups are warranted.

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Declaration of Conflicting Interests

The author(s) declared the following potential conflicts of interest with respect to the research, authorship, and/or publication of this article: Dr. Barry Reisberg is the developer and copyright holder of the Global Deterioration Scale which was used in this study.

Keywords

neuropsychology; neuropsychiatric symptoms; depression; cognitive status; dementia; Hispanic elderly

Introduction

The elderly population, especially those aged 65 years and older, is projected to increase in the next 4 decades, and ethnic/racial minority groups are expected to increase more than white Americans.¹ In 2010, whites represented 80% of the US population older than 65 years of age, but this number is projected to decrease to 59% in 2050. However, the percentage of the Hispanic elderly population in the United States is projected to increase from 7% to 20%.² This increase is significant, especially in the context of a higher prevalence and incidence rate of dementia among Hispanic elderly population compared with non-Hispanic whites.^{3,4} For the 65 to 74, 75 to 84, and 85 age-groups, the reported prevalence of dementia, including Alzheimer disease (AD), was 7.5%, 27.9%, and 62.9% for Hispanics and 2.9%, 10.9%, and 30.2% for whites.³ However, after age and education were controlled, differences in rate of dementia disappeared. Compared to white elderly population, Hispanic elderly population are more likely to be diagnosed with dementia at more advanced stages of the disease,⁵ which may deprive them of useful early pharmacologic and nonpharmacologic interventions. Identification of at-risk Hispanic elderly population represents a challenge in both clinical and research settings due to cultural barriers such as language, low educational attainment, and low income^{5,6} as well as a negative attitude about participation in research. Fitten and colleagues reported that 22% of Hispanic elderly patients with dementia were symptomatic for 5 years before receiving a diagnosis, and lower acculturation level and lower income were among the factors that influenced this delayed diagnosis.

Neuropsychological Testing

Neuropsychological tests are widely used in dementia research because of their correlation with global measures of cognitive status and their ability to predict future intellectual decline. For example, tasks of speed/attention, memory and learning, visuospatial function, language, and executive function differentiate persons with mild cognitive impairment (MCI) from normal controls⁷; poor performance on tests of episodic memory (eg, delayed recall) and language (eg, verbal fluency) is useful for identifying early AD⁸; and tasks of delayed verbal recall predict future decline to AD.⁹⁻¹²

Although specific neuropsychological tests are generally useful in detecting cognitive function/decline, some tests are more reliable predictors among white elderly population than among Hispanic elderly population.¹³⁻¹⁶ It is important to find accurate measures of cognitive functioning that are not affected (or are only minimally affected) by the individual's overall intellectual ability and sociodemographic characteristics. For instance, the Digit Symbol subtest of the Wechsler Adult Intelligence Scale (WAIS), a test of psychomotor and executive functioning, is relatively independent of memory and overall intellectual ability,¹⁷ and it appears to be sensitive to cognitive changes related to AD.

However, it is noteworthy that performance on this task may rely on intact attentional function that has been recognized as one of the earliest changes observed in AD.¹⁸ The WAIS-Digit Symbol effectively differentiates individuals with normal cognitive function from those with MCI and from those with early AD.¹⁹ Among patients with mild AD, this same test was important in distinguishing those who progressed to moderate or severe AD from those whose dementia remained unchanged²⁰; and it was useful in differentiating decliners from nondecliners to dementia or AD.^{11,21}

Depressive Symptoms

The evaluation of neuropsychiatric symptoms (eg, depression) as predictors of cognitive status/dementia is inexpensive, brief, and probably less dependent than neuropsychological tests on the intellectual level or educational experience of the individual. Neuropsychiatric symptoms have been found to be associated with a higher prevalence of dementia, higher rate of progression to dementia at follow-up, more deficits in neuropsychological functioning,^{22,23} and more AD neuropathology.²⁴ Depression and apathy/lack of motivation have been found to be the most frequent neuropsychiatric symptoms in MCI and dementia,²⁵ and their predictive accuracy in identifying individuals with AD at risk of greater cognitive decline has also been evaluated.²⁶ Other studies provide support for an association between depressive symptoms and dementia/cognitive decline.²⁷⁻³¹ Specific depression symptoms such as the mood item from the Hamilton Depression Rating Scale (HDRS)³² and the motivation-related depressive symptoms (lack of interest, psychomotor change, loss of energy, and concentration difficulties) are associated with cognitive decline.^{31,33} However, others have found either negative results³⁴ or an association that interacts with other factors such as gender,³⁵ educational attainment,³⁶ age of depression onset,³⁷ and preexisting cognitive deficits.³⁸ Taken together, these studies suggest that depression symptoms may be valid predictors for at least some specific groups.

Little is known about depression symptoms as predictors of cognitive function/decline among Hispanic elderly population. One study examined the association between depression and cognitive decline as measured by change in Mini-Mental State Examination (MMSE)³⁹ score over 7 years in Mexican Americans.⁴⁰ Findings revealed that participants with clinically relevant depressive symptoms had greater decline than those without clinically relevant depressive symptoms, after adjusting for demographics, activities of daily living (ADLs), and medical conditions. Inconsistent with this finding, a more recent longitudinal study examining the relationships between cognitive functioning and depression over 3 years among Hispanics (mainly Cubans) found that depressive symptoms did not predict cognitive decline but poorer cognitive functioning predicted higher depressive symptoms.⁴¹ Differences in methodology may explain the discrepancy in the findings from studies of Perrino et al and Raji et al, including the sample sizes, cognitive tests, cultural backgrounds, and acculturation levels of the Hispanic participants.

The current study adds to the existing literature by examining the accuracy of both validated neuropsychological tests and depressive symptoms for predicting global cognitive status among relatively highly educated Hispanic elderly population with diverse levels of cognitive functioning and including a comparison white elderly group. This research

examines (1) the validity of 7 neuropsychological tests for prediction of cognitive status in Spanish-speaking Hispanic elderly population, (2) whether depression symptoms predict global cognitive status beyond the 7 neuropsychological tests, and (3) whether neuropsychological tests and depression symptoms predict global cognitive status differently for English-speaking white and Spanish-speaking Hispanic groups.

Methods

Participants

Participants were community-dwelling elderly individuals from a longitudinal database (N = 4334) of the New York University Alzheimer's Disease Center (NYU-ADC). Participants were interviewed and tested in their language of preference (Spanish or English). The demographic characteristics of all participants comprising the entire database were as follows: they were predominately white (86.8%) and female (63.3%), with a mean age of 68.41 years (standard deviation [SD] = 13.87), and formal educational level of 14.61 years (SD = 4.60). They signed an institutional review board-approved consent form and received comprehensive medical, psychiatric, neurologic, laboratory, and neuroimaging (computed tomographic or magnetic imaging) evaluations at baseline. The exclusionary criteria were stroke; movement and motor system disorders; malignancy; significant cardiovascular, rheumatologic, endocrinologic, hematologic, pulmonary, gastrointestinal, or psychiatric illness (including major depression); and a history of alcohol or drug abuse.

All participants received diagnoses that were determined at a clinical consensus meeting. The diagnosis of AD was based on well-established diagnostic and research criteria, that is, the Diagnostic and Statistical Manual of Mental Disorders (Fourth Edition)⁴² and the National Institute of Neurological and Communicative Disorders and Stroke/ Alzheimer's Disease and Related Disorders⁴³ criteria. The normal (NL) diagnosis was based on the Global Deterioration Scale (GDS) rating (GDS = 1-2),⁴⁴ on normal performance on cognitive tests and on normal medical data. The criteria for the diagnosis of MCI were memory complaint as reported by the patient/informant; GDS rating = 3; mild cognitive deficits (especially memory); intact general cognitive function; normal ADLs; and absence of dementia.⁴⁵ The MCI and AD (GDS > 3) diagnoses imply a presumption of underlying AD pathology.

For all cases, the baseline visit was the participant's first visit to the NYU-ADC and baseline data were exclusively used for the current analyses. Two ethnic groups were selected for inclusion in this study, called "Hispanics" and "whites." Participants were included in the Hispanic group if they self-identified themselves as Hispanic, and their primary language was either Spanish or English. One Hispanic participant was included who was born in Guatemala and reported Spanish as primary language but did not report any information regarding ethnicity or race. Participants were eligible for the white group if they identified themselves as white, but not as Hispanic, and their primary language was English.

Additional inclusion criteria were normal to moderately impaired cognitive functioning (GDS rating 1-5), MMSE score of 10 or more, age of 50 years or more. Since there were many more whites (n = 2044) than Hispanics (n = 174 participants, including Spanish- and

English-speaking Hispanic), for each Hispanic participant, we sought to match for inclusion a white participant with complete cognitive and depression data, who was clinically and demographically similar to the Hispanic participant.

Matching criteria were the same values for GDS stage, gender, and clinical diagnosis (NL, MCI, or AD). Additional matching criteria were similarity of age (within 5 years, but typically within 2 years) and education (within 3 years, but always within 2 years).

The matched sample consisted of 105 pairs of Hispanic and white participants. There were complete neuropsychological and depression data for 82 pairs. Of these, we selected all 52 pairs for this study for which the primary language of the Hispanic participants was Spanish. The rationale for including only Spanish-speaking Hispanics was the literature that suggests that Spanish-speaking Hispanics perform more poorly than English-speaking Hispanics on neuropsychological tests, indicating their relevance.¹⁵ The flowchart (Figure 1) summarizes the selection process.

Table 1 describes the country of origin and race of the samples. Table 2 describes both Hispanics and whites on perfectly matched variables. Although the samples were approximately matched on age and education, matched sample *t*-tests were used to assess differences in age and education. The results of these tests are presented in Table 3. The Hispanics were younger ($P = .021$) and less educated ($P < .0005$) than their matched whites. Multiple correlations of the differences between the matched participants in age and education with the 10 neuropsychological and depression differences were not significant, (age: $F_{10,41} = 1.521$, $P = .167$; education: $F_{10,41} = .662$, $P = .752$). None of the correlations of any neuropsychological or depression differences with age or education differences were significant by the Holm criterion (see subsequently). Therefore, these differences in age and education were not used as additional control variables in the statistical analyses.

Predicted Global Status Measure

The measure predicted by the neuropsychological tests and depression symptoms in the regression analyses was the GDS, a 7-point scale that assesses global cognitive and functional status based on well-defined criteria. Individuals with a GDS rating of 1 and 2 are functionally and cognitively unimpaired; however, those with a GDS rating of 2 present with subjective memory complaints that are not objectively supported by their performance on neuropsychological tests. Individuals with a GDS rating of 3 present with subjective memory complaints that are corroborated by mildly impaired performance on cognitive tests. These elders comprise those with MCI. Finally, individuals with a GDS rating of 4 or higher have sufficient cognitive and functional deficits to receive a diagnosis of dementia, with higher scores indicating greater levels of dementia impairment (GDS = 4, mild; GDS = 5, moderate; GDS = 6, moderately severe; and GDS = 7, severe). The GDS has demonstrated to correlate with neuropsychological and neuroimaging assessments, and the progression from normal brain aging/normal aging to the MCI and dementia stages of AD.^{46,47} The GDS score was rated independent of the neuropsychological data, and clinicians assigning the GDS rating were blind to the neuropsychological test results.

Neuropsychological and Depression Predictors

There were 7 neuropsychological test scores derived from 5 neuropsychological instruments. Three of these tests were included because of their consistent sensitivity in their prediction of cognitive status/decline in the general population: immediate and delayed recall scores of the Paragraph Recall subtest (also known as the NYU-Paragraph Test) of the Guild Memory Test^{11,48,49} and the Digit Symbol Substitution Subtest of the WAIS.⁵⁰ Four additional neuropsychological tests were immediate and delayed scores from the Paired Associates subtest of the Guild Memory Test, the Memory for Designs subtest of the Guild Memory Test, and the WAIS Vocabulary subtest. These 7 neuropsychological tests have been previously described.^{46,51} Spanish language translations for all 7 neuropsychological tests were used. To our knowledge, for Spanish-speaking Hispanics, normative data and psychometric properties are available only for the WAIS subtests.⁵²⁻⁵⁴

Depression symptoms were assessed by the total score of the 21-item HDRS and 2 of its items, Work and Activities, and Retardation. These 2 items were selected a priori as predictors to represent motivation-related/apathy symptoms that have been associated with the onset of AD in whites³³ and greater cognitive decline in Hispanics with AD.²⁶ An alternative 19-item sum (HDRS-19), excluding these 2 items, was used in a parallel analysis for comparison.

Hamilton Depression Rating Scale.—The 21-item version of the HDRS is a clinician-administered depression inventory with item scores ranging from 0 to 2 through 0 to 4. The advantages of the HDRS include its administration by an interviewer rather than a self-administered questionnaire and validity when used with patients with moderate dementia.⁵⁵ Successful administration of the HDRS relies on the prowess and sensitivity of the interviewer who asks culturally relevant questions corresponding to the questionnaire item. Although the HDRS has been used with the Hispanic population,^{56,57} to our knowledge, its psychometric properties have not been evaluated with this population.

Overall, the selection of the GDS as the predicted criterion measure and the selection of the neuropsychological tests and the HDRS as predictors were dictated by both theoretical and practical reasons: (1) they have been found to be sensitive to the prediction of dementia^{11,19,21,31,46,47}; (2) the neuropsychological tests cover different cognitive domains (eg, memory, language, and attention/psychomotor functioning); and (3) most participants had complete data on all these variables.

Analytic Methods

Hierarchical regression analyses were performed, with the GDS rating (treated as a continuous variable) as the dependent variable, separately for the white and Spanish-speaking Hispanic groups. The regression analysis entered 3 sets of predictors: demographics (age, gender, and years of education), 7 neuropsychological tests, and the HDRS-total score and 2 items. Each neuropsychological test was evaluated controlling for demographics and then also for the other neuropsychological tests to examine its contribution to the dependent variable (GDS) beyond the other tests. Each depression predictor was evaluated controlling for demographics, then also controlling for the

neuropsychological tests to assess its contribution beyond the neuropsychological tests. Finally, each depression predictor was evaluated also controlling for the other depression predictors to assess its contribution beyond the neuropsychological tests and the other depression predictors. To compare partial correlations in different samples, Fisher z transformation was employed.

To assess whether neuropsychological tests and depression symptoms predict global cognitive status differently among matched white and Spanish-speaking groups, both groups were included in a single hierarchical regression analysis predicting GDS. For this analysis, the difference between whites and Spanish-speaking Hispanics in the prediction of global cognitive status using each neuropsychological or depression predictor was represented by an interaction. Each interaction was calculated as the product of the predictor and the dichotomous variable distinguishing the groups. Hierarchical regression analysis entered the following sets of predictors: the difference between groups; the 3 demographic variables (age, gender, and education); their interactions with the difference between groups; the 7 neuropsychological and the 3 depression predictors; and their interactions with the difference between groups. The groups were perfectly matched on GDS and gender, and—using the average of the pair—on the demographic control variables, age and education. If the groups had not been matched, the analysis would unquestionably have controlled for demographic variables (group, age, gender, and education). Due to matching, the first and third steps of the regression analysis did not account for any variation. Nonetheless, these steps were included in the analysis to remove from the model the degrees of freedom referring to the variables on which there was exact matching. A subsidiary analysis entered the 7 interactions for neuropsychological predictors, followed by the 3 interactions for the depression predictors.

Multiple tests of significance—Results with $P < .05$ are called “significant.” The Holm procedure,⁵⁸ a more powerful variation of the Bonferroni procedure, was used to provide a more conservative criterion that adjusts for k -tests. After the test of each result, if it is not significant, testing stops. The criterion for the most significant result is $.05/k$, which is prescribed by the Bonferroni inequality for all tests. If it is significant, the criterion for the next most significant result is $.05/(k - 1)$. This is repeated until the criterion for the least significant result is $.05/[k - (k - 1)] = .05/1 = .05$.

The evaluation of (1) the validity of 7 neuropsychological tests in Spanish-speaking Hispanic elderly population has $k = 7$; (2) whether depression symptoms predict global cognitive status beyond the 7 neuropsychological tests has $k = 3$. The parallel analyses for whites have the same k values; and (3) whether the combined neuropsychological tests and depression symptoms differentially predict global cognitive status for English-speaking white and Spanish-speaking Hispanic groups does not have multiple tests of significance.

Results

Prediction of Cognitive Status by Baseline Neuropsychological Test Performance

Hierarchical regression analysis showed that good performance (high scores) on most of the 7 neuropsychological tests separately predicted good global cognitive status (low GDS

rating) among Hispanics, after controlling only for age, education, and gender. All were significant by the Holm criteria (separate partial $r = -.384$ to $-.536$; $P = .006$ to $< .0005$), except for WAIS-Vocabulary, which was only significant (partial $r = -.311$, $P = .030$), and the immediate recall of the Paired Associates subtest, which approached significance (partial $r = -.270$, $P = .061$). The 7 neuropsychological tests collectively explained 38.6% of the residual variance after controlling for demographics ($F_{7,41} = 3.683$, $P = .004$). In contrast, predictions for all 7 neuropsychological tests were stronger for whites (separate partial $r = -.565$ to $-.797$, $P < .0005$), collectively explaining 75.8% of the residual variance ($F_{7,41} = 18.238$, $P < .0005$).

For Hispanics, when additionally controlling each neuropsychological test for the others, the only significant predictor was the immediate recall of the NYU-Paragraph Test (partial $r = -.367$, $P = .016$; Table 4). In contrast, the delayed recall of the NYU-Paragraph Test (partial $r = -.539$, $P < .0005$) and delayed recall WAIS-Digit Symbol (partial $r = -.490$, $P < .001$) were significant predictors of cognitive status for whites by the Holm criteria.

Comparisons using Fisher z transformation between the 2 ethnic groups of partial correlations, controlling for demographics and for the other neuropsychological tests, showed a difference for the delayed recall of the NYU-Paragraph Test, significant by the Holm criterion ($P = .001$), and a difference approaching significance for the immediate recall of the NYU-Paragraph ($P = .096$) and WAIS-Digit Symbol ($P = .089$).

Prediction of Global Cognitive Status by Baseline Depression Symptoms

More depression (higher scores) on 2 of the depression symptoms (Work and Activities and Retardation) significantly predicted poor cognitive status by the Holm criteria (a higher GDS rating) among Hispanics, after controlling for age, education, and gender (partial $r = .263$ -.645; $P = .068$ -.0005), and HDRS-total score approached significance (partial $r = .263$, $P = .068$). Collectively, they explained 47.8% of the residual variance after controlling for demographics ($F_{3,45} = 13.754$, $P < .0005$). After also controlling for the 7 neuropsychological tests, each of the 3 depression predictors (partial $r = .307$ -.648; $P = .048$ to $< .0005$) were significantly associated with global cognitive status (ie, GDS ratings), further demonstrating the additional contribution of these affective variables (Table 4). In the Hispanics, the 3 depression predictors explained 43.5% of the residual variance in the GDS ratings beyond the variance explained by the demographic variables and the neuropsychological tests ($F_{3,38} = 9.725$, $P < .0005$). However, when also controlling each depression predictor for the other 2, only Retardation (partial $r = .463$, $P = .003$) was significantly associated with global cognitive status. Among whites, all 3 depression predictors were strongly significantly associated with cognitive status (partial $r = .311$ -.497; $P = .030$ -.0005), after controlling only for demographics; collectively, they accounted for 28.1% of the residual variance [$F_{(3,45)} = 5.859$, $P = .002$]. Unlike the Hispanics, after also controlling for the 7 neuropsychological tests, none of the depression predictors (partial $r = .214$, $P = .174$) were significant predictors of global cognitive status. Thus, they made little additional contribution, collectively explaining only 5.7% of the residual variance after controlling for demographics and the neuropsychological tests ($F_{3,38} = .811$, $P = .496$).

Comparisons using Fisher z transformation between the 2 ethnic groups, of partial correlations controlling for demographics and the 7 neuropsychological tests, showed a difference for Retardation, significant by the Holm criterion ($P = .014$), and a difference approaching significance for Work and Activities ($P = .053$).

Alternative analyses—An alternative HDRS summary (HDRS-19) excluded Work and Activities and Retardation items from the total, but included the other 19 items. The HDRS-19 was almost perfectly correlated with the original 21-item HDRS-total score for both the Hispanics ($r = .919$) and the whites ($r = .938$). When the hierarchical regression analysis was repeated using the HDRS-19, the result for prediction by that depression measure, rather than the HDRS-total score, as presented in Table 4, remained nonsignificant for both Hispanics (partial $r = .054$, $P = .734$, nonsignificant) and whites (partial $r = .45$, $P = .779$).

Regression analysis showed that the neuropsychological and the depression symptoms (HDRS-total score, Work and Activities, and Retardation) predicted global cognitive status differently for English-speaking white and Spanish-speaking Hispanic groups ($F_{10, 76} = 2.350$, $P = .018$). A subsidiary analysis of the interactions showed that differences in the neuropsychological tests were not significant ($F_{7, 79} = 1.693$, $P = .123$) but that depression symptoms ($F_{3, 76} = 3.506$, $P = .019$) contributed significantly. As reported in Table 4, depression symptoms were predictive only for Hispanics.

Discussion

Despite the increased risk of both depression and dementia in the Hispanic elderly population,^{3,4,59} there is limited research addressing the accuracy with which validated neuropsychological tests and depression symptoms may predict global cognitive status in this population. The present cross-sectional study adds to the longitudinal findings of others^{40,41} on the relationship of depression and cognitive performance to global status in several ways by (1) using a comprehensive neuropsychological test battery to predict global cognitive status; (2) using a clinician-administered depression scale to predict global cognitive status; (3) examining the contributions of both neuropsychological tests and depression symptoms to the prediction of cognitive status among Hispanic elderly population with relatively high educational levels; and (4) including a matched white elderly group.

This cross-sectional study examined the association of neuropsychological tests and depressive symptoms with global cognitive functioning/status in 2 distinct ethnic groups, Spanish-speaking Hispanics and whites. These findings revealed that predictors of global cognitive status were somewhat different for these 2 ethnic groups. Overall, in both ethnic groups most neuropsychological tests were associated by the Holm criterion (with the exceptions for Hispanics of immediate recall of Paired Associates, and that WAIS-Vocabulary did not meet Holm criteria) with cognitive status when only controlling for demographics. However, when also controlling for the other 6 neuropsychological tests, immediate recall of the NYU-Paragraph Test was the only neuropsychological test significantly associated with cognitive status—although not by the Holm criteria—among

Hispanics, and delayed recall of the NYU-Paragraph Test and the WAIS-Digit Symbol subtest were the only tests significantly associated with cognitive status among their matched whites, both significant by the Holm criteria. After controlling for demographics, among Hispanics, the 2 depression items (Work and Activities and Retardation) were associated with cognitive status also by the Holm criteria but not the HDRS-total score. Among whites, all 3, the HDRS-total score and the 2 items, were associated with the Holm criteria. The lack of an association of an overall depression scale with cognition among Hispanics has been previously reported.⁴¹ However, only among Hispanics was there a significant additional contribution of HDRS-total score and the 2 items beyond what was explained by the demographics and the neuropsychological tests (explaining 43.5% of the residual variance). Other analyses that controlled for the demographics and the 7 neuropsychological tests showed that the HDRS-total score and the 2 items were significantly associated (and also by the Holm criteria) with cognitive status in the Hispanic group. It is noteworthy that Retardation was the only depression symptom associated (and also by the Holm criteria) with global cognitive status after also controlling for Work and Activities and HDRS-total score. Overall, these results suggest that examining only the total score from a depression scale may not be sufficient to improve prediction of global cognitive status.

Studies have used the MMSE as a measure of global cognitive status/cognitive function.^{28,40} The effect of retardation also remained unchanged when the MMSE (data not shown) was used to predict global cognitive status. This is of interest since it demonstrated the generalization of the Retardation result with 2 different measures of global cognitive status, the GDS and the MMSE.

The association of motivation-related/apathy symptoms with cognitive functioning/decline among whites, and also among Hispanics, is consistent with previous research.^{26,29,30,33} However, this study extends previous findings by demonstrating that among Hispanics, but not among whites, depressive symptoms can add to the prediction of global cognitive status beyond what can be explained by neuropsychological tests. The greater relevance of depressive symptoms in Hispanics than in whites is consistent with the lower reliability of cognitive tests in this group, reflecting various factors including quality of education and cultural experience.

The emerging literature suggests associations between specific neuropsychiatric symptoms and cognitive functioning.^{26,33} A variety of motivation-related depression symptoms have been associated with brain dysfunction and dementia. Apathy and mental slowness predicted white matter changes in dementia⁶⁰ and psychomotor retardation and decrease in activities of interest were associated with frontostriatal–limbic dysfunction.⁶¹ Anhedonia, apathy, and anergia were associated with dementia.⁶² These symptoms were in turn associated with greater lacunar volume in white matter, after adjusting for cognitive status, age, gender, and education.

Previous studies have shown that whites perform better than Hispanics on neuropsychological tests.^{13,14} The current results add to the literature on cross-cultural neuropsychology by demonstrating that neuropsychological tests also predict global

cognitive status better among whites (explaining 75.8% of the residual variance) than among Spanish-speaking Hispanics (explaining 38.6% of the residual variance).

This study had several limitations including its cross-sectional design so that causality cannot be established and a relatively small sample size that did not include some constituents of the Hispanic population such as Mexican Americans. Although participants were approximately matched on age (always within 2 years) and education (typically within 2 years), Hispanics were significantly younger (66.9 vs 67.4) and less educated (13.0 vs 13.9) than whites. Moreover, our use of years of formal education may not have been sensitive enough to reveal some differences in educational attainment between the 2 ethnic groups.^{63,64} Some of the strengths of this study include the perfect matching of the 2 groups on clinical diagnosis, GDS rating, and gender; and the use of a neuropsychological battery that covered several areas of cognitive function.

These results suggest that neuropsychological assessment of Spanish-speaking Hispanics should be supplemented by other measures, including consideration of specific symptoms and overall diagnostic scales. The Retardation item of the HDRS and the NYU-Paragraph Test were particularly associated with global cognitive status in this study. The study illustrates the relevance of studies of specific ethnic/racial and sociodemographic subgroups for refining cognitive status assessment procedures. The findings also have clear relevance for proper treatment-related assessment across diverse cultures. These findings also suggest that the selection of assessments of the efficacy of a potential treatment may have to be modified when evaluating elderly individuals from diverse cultural backgrounds.

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Figure 1.
Selection of study participants.

Table 1

Country of Origin and Race for Hispanics and Their Matched White Study Participants.

Hispanics						Whites		
Country/Region of Origin			Race			Country/Region of Origin		
	n	% ^a		n	% ^a		n	% ^b
Puerto Rico	16	30.8	White	26	50.0	United States	47	90.4
United States ^c	9	17.3	Black	2	3.8	Europe	3	5.8
Cuba	10	19.2	Hispanic	5	9.6	Brazil	1	1.9
Dominican Republic	4	7.7	Unknown	19	36.5	Australia	1	1.9
Ecuador	3	5.8						
Colombia	3	5.8						
Argentina	3	5.8						
Panama	2	3.8						
Chile	2	3.8						

^aPercentage of the Hispanic study participants.^bPercentage of the white study participants.^cExcluding Puerto Rico.

Table 2

Exact Matching Characteristics of the 2 Ethnic Groups.

	N	%
Exact matches	52	100
Female	43	82.7
GDS rating		
1	4	7.7
2	21	40.4
3	13	25
4	10	19.2
5	4	7.7
Diagnosis		
Normal (NL)	25	48.1
Mild cognitive impairment (MCI)	13	25
Alzheimer disease (AD)	14	26.9

Abbreviation: GDS, Global Deterioration Scale.

Table 3

Approximate Matching Characteristics for Hispanics and Their Matched Whites.

	Hispanics, n = 52, Mean (SD)	Whites, n = 52, Mean (SD)	Differences, n = 52, Mean (SD)	t (51)	P
Age, years	66.9 (–9.8)	67.4 (–10.2)	–0.6 (–1.7)	2.386	.021
Education	13 (–3.8)	13.9 (–3.6)	–0.9 (–1.4)	4.455	<.0005

Abbreviation: SD, standard deviation.

Table 4

Association Between Predictors and GDS (1-5) Among Hispanics and Their Matched Whites.

Predictor	Hispanics, n = 52		Whites, n = 52	
	Partial r	P	Partial r	P
A. Neuropsychological Tests ^a				
Paragraph-I	-.367	.016	-.013	.936
Paragraph-D	.107	.494	-.539 ^b	<.0005
Digit Symbol	-.155	.32	-.490 ^b	.001
Paired Associates-I	-.128	.415	.144	.356
Paired Associates-D	.12	.443	-.065	.678
Vocabulary	-.135	.388	-.001	.996
Memory for Designs	-.185	.234	-.097	.536
B. Depression ^c				
Work and Activities	.529 ^b	<.0005	.15	.341
Retardation	.648 ^b	<.0005	.214	.174
HDRS-total score	.307 ^b	.048	.12	.45

Abbreviations: I, immediate; D, delayed; HDRS, Hamilton Depression Rating Scale; GDS, Global Deterioration Scale.

^aControlling for age, gender, education, and the other 6 neuropsychological tests.^bSignificant at .05 by Holm multiple comparisons procedure.^cControlling for age, gender, education, and all 7 neuropsychological tests.