Published in final edited form as:

J Neuropsychiatry Clin Neurosci. 2010 ; 22(4): 417–425. doi:10.1176/appi.neuropsych.22.4.417.

Predictors of Performance on the MMSE and the DRS-2 Among American Indian Elders

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Abstract

Little is known about factors that predict older American Indians' performance on cognitive tests. This study examined 137 American Indian elders' performance on the MMSE and the Dementia Rating Scale—Second Edition (DRS-2). Multivariate regression identified younger age, more education, not receiving Supplemental Security Income, and frequent receipt of needed health care as predictors of better performance on the MMSE. Better performance on the DRS-2 was predicted by more education, boarding school attendance, not receiving Supplemental Security Income, and frequent receipt of needed health care. This study points to the importance of economic and educational factors on cognitive test performance among American Indian elders.

Despite a dramatic increase in American Indian life expectancy in recent years,¹ remarkably little is known about the nature and frequency of cognitive impairment among older American Indians.² Although a few studies have examined the utility of standard neuropsychological testing in this population,^{3–5} little is known about the performance on common neurocognitive screening measures among American Indian elders. This gap is especially noteworthy since American Indians have high rates of several conditions that increase risk for poor cognitive functioning, such as alcohol abuse and addiction,^{6–8} diabetes,^{9,10} traumatic brain injury,^{11,12} and overweight/obesity and cardiovascular disease.^{13,14} Further, American Indians are disproportionately poor (28.4% compared with 12.4% of the U.S. general population),¹⁵ and low socioeconomic status has been linked to several factors that might affect cognitive ability. These include pre- and postnatal

complications, malnutrition, exposure to environmental toxins, increased risk of head injury, and risky health behaviors.^{16,17}

This constellation of factors suggests that American Indians may be at considerable risk for the development of cognitive disorders associated with aging. As the population of older American Indians continues to increase, so does the need to develop methods by which to identify cognitive impairment and its optimal assessment in this population.

American Indians, Dementia Prevalence, and Cognitive Testing

A handful of small, non-population-based, empirical studies have examined dementia among American Indian and Canadian First Nations people.^{3–5,18–24} Overall, most studies of cognitive test performance to date typically have shown little difference between Native and non-Native samples, although most of these investigations have been conducted with relatively acculturated tribes,^{3–5,22,25} some of whom also have relatively low levels of genetic American Indian heritage.²¹ This is important because acculturation status may affect elders' performance on cognitive tests.²⁶

An earlier investigation by this research team²⁷ examined older American Indians' scores on the Mini-Mental State Examination (MMSE)²⁸ and the Mattis Dementia Rating Scale—Second Edition (DRS-2)^{29,30} compared with age- and education-adjusted norms developed with 18,000 community-dwelling participants (age 18–85+ years) in the NIMH Epidemiological Catchment Area Program survey.³¹ For the purpose of that investigation, possible cognitive impairment was defined as performance greater than 2 standard deviations below the mean of each participant's corresponding age- and education-matched cohort. Utilizing this criterion, 10.9% of the sample had possible cognitive impairment. For the DRS-2, no large-scale, population-representative norms were available, so the most demographically comparable published norms available were employed. These were age-adjusted norms derived from 36 European American and 53 African American urban norms³² with fairly similar age and education levels (mean age=74 years [SD=5.9], range=62–95; mean education=10.5 years [SD=3.6]).³² Again employing the criterion of performance greater than two standard deviations below the mean of each participant's DRS-2 score to an age-matched cohort to define possible impairment, 27.4% of elders had possible cognitive impairment. Gender was significantly associated with performance on both tests and education with the DRS-2, the latter finding accounted for by the lack of education adjustments in the Vangel & Lichtenberg 1995 norms. The article concluded that the examination of the possible effects of ethnicity, socioeconomic status, type/character of education, and language on MMSE and DRS-2 performance is essential in understanding cognitive test performance and developing culturally appropriate norms.²⁷

Factors Associated With Performance on the MMSE and DRS-2

A number of factors are related to performance on cognitive measures. Age,^{32,33} education,^{32,34,35} and language¹⁷ are well-known contributors to differential performance on such measures, whether directly, in combination, or reflecting the influence of other variables for which age, education, and language serve as proxies. The effects of ethnicity/race also contribute to performance differences on cognitive measures, although the extent

of their contribution is variable.³⁶ Socioeconomic status has been found to affect performance on the MMSE.³⁷ Ethnic minorities generally score lower on many cognitive tests, even after correcting for years of education and socioeconomic status.³⁸ While no definitive explanations can be found for these disparities, possible contributors include lower quality educational experiences³⁸ and associated socioeconomic deprivations (e.g., poor nutrition, inadequate health care, etc.) that contribute to poorer cognitive health.³⁶

With this in mind, our work examines performance on the MMSE and the DRS-2 in a community-dwelling American Indian sample. The goal was to investigate the predictors of differential performance on these assessment instruments in this culturally unique population, since it is likely that performance reflects factors other than neurocognitive disease alone. It was hypothesized that several variables, including health factors (e.g., alcohol problems, stroke, head injuries); language proficiency (both English and tribal language); education; boarding school history; indicators of economic need; ethnic identity; age; gender; and blood quantum would be predictive of performance on the two cognitive measures.

METHODS

The setting for data collection was a northern plains reservation; in order to protect tribal confidentiality, the name of the tribe participating in this study will not be specified.³⁹ This study was approved by the tribe's government, the Indian Health Service, and the Colorado Multiple Institutional Review Board. All participants signed approved consent forms.

Participants

One hundred forty American Indians 60 years old or older were recruited from 10 Administration on Aging-funded senior nutrition program sites throughout the reservation and several nearby off-reservation trust areas; 137 participants completed the MMSE and 129 of these participants completed the DRS-2.

Criteria for utilizing the senior nutrition program included being age 60 or older, American Indian, and residing within a five-mile-radius of a senior nutrition center. The program served the majority (83%) of the reservation's older American Indians, excluding those in very remote areas or those who were uninterested. Ninety-three percent of elders invited to participate in the interviews did so.

Procedures

Cognitive Assessments—The study commenced with focus groups conducted on the reservation with elders and senior nutrition program personnel to identify potentially problematic items on the MMSE and DRS-2 with respect to comprehensibility and cultural relevance. When a problematic item was identified, minimal modifications were made (e.g., “room” was substituted for “floor” in the Orientation section of the MMSE since few buildings on the reservation have more than one story). In such cases, retention of the original wording would likely have led to confusion and thus incorrect responses.

This process was followed by administration of the MMSE and DRS-2. The measures were administered in English by trained research assistants who were tribal members. The MMSE was administered using the method described by Folstein et al.²⁸ The version of the DRS-2 used in this study was the DRS-2™, and the administrative procedures outlined in the manual for this measure were employed.²⁹ In light of our prior findings identifying problems with the application of currently available norms to the interpretation of MMSE and DRS-2 in this population,²⁷ the present study used only raw scores on these measures for all statistical analyses.

Demographic, Health, Ethnicity, and Language Assessments—These measures were adapted from those used in the American Indian Service Utilization and Psychiatric Epidemiology Risk and Protective Factors Project (AI-SUPERPFP).⁴⁰ The demographic variables included age and gender. The health variables included a self-reported history of diabetes, heart disease, “bad headaches/migraines,” stroke, head injuries/concussion, and “alcohol problems.” The two language variables asked participants, “How well do you speak your Native language?” (0=I do not speak my tribal language, 1=I speak it a little, but not very well, 2=I speak it moderately well, 3=I speak my tribal language very well) and “How well do you speak English?” (0=I do not speak English, 1=I speak it a little, but not very well, 2=I speak it moderately well, 3=I speak English very well). Participants were asked four questions regarding their ethnic identity: how important it was to them that they maintained their tribal identity and their tribe’s values and practices, how important it was to them that they maintained a white identity and white values and practices, to rank the extent to which they followed the tribal way of life, and to rank the extent to which they followed the non-Indian way of life (0=not at all, 1=a little, 2=somewhat, 3=very much).

Two questions focused on education. The first variable differentiated between *completed 12 or more years of education* and *completed fewer than 12 years*. The second measure included whether or not the participant reported *a history of having attended boarding school*. The term “boarding school” refers to residential schools intended to provide a basic education as well as to assimilate American Indian students into American society and to facilitate conversion to Christianity.⁴¹ Nine variables measured participants’ subjective impressions of their economic need: receipt of Temporary Assistance for Needy Families (TANF), General Assistance, or other welfare benefits; Supplemental Security Income (i.e., a federal program that provides cash for basic needs for impoverished aged, blind, and disabled people);⁴² Social Security supplement/retirement benefits; or food stamps/an electronic benefits transfer card. The second set of variables measuring economic need asked participants to rank how often they had the following: “enough food to eat,” “the health care you need,” “enough clothes,” “a decent place to live,” and “relatives asking you for money” (0=never, 1=almost never, 2=sometimes, 3=often, 4=almost always).

For self-reported American Indian ancestry, the participant was asked to state his or her *blood quantum*. On this reservation, as in many American Indian communities,⁴³ a culturally recognized distinction is made between “full bloods” and so-called “mixed bloods,” but the latter category is not universally associated with any specific blood quantum. Given the myriad possibilities for blood quantum ratios (e.g., one-fourth, one-half,

three-fourths, etc.), a decision was made to draw the cutoff at greater than three-fourths. Approximately 55% of the sample reported a blood quantum in this range.

Analyses

Statistical analysis was performed using SPSS version 17.0⁴⁴ and mainly included descriptive statistics, as well as t tests and correlations for continuous data. Univariate regression models determined the strength of individual variables' associations, including health factors, language fluency, ethnic identity, education, indicators of economic need, age, gender, and blood quantum, with raw MMSE and DRS-2 scale scores. Using backward elimination, multivariate regression models were run to determine the final models for raw MMSE and DRS-2 scale score prediction.

RESULTS

MMSE scores ranged from 16 to 30, while DRS-2 scores ranged from 93 to 143. Approximately 93% of both male and female participants had MMSE scores between 21 and 30. Sample characteristics comparing those with less than or equal to and more than 12 years of education are summarized in Table 1.

Results demonstrating variables that were individually associated with higher MMSE and DRS-2 scores using t tests and correlations are presented in Table 2.

In a multivariate model for the MMSE (after controlling for gender and age), being younger, reporting 12 or more years of education, not receiving Supplemental Security Income, and often having needed health care predicted higher MMSE scores (Table 3). In the DRS-2 multivariate model (after controlling for gender and age), reporting 12 or more years of education, having attended boarding school, not receiving Supplemental Security Income, and often having needed health care predicted higher scores. No significant interactions were identified.

As several culture-related variables were individually associated with higher MMSE and DRS-2 scores but were not significant in the multivariate model, we ran additional analyses to look at the interrelationships of the independent variables to assist in explaining these findings. English proficiency's univariate relationship to higher MMSE and DRS-2 scores was explained by 12 or more years of school (mean English proficiency =2.71 [SD=0.59] for those with 12 or more years of school compared with mean=2.21 [SD=0.78] for those with 11 or fewer years; t test=-4.23, p<0.001). English proficiency's univariate relationship to higher DRS-2 scores was explained by a history of attending boarding school (mean English proficiency =2.56 [SD=0.65] among those attending boarding school compared with mean=2.00 [SD=0.86] for those who did not; t test=-3.71, p<0.001). The extent of following the non-Indian way of life's univariate relationship to higher MMSE and DRS-2 scores was explained by 12 or more years of education (mean non-Indian way of life =2.20 [SD=0.87] for those with 12 or more years of education compared with mean=1.54 [SD=1.00] for those with 11 or fewer years; t test=-4.11, p<0.001). Finally, reporting less than or equal to three-fourths blood quantum's univariate relationship to higher DRS-2 scores was explained by often having needed health care (mean having needed health care

=3.37 [SD=0.86] for those with less than or equal to three-fourths blood quantum compared with mean=3.00 [SD=1.12] for those with greater than three-fourths blood quantum; t test=2.11, $p=0.036$).

DISCUSSION

In general, education and indicators of economic need predicted higher scores on both the MMSE and DRS-2 in this sample of American Indian elders. Having more formal education was related to better performance on both the MMSE and the DRS-2; in addition, younger age was related to better performance on the MMSE. Age and education have been found to be associated with better performance in previous studies of these measures in other populations.^{31,32,37,45–47} Additionally, boarding school attendance was related to higher scores on the DRS-2. Since to our knowledge, this is the first study to examine this measure in an American Indian group, it is not clear why those who attended boarding school performed better on the DRS-2, although it is possible that the acculturative aspect of the boarding school experience may have played a role in some way, perhaps by providing a heuristic framework that made it easier for boarding schools attendees to complete measure-specific assessment tasks that reflected a Western, biomedical conceptualization of cognition.

It is worth noting the complex relationship between performance on the cognitive tests, the educational variables, English proficiency, adherence to a non-Indian way of life, and blood quantum. In particular, we found an association between English proficiency and MMSE and DRS-2 scores, although both of these relationships were explained by the 12 or more years of education variable. Those who reported 12 or more years of school were more likely to report greater English proficiency. In addition, we found an association between English language and the DRS-2 scores, which was explained by a history of boarding school attendance. Those who reported a history of boarding school were more likely to report greater English proficiency. It is not clear why this finding occurred with the DRS-2 score only. We found an association between the extent of following the non-Indian way of life and MMSE and DRS-2 scores—again both of these relationships were explained by the 12 or more years of education variable. Finally, we found an association with blood quantum and the DRS-2 score, which was explained by often having needed health care.

Those who reported more frequently receiving needed health care had better scores on both the MMSE and DRS-2. Here it is important to note that rudimentary health care through the Indian Health Service is supposed to be universally available to American Indians on this reservation, although in reality the system is chronically underfunded and struggles to keep up with demand.⁴⁸ It follows that those who were able to negotiate their way through this system and receive the care they needed may have been advantaged in other ways as well, including better cognitive health and/or test-taking ability.

The relationship between nonreceipt of Supplemental Security Income and higher MMSE and DRS-2 scores is not surprising given the level of impoverishment of recipients of these benefits. For instance, an individual is prohibited from having more than \$2,000 in resources (e.g., cash, bank accounts, land, life insurance, personal property, and vehicle) in order to

qualify for the program.⁴² Supplemental Security Income recipients may therefore be disadvantaged in a number of ways that might impact their cognitive functioning and/or test-taking aptitude or ability, including early nutrition, educational opportunities, and parental involvement in early education efforts.

Of the seven health variables examined here, bad headaches/migraines was the only health-related variable that was significant at the univariate level. However, this variable dropped out of the final multivariate regression models. That health problems emerged as nonsignificant may reflect the inadequacies of a self-report method of ascertaining their presence/absence. Further, the lack of significance of gender here is striking and is in contrast to our earlier work which used normative data rather than raw scores;²⁷ however, this finding is consistent with that of others.^{31,32,49} Likewise, we did not find an effect of blood quantum in this study, which is consistent with some studies' findings of the nonsignificance of race on the DRS-2 in samples of whites and African Americans.^{32,50}

This study has several limitations, one of the most obvious being its focus on one tribe and its use of a purposive sample drawn from senior nutrition program sites. Although these nutrition program sites are believed by many community members to be more universally utilized in reservation settings than comparable programs that serve the general population, the possibility exists that unique characteristics of this sample limit generalizations to the larger American Indian population. Also, socioeconomic status was not assessed comprehensively but was instead evaluated via indicators of economic need. In addition, we were unable to explore possible relationships between gender and ethnic identity, language fluency, and self-reported health conditions. While potentially interesting, such additional analyses are beyond the scope of this study yet are worthy of future investigation. Lastly, this research did not include a clinical neuropsychiatric examination as a source of external validation of neurological (including cognitive), psychiatric, and general health status; accordingly, potentially informative clinical characteristics of study participants may be opaque to detection in the present study and hence not entered into the regression models predicting MMSE and DRS-2 scores in this sample.

Despite these limitations, the present findings suggest that educational factors and economic resources are related to performance on the MMSE and DRS-2 among older American Indians. Such factors must be considered when selecting these measures, and by extension other assessments of cognitive performance, for use and interpretation in these populations.

Acknowledgments

We wish to thank the tribal members who so generously volunteered their time to take part in this study. This research was funded by a grant from the National Institute on Aging (K01 AG20232-03, Lori L. Jervis, principal investigator).

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TABLE 1

Demographic Characteristics

	<12 Years School		12 Years School		Total		Analysis
	n	%	n	%	n	%	
Gender							
Male	23	27.1	17	30.9	40	28.6	
Female	62	72.9	38	69.1	100	71.4	
Age							
60–69	40	47.1	34	61.8	74	52.9	
70+	45	52.9	21	38.2	66	47.1	
Blood quantum							
>3/4	52	61.2	25	45.5	77	55.0	
Education							
Boarding school attendance	54	63.5	47	85.5	101	72.1	$\chi^2=7.987$ p=0.005
Self-reported health conditions (lifetime)							
Diabetes	42	49.4	23	41.8	65	46.4	
Heart disease	34	40.0	21	38.2	55	39.3	
Alcohol problems	17	20.0	14	25.5	31	22.1	
Bad headaches/migraines	24	28.2	15	27.3	39	27.9	
Head injuries or concussion	12	14.1	11	20.0	23	16.4	
Dementia	18	21.2	5	9.1	23	16.4	
Stroke	12	14.1	8	14.5	20	14.3	
Indicators of economic need	n	%	n	%	n	%	
Currently receiving TANF, General Assistance, or other welfare benefits	10	11.8	3.0	5.5	13	9.3	
Currently receiving Supplemental Security Income	50	58.8	21	38.2	71	50.7	$\chi^2=5.692$ p=0.017
Currently receiving Social Security retirement benefits	45	52.9	26	47.3	71	50.7	
Currently receiving food stamps or an EBT card	15	17.6	2.0	3.6	17	12.1	$\chi^2=6.144$ p=0.013
	Mean	SD	Mean	SD			
How often has enough food to eat	3.7	0.7	3.6	0.8			
How often has needed health care	3.1	1.0	3.3	1.1			
How often has enough clothes	3.7	0.7	3.7	0.6			

	<12 Years School		12 Years School		Total		Analysis
	n	%	n	%	n	%	
How often has a decent place to live	3.6	1.0	3.8	0.6			
How often has relatives asking for money	1.9	1.3	2.2	1.2			
Language fluency							
Tribal language	2.1	1.1	1.8	1.3			
English language	2.2	0.8	2.7	0.6			t test=-4.0 p<0.001
Ethnic identity							
Importance of maintaining tribal identity, values, and practices	2.3	0.9	2.5	0.7			
Importance of maintaining white identity, values, and practices	1.4	1.0	1.9	0.9			t test=-3.4 p=0.001
Extent of following tribal way of life	1.6	1.0	1.8	1.0			
Extent of following non-Indian way of life	1.5	1.0	2.2	0.9			t test=-4.1 p<0.001
Test Scores							
MMSE	26	3.3	27.7	2.1			t test=-3.7 p<0.001
DRS-2	123	9.8	129.9	9.6			t test=-4.0 p<0.001

MMSE=Mini-Mental Status Examination; DRS-2=Mattis Dementia Rating Scale—Second Edition; TANF=Temporary Assistance for Needy Families; EBT=electronic benefits transfer card

TABLE 2
Associations of Demographic, Health, Cultural, and Economic Factors With Raw MMSE and DRS-2 Scores

	MMSE Raw Score				DRS-2 Raw Score			
	n	Mean	SD	p	n	Mean	SD	p
Gender								
Male	40	25.9	3.3	0.044	38	122.6	11.8	0.038
Female	97	27.0	2.8		91	127.2	9.3	
Age								
60–69	72	27.2	3.0	0.030	69	127.5	10.7	0.046
70+	65	26.1	2.9		60	123.9	9.5	
Blood quantum								
>3/4	75	26.4	3.1	0.243	70	123.3	9.6	0.002
Education								
12 years	55	27.7	2.1	<0.001	54	129.9	1.3	<0.001
Boarding school attendance	101	27.0	2.8	0.036	94	127.7	9.5	<0.001
Self-reported health conditions (lifetime)								
Diabetes	63	26.7	2.4	0.789	57	125.6	8.9	0.813
Heart disease	53	26.5	3.0	0.657	48	125.4	9.7	0.746
Alcohol problems	31	26.5	3.3	0.692	30	124.0	9.8	0.270
Bad headaches/migraines	39	25.8	2.8	0.035	36	122.1	10.4	0.009
Head injuries or concussion	23	27.2	2.6	0.338	21	127.7	11.0	0.359
Dementia	23	26.2	3.5	0.426	22	126.3	9.4	0.822
Stroke	20	26.8	2.4	0.836	18	126.9	7.8	0.637
Indicators of economic need								
Currently receiving TANF, General Assistance, or other welfare benefits	13	26.2	3.0	0.513	11	127.0	7.7	0.693
Currently receiving Supplemental Security Income	69	26.1	3.2	0.028	62	122.6	10.7	<0.001
Currently receiving Social Security retirement benefits	70	26.7	2.6	0.955	66	126.9	8.0	0.232
Currently receiving food stamps or an EBT card	16	26.5	2.3	0.808	16	122.4	5.8	0.037
	r_s	p			r_s	p		
How often has enough food to eat	–0.04	0.652			0.130			0.142
How often has needed health care	0.19	0.029			0.323			<0.001

	MMSE Raw Score				DRS-2 Raw Score			
	n	Mean	SD	p	n	Mean	SD	p
How often has enough clothes		0.01		0.940		0.084		0.346
How often has a decent place to live		0.07		0.423		0.139		0.115
How often has relatives asking for money		0.09		0.280		0.067		0.448
Language fluency								
Tribal language		-0.18		0.036		-0.320		<0.001
English language		0.20		0.018		0.222		0.011
Ethnic identity								
Importance of maintaining tribal identity, values, and practices		0.19		0.026		0.231		0.008
Importance of maintaining white identity, values, and practices		0.02		0.85		0.134		0.131
Extent of following tribal way of life		-0.03		0.711		0.107		0.226
Extent of following non-Indian way of life		0.15		0.077		0.282		0.001

MMSE=Mini-Mental Status Examination; DRS-2=Mattis Dementia Rating Scale—Second Edition; TANF=Temporary Assistance for Needy Families; EBT=electronic benefits transfer card

TABLE 3

Multivariate Relationships of Health, Cultural, Economic, and Demographic Factors With Raw MMSE and DRS-2 Scores

	<u>MMSE Raw Score</u>		<u>DRS-2 Raw Score</u>	
	β	p	β	p
Gender				
Male	1.0		1.0	
Female	0.150	0.064	0.149	0.051
Age				
60–69	1.0		1.0	
70+	–0.171	0.034	–0.134	0.078
Education				
12 years	0.203	0.015	0.195	0.015
Boarding school attendance			0.197	0.012
Indicators of economic need				
Currently receiving Supplemental Security Income	–0.173	0.035	–0.254	0.001
How often has needed health care	0.188	0.022	0.268	0.001