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Research Article

Investigating the Relationship Between Marital Status and Ethnicity on Neurocognitive Functioning in a Rural Older Population: A Project FRONTIER Study

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Abstract

Objectives: Research indicates being married is related to better physical and psychological health. Little is known regarding the relationship between marital status and neurocognitive functioning and whether it differs based on ethnicity (Hispanic vs non-Hispanic). This is the first study to examine this relationship in a sample of aging adults in rural Texas.

Methods: Data from 1,864 participants (M_{age} = 59.68, standard deviation $[SD]_{age}$ = 12.21), who were mostly Hispanic (n = 1,053), women (n = 1,295), and married (n = 1,125) from Project Facing Rural Obstacles to Healthcare Now Through Intervention, Education, & Research were analyzed. Neuropsychological testing comprised Repeatable Battery for the Assessment of Neuropsychological Status, Trails Making Test, and Clock Drawing. Participants were dichotomized, married, and unmarried.

Results: There was a significant interaction between Hispanic identity and marital status on overall neurocognitive functioning (F(1, 1,480) = 4.79, p < .05, η_p^2 = 0.003). For non-Hispanic individuals, married individuals had higher overall neurocognitive functioning compared to unmarried individuals, whereas neurocognitive functioning for Hispanic individuals did not significantly differ between married and unmarried individuals. There were significant main effects as married individuals (M = 84.95, SD = 15.56) had greater overall neurocognitive functioning than unmarried individuals (M = 83.47, SD = 15.86; F(1, 1,480) = 14.67, p < .001, η_p^2 = 0.01), Hispanic individuals (M = 78.02, SD = 14.25) had lower overall neurocognitive functioning than non-Hispanic individuals (M = 91.43, SD = 15.07; F(1, 1,480) = 284.99, p < .001, η_p^2 = 0.16).

Discussion: Hispanics living in rural areas experience additional stressors that could lead to worse neurocognitive functioning, which is supported by the Lifespan Biopsychosocial Model of Cumulative Vulnerability and Minority Health, which postulates that race/ethnicity/socioeconomic-status-related stressors exacerbate the impact of other life stressors. Reduction of stress on rural Hispanics should be a priority as it could positively affect their neurocognitive functioning.

Keywords: Ethnic minority, Neuropsychological functioning, Older adults, Rural health

There are more than 60 million people in the United States over the age of 65, with the aging population projected to increase by 94.7 million by 2060, especially ethnic minority older adults (Profile of Older Americans, 2022). Currently, one in four older adults identify as an ethnic or racial minority (Profile of Older Americans, 2022). Further, due to aging-in-place initiatives (i.e., senior support network that connects service providers with older homeowners, their families, and caretakers so they can stay in their current living situation), the number of older adults living in rural areas is also estimated to significantly increase in the next 10 years (Callahan, 1993). There is a robust amount of research that has highlighted how individuals in rural areas have less access to health care and limited access to specialty professionals, such as neurologists and neuropsychologists, who might diagnose neurocognitive impairment, which is an early indication of Alzheimer's Disease and Alzheimer's Disease-Related Dementias (AD/ADRD) for some individuals (Minden et al., 2008; Morgan et al., 2009). Not only do older adults in rural areas face reduced access to health care (compared to older adults in urban areas), but research has indicated they have lower rates of insurance coverage (Smith & Trevelyan, 2019), higher rates of emergency department visits (Greenwood-Ericksen & Kocher, 2019), and higher rates of heart failure

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(Coughlin et al., 2019). In addition to reduced access, many people (more than 15% live below the poverty line compared to less than 11% in urban areas; Creamer et al., 2022) living in rural areas also face the prominent risk factor of low income, which has been found to significantly predict lower neurocognitive functioning (e.g., George et al., 2020).

Further complicating the aging process for older adults in rural areas is that rates of divorce are at an all-time high for adults 65+ in the United States (Brown & Lin, 2022). This is problematic as marital status is one of the most robust predictors of quality of life, physical health, and mortality (Gobbens & Remmen, 2019; Monserud, 2019; Parker et al., 2003). The importance of sex should be noted as research has found marital status, specifically being married as a protective factor, differs (e.g., Ramezankhani et al., 2019) depending on sex. For example, Ramezankhani et al. (2019) found that being married was a protective factor for hypertension and mortality in men, but among women, it was only a protective factor for type 2 diabetes. Research has failed to examine the role of marital status on neurocognitive functioning in older adults, especially for ethnic minority older adults, even though research has highlighted marital status is a possible risk/protective factor for neurocognitive functioning (Liu et al., 2019). Therefore, this study examined the relationship between marital status and ethnicity (Hispanic vs non-Hispanic) on neurocognitive functioning in a sample of aging adults in rural Texas and took into account sex as an important covariate.

As individuals age, their risk of neurocognitive impairment increases, and due to medical advances that promote longer lives, individuals experience more severe neurocognitive impairment for more prolonged periods of their life span (Zlokovic et al., 2020). Neurocognitive impairment (e.g., learning and memory, executive functioning, long-term processing, and executive functioning) predominantly affects aging adults (Mapstone et al., 2003). Further, impairment in these neurocognitive domains can be a symptom of mild cognitive impairment, and further decline can lead to AD/ADRD (Fang et al., 2022). However, despite an understanding that neurocognitive impairment is a risk for aging adults in the United States, differences in neurocognitive impairment based on sociodemographic factors (e.g., Hispanic vs non-Hispanic; urban vs rural) are not well understood. Further complicating our understanding of the relationship between neurocognitive functioning and sociodemographic factors is that previous studies predominantly use screeners (e.g., Mini-Mental State Examination, Montreal Cognitive Assessment) to evaluate overall neurocognitive functioning, which limits our ability to fully understand if certain sociodemographic factors affect multiple aspects of neurocognitive functioning. This is problematic, given that ethnic minorities have higher rates of neurocognitive impairment and AD/ADRD than nonethnic minorities (Burke et al., 2019; Chin et al., 2011) and possible intervention targets might differ if sociodemographic factors affect different aspects of neurocognitive functioning. More specifically, Hispanic individuals are 1.5 times more likely to have AD/ADRD than non-Hispanic individuals (Race, Ethnicity, and Alzheimer's, 2020). Yet, despite this increased prevalence of AD/ADRD in Hispanic individuals, research has indicated that ethnic minorities have more barriers with identification, prevention, and health care utilization (Burke et al., 2019; Chin et al., 2011; Race, Ethnicity, and Alzheimer's, 2020), and Hispanic individuals are less likely to actually be diagnosed with AD/ADRD (Mukadam et al., 2013). Therefore, there is a critical need to understand risk/protective factors related to AD/ADRD, such as marital status, as well as to identify barriers to early detection of symptoms of AD/ADRD, including neurocognitive impairment for this population.

Despite a lack of research into whether sociodemographic factors predict cognitive functioning, The Lifespan Biopsychosocial Model of Cumulative Vulnerability and Minority Health (Myers, 2009) provides us with a framework for understanding the relationship between ethnicity and living in rural areas on neurocognitive functioning. The Lifespan Biopsychosocial Model of Cumulative Vulnerability and Minority Health states that race/ethnicity/socioeconomic status (SES)-related stressors (e.g., racism, discrimination, class prejudice, and lack of access to health care) contribute to greater stress among racial–ethnic minorities (Myers, 2009). Indeed, stressors that are unique and prevalent to racial–ethnic minorities (e.g., discrimination, acculturative stress, and neighborhood-related stressors; Muñoz et al., 2021; Sheffield & Peek, 2009; Zahodne et al., 2020) throughout the life span can result in worse neurocognitive functioning (Watson et al., 2019). Therefore, based on previous findings, we hypothesize that ethnic minority individuals and individuals living in rural areas in West Texas will have worse neurocognitive functioning compared to nonethnic minorities and individuals living in urban areas due to increased stressors throughout the life span. Yet, these relationships have not been tested in this unique population.

Although Hispanic (vs non-Hispanic) individuals have been found to have lower neurocognitive functioning, there is evidence that social support is protective against neurocognitive functioning and increases positive outcomes (e.g., quality of life; Hagan, 2020; Leung et al., 2015). Most social support for non-Hispanic individuals has been found to come from their spouse, whereas research has indicated that Hispanic individuals have more avenues for gaining social support (e.g., siblings, parents, and friends; Katiria Perez & Cruess, 2014). The findings have indicated that being married is associated with people living longer and healthier lives than those who are unmarried, divorced, or widowed (Kiecolt-Glaser & Newton, 2001; Robles et al., 2014; Shrout, 2021). Our understanding of the relationship between marital status and neurocognitive functioning is limited, but the Dyadic Biobehavioral Stress Model, which highlights the importance of marital status on health outcomes (Shrout, 2021), provides a strong theoretical rationale for why marital status, being married specifically, will be a protective factor for greater neurocognitive functioning, especially for non-Hispanic individuals. Even though this relationship (marital status and neurocognitive functioning) has not been investigated to date, empirical evidence from similar fields suggests marital status is a protective factor for mental health (i.e., anxiety, depression, chronic stress, and insomnia; Shi et al., 2020) and physical health (e.g., hypertension, type 2 diabetes, and mortality; Ramezankhani et al., 2019). Thus, there appears to be a strong theoretical rational and empirical evidence from similar fields (e.g., mental health and physical health) that a relationship exists between marital status and neurocognitive functioning.

Research Overview and Hypotheses

This study aimed to investigate the relationship between being married (vs unmarried, divorced, separated, or widowed) on neurocognitive functioning, while also investigating if differences exist between Hispanic and non-Hispanic individuals.

We also aim to bridge the gap that has impeded our field as we investigate the relationship between sociodemographic factors and multiple aspects of neurocognitive functioning including rote memory, executive functioning, long-term processing/memory, and visuospatial/constructive memory. Based on past findings and the Lifespan Biopsychosocial Model of Cumulative Vulnerability and Minority Health, we hypothesize that non-Hispanic aging adults will have higher neurocognitive functioning than Hispanic aging adults. Further, being married will be related to higher neurocognitive functioning regardless of ethnicity, but we will see a greater difference between non-Hispanic individuals who are married compared to non-Hispanic individuals who are not married than Hispanic individuals.

Method

Participants

Participants' (N = 1,864) data were collected as part of Project FRONTIER (Facing Rural Obstacles to Healthcare Now Through Intervention, Education, & Research), an epidemiological study of cognitive aging among rural-dwelling individuals. Participants were recruited from Cochran and Parmer Counties, located in West Texas, United States. Recruitment utilized a community-based participatory research approach, which has been previously described (O'Bryant et al., 2009). Broadly, recruitment was conducted by in-person community recruiters (e.g., brochures, presentations, door to door). Individuals above the age of 40 residing in one of the two counties were eligible to participate. There were 1,295 (69.8%) women and 561 (30.2%) men; 1,053 (58.3%) Hispanics and 752 (41.7%) non-Hispanics; 1,771 (95.0%) White, 51 (2.7%) Black/African American, and 32 (1.71%) other; 1,125 (70.3%) married participants and 475 (29.7%) unmarried participants (i.e., never married, divorced, widowed, and separated), with a mean age of 59.68 years (standard deviation [SD] = 12.21). More specifically, the Hispanic population endorsed predominantly being Mexican American (n = 1,016; 96.5%). Participants were asked the language (i.e., English, Spanish) they felt most comfortable speaking and reading and were administered the measures in that language. Most of the participants (n = 1,492; 80.0%) were administered the assessment in English with the others being administered in Spanish. There were no differences, regarding all neurocognitive functioning measures, between participants who were administered the entire assessments in Spanish and English (p's > .05).

Procedure

This study was conducted following IRB approval (Blinded for Publication IRB #L06-028) and all participants provided informed consent. After completing informed consent, each participant underwent a medical examination, clinical lab work, an interview, and neuropsychological testing.

Measures

Demographic questionnaire

Participants answered a demographic questionnaire to assess gender, ethnicity (Hispanic vs non-Hispanic), marital status (married, widowed, divorced, separated, and never married), and age. Marital status was dichotomized into married and unmarried, which included widowed, divorced, separated, and never married.

Neurocognitive functioning

Five measures examined different aspects of neurocognitive functioning. The Repeatable Battery for the Assessment of Neuropsychological Status (RBANS; Randolph, 2010) measures overall cognitive functioning. The Trails Making Test A (TMT-A) measures rote memory and Trails Making Test B (TMT-B) measures executive functioning(Ciolek, 2019). The Clock Drawing Test (CLOX-1) is an assessment of long-term processing and memory, and CLOX-2 is an assessment of visuospatial/visuoconstructive ability (Menon et al., 2011).

Repeatable Battery for the Assessment of Neuropsychological Status

The RBANS includes 12 subtests that assess five cognitive domains (Duff, Schoenberg et al., 2005): Attention (coding and digit span subtests), Language (semantic fluency and picture naming subtests), Visuospatial/Constructional (line orientation and figure copy subtests), Immediate Memory (list and story memory subtests) and Delayed Recall (list recall and recognition, story recall, and figure recall subtests). The overall score ranges from 40 to 160, with scores below 78 indicating impaired cognitive functioning (Karantzoulis et al., 2013). The RBANS demonstrates good reliability and validity (Randolph, 2010), and good accuracy in identifying overall neurocognitive functioning (Duff et al., 2008). Within a sample of older community-dwelling adults, coefficients of stability ranged from 0.58 to 0.83 for the indexes measured through test–retest stability (Duff, Beglinger et al., 2005).

Trails Making Test

The TMT measures attention, visual screening, memory, and processing speeds and has been shown to be an accurate measure in evaluating cognitive functioning (Carone, 2006; Llinàs-Reglà et al., 2017). Both TMT-A and TMT-B require the participant to connect circles on a piece of paper. The pencil cannot be lifted while connecting the circles, and any errors are immediately pointed out for correction. The score is based on the overall time (in seconds) required to complete the connections accurately. The effect of mistakes thus increases the time required to complete the test, which leads to lower scores and indicates increased impairment. Both tests are stopped after 5 min if not completed. Retest reliability of TMT A is between 0.76 and 0.89 and retest reliability of TMT B is between 0.86 and 0.94 (Wagner et al., 2011).

The TMT-A assesses rote memory ability and consists of circles labeled 1–25. Participants are instructed to draw connecting lines to each circle in numerical ascending order (i.e., 1-2-3-4, etc.). For individuals aged 55–75, a score of 42 s or below is considered normal, with scores above 70 s indicating cognitive impairment (Ashendorf et al., 2008). For individuals aged 75–98, a score of 51 s or below is considered normal, with scores above 79 s indicating cognitive impairment (Ashendorf et al., 2008).

The TMT-B measures executive functioning and consists of circles labeled with numbers (1–13) and letters (A–L). Participants are instructed to draw connecting lines to each circle in alternating numerical and alphabetical ascending order (i.e., 1-A-2-B-3-C, etc.). For individuals aged 55–75, a score of 101 s or below is considered normal, with scores above 273 s indicating cognitive impairment (Ashendorf et al., 2008). For individuals aged 75–98, a score of 128 s or below is considered normal, with scores above 273 s indicating cognitive impairment (Ashendorf et al., 2008).

Table 1. Means for Each Level of Income on Each Dependent Variable

Dependent measure	<10	10–20	20–30	30–40	40–50	50–60	60–70	>70
Overall cognitive functioning	76.07[a]	79.33[b]	84.53[c]	86.76[cd]	90.28[de]	94.69[ef]	91.86[de]	97.08[f]
Rote memory	40.48[a]	39.06[a]	40.44[ab]	38.89[ab]	42.37[bc]	41.86[abc]	43.98[c]	43.59[c]
Executive functioning	45.41[a]	43.74[ab]	48.28[c]	45.83[bc]	49.42[bc]	45.89[abc]	50.29[c]	49.67[c]
Long-term processing/memory	11.13[a]	11.73[b]	12.17[c]	11.62[bd]	12.57[c]	12.63[c]	12.23[bcd]	12.85[c]
Visuospatial/constructive memory	12.43[a]	13.14[b]	13.51[c]	13.22[bcd]	13.68[bcde]	13.72[bcde]	13.66[bcde]	13.97[ce]

Notes: Income groups are in thousands. Superscripts denote mean differences at $p < .05$ between groups within each dependent variable.

Clock Drawing Test

The CLOX assesses long-term attention, planning, visual memory, motor programming, and visuospatial/constructive abilities (Beber, 2016; Shulman, 2000). Scoring criteria are identical for CLOX 1 and CLOX 2. Total scores range from 0 to 15, with a score less than 10 reflecting abnormal functioning (Royall, 1998). One point is given for each accurately drawn feature of the clock (e.g., circle present, numbers 1–12, correct spacing, minute hand longer than hour, etc.). The CLOX has been proven valid and reliable (Cronbach's $\alpha = 0.82$) for the detection of cognitive impairment in older adults (Forti et al., 2010; Royall, 1998; Shulman, 1986). CLOX 1 is an unprompted free-draw task that relies on executive control. Participants are given a blank sheet of paper and are instructed to draw a clock from memory that says "1:45." CLOX 2 relies more on visuospatial/visuoconstructive capabilities. Participants observe the examiner drawing a clock, setting the hands to "1:45," placing the 12, 6, 3, and 9 first, and making the hands into arrows. The participant is then instructed to copy the examiner's clock.

Data Analysis

First, a multivariate analysis of variance (MANOVA) was used to test for the presence of multivariate main effects and the interactions between two independent variables (marital status and Hispanic identity) as well as the main effects of two control variables (sex and income; income was divided into eight distinct ranges, see Table 1) on the five neurocognitive dependent variables: overall neurocognitive functioning, rote memory, executive functioning, long-term processing and memory, and visuospatial/visuoconstructive ability. Afterward, we used post hoc analyses of variance (ANOVAs) to test the effects of our independent variables on each individual dependent variable. Where appropriate, we first present the interaction between Hispanic identity and marital status for each post hoc ANOVA using simple main effects, and then the overall main effects if any exist. Where overall main effects of income are present, we describe the general trend rather than specify each category, but see Table 1 for the exact differences between all eight income groups.

Results

A MANOVA was used to test whether marital status (currently married vs not married) would moderate the relationship between ethnic identity (Hispanic vs Non-Hispanic) and five neurocognitive dependent variables controlling for sex and income. Results indicated a multivariate effect of Hispanic identity ($V = 0.20$, $F(5, 1{,}318) = 65.99$, $p < .001$), a multivariate effect of marital status ($V = 0.01$, $F(5, 1{,}318) = 3.72$, $p = .004$), and a multivariate interaction between Hispanic identity and marital status ($V = 0.02$, $F(5, 1{,}318) = 5.01$, $p < .001$) on neurocognitive functioning. Additionally, sex ($V = 0.02$, $F(5, 1{,}318) = 4.62$, $p < .001$) and income ($V = .14$, $F(35, 6{,}610) = 5.30$, $p < .001$) both showed multivariate effects on neurocognitive functioning. See Table 2 for a complete summary of the MANOVA.

Table 2. Effects of Marital Status and Ethnicity on All Measures of Neurocognitive Functioning Controlling for Sex and Income

Effect	Pillai's trace (V)	$F(5, 1{,}348)$
Hispanic	0.18	61.13***
Married	0.01	3.52**
Hispanic × Married	0.02	5.01***
Sex	0.02	4.62**
Income	0.14	5.30***

Notes: ** $p < .01$. *** $p < .001$.

Overall Neurocognitive Functioning (RBANS)

There was no significant interaction between Hispanic identity and marital status on overall neurocognitive functioning ($F(1, 1{,}449) = 2.40$, $p = .12$, $\eta_p^2 = 0.003$, see Table 3). Overall, neurocognitive functioning showed a significant main effect of Hispanic identity ($F(1, 1{,}449) = 130.64$, $p < .001$, $\eta_p^2 = 0.16$) such that Hispanic individuals ($M = 78.02$, $SD = 14.25$) had significantly lower overall neurocognitive functioning than non-Hispanic individuals ($M = 91.43$, $SD = 15.07$). There was no main effect of marital status ($F(1, 1{,}449) = 14.67$, $p < .001$, $\eta_p^2 = 0.01$). There was a main effect of sex ($F(1, 1{,}449) = 14.67$, $p < .001$, $\eta_p^2 = 0.03$), such that males ($M = 82.19$, $SD = 16.66$) had significantly lower overall cognitive functioning than females ($M = 84.98$, $SD = 15.72$). Finally, there was a significant main effect of income ($F(1, 1{,}449) = 27.37$, $p < .001$, $\eta_p^2 = 0.12$). Generally, as income increased, overall cognitive function improved.

Rote Memory (TMT-A)

There was a significant interaction between Hispanic identity and marital status on rote memory ($F(1, 1{,}442) = 8.86$, $p = .001$, $\eta_p^2 = 0.006$, see Table 3). For non-Hispanic individuals, rote memory did significantly differ ($t(1{,}474) = 2.30$, $p = .02$, $d = 0.12$) between married ($M = 42.09$, $SD = 9.98$) and unmarried ($M = 39.78$, $SD = 12.09$) individuals. For Hispanic individuals, there was also a significant difference ($t(1{,}474) = 2.54$, $p = .01$, $d = 0.13$) in rote memory between

Table 3. Effects of Marital Status and Ethnicity (Main Variables of Interest) on Each Neurocognitive Functioning Variable

	Marital status		Hispanic identity		Interaction	
Dependent measure	*F*	η_p^2	*F*	η_p^2	*F*	η_p^2
Overall cognitive functioning	0.02	0.001	130.64***	0.08	2.39	0.001
Rote memory	0.79	0.001	1.72	0.001	8.86***	0.006
Executive functioning	0.34	0.001	26.73***	0.02	3.74	0.003
Long-term processing/memory	0.22	0.001	4.15*	0.002	7.05**	0.005
Visuospatial/constructive memory	0.34	0.001	4.05*	0.002	2.43	0.002

	Sex		Income	
Dependent measure	*F*	η_p^2	F	η_p^2
Overall cognitive functioning	38.53***	0.03	27.37***	0.12
Rote memory	6.84**	0.005	2.58*	0.01
Executive functioning	1.98	0.001	2.71**	0.01
Long-term processing/memory	20.61***	0.01	7.83***	0.04
Visuospatial/constructive memory	13.55***	0.009	9.27***	0.04

Notes: $^*p < .05$. $^{**}p < .01$. $^{***}p < .001$.

married ($M = 37.72$, $SD = 13.86$) and unmarried ($M = 40.24$, $SD = 12.98$) individuals, but the effect reversed direction. For non-Hispanic individuals, being married was related to better rote memory, but for Hispanic individuals, the opposite was true. There was no main effect of Hispanic identity (F(1, 1,442) = 1.72, $p = .19$, $\eta_p^2 = 0.001$) or marital status (F(1, 1,442) = 0.80, $p = .37$, $\eta_p^2 = 0.001$). There was a main effect of sex (F(1, 1,442) = 6.84, $p = .008$, $\eta_p^2 = 0.004$), such that males ($M = 39.62$, $SD = 13.09$) had worse rote memory than females ($M = 40.93$, $SD = 13.51$). Finally, there was a significant main effect of income (F(1, 1,442) = 6.84, $p = .008$, $\eta_p^2 = .004$). Generally, as income increased, rote memory increased.

Executive Functioning (TMT-B)

There was no significant interaction between Hispanic identity and marital status on executive functioning (F(1, 1,333) = 3.74, $p = .05$). There was a significant main effect of Hispanic identity on executive functioning (F(1,1,333) = 26.73 $p < .001$, $\eta_p^2 = 0.02$, see Table 3) such that non-Hispanic individuals ($M = 48.58$, $SD = 13.99$) had better executive functioning than Hispanic individuals ($M = 44.70$, $SD = 24.53$). There was no significant difference (F(1, 1,333) = .14, $p = .71$, $\eta_p^2 = 0.001$) between married and unmarried individuals, or males and females (F(1, 1,333) = 1.98, $p = .16$, $\eta_p^2 = 0.001$). Finally, there was a significant main effect of income (F(1, 1,333) = 2.71, $p = .009$, $\eta_p^2 = 0.01$). Generally, higher-income ranges were associated with better executive functioning, although the pattern was less clear compared to that seen in overall cognitive functioning and rote memory.

Long-Term Processing and Memory—CLOX 1

There was a significant interaction between Hispanic identity and marital status on long-term processing and memory (F(1, 1,491) = 7.50, $p = .006$, $\eta_p^2 = 0.005$, see Table 3). Specifically, for non-Hispanic individuals, married individuals ($M = 12.43$, $SD = 2.51$) received higher scores on long-term processing and memory (t(1,523) = 2.39, $p = .02$, $d = 0.12$) compared to unmarried individuals ($M = 11.94$, $SD = 2.40$). However, for Hispanic individuals, long-term processing and memory did not significantly differ (t(1,480) = 1.33, $p = .18$) between married ($M = 11.41$, $SD = 2.58$) and unmarried ($M = 11.67$, $SD = 2.47$) individuals. There was also a significant main effect of Hispanic identity (F(1, 1,491) = 4.14, $p = .04$, $\eta_p^2 = 0.002$) such that Hispanic individuals ($M = 11.56$, $SD = 2.59$) had significantly lower long-term processing and memory than non-Hispanic individuals ($M = 12.28$, $SD = 2.52$). For the overall sample, there was no difference (F(1, 1,491) = .22, $p = .64$, $\eta_p^2 = 0.001$) between married and unmarried individuals. There was a main effect of sex (F(1, 1,491) = 20.61, $p < .001$, $\eta_p^2 = 0.01$), such that males ($M = 11.54$, $SD = 2.70$) had worse long-term processing and memory than females ($M = 12.01$, $SD = 2.52$). Finally, there was a main effect of income (F(1, 1,491) = 7.83, $p < .001$, $\eta_p^2 = 0.04$). Generally, as income increased, long-term processing and memory improved.

Visuospatial/Visuoconstructive Performance—CLOX 2

There was no significant interaction between Hispanic identity and marital status on visuospatial/visuoconstructive ability (F(1, 1,492) = 2.23, $p = .14$, $\eta_p^2 = 0.04$). There was a significant main effect of Hispanic identity on visuospatial/visuoconstructive ability (F(1, 1,492) = 22.62, $p < .001$, $\eta_p^2 = 0.01$, see Table 3) such that non-Hispanic individuals ($M = 13.54$, $SD = 1.96$) had better visuospatial/visuoconstructive ability compared to Hispanic individuals ($M = 12.93$, $SD = 2.48$). There was no significant difference (F(1, 1,492) = 1.33, $p = .25$, $\eta_p^2 = 0.001$) between married and unmarried individuals. There was a main effect of sex (F(1, 1,492) = 13.54, $p < .001$, $\eta_p^2 = 0.009$), such that males ($M = 12.95$, $SD = 2.58$) had worse visuospatial/visuoconstructive ability than females ($M = 13.28$, $SD = 2.13$). Finally, there was a main effect of income (F(1, 1,492) = 7.83, $p < .001$, $\eta_p^2 = 0.04$). Generally, as income increased, visuospatial/visuoconstructive ability improved. See Table 4 for all groups' means for ethnicity, marital status, and sex.

Discussion

It is well documented that being married is related to better physical and psychological health (e.g., Kiecolt-Glaser & Newton, 2001; Liu et al., 2019; Robles et al., 2014; Shrout, 2021). Yet, our understanding of the relationship between marital status and neurocognitive functioning is poor despite increasing life spans, which increases the risk for neurocognitive decline, and divorce rates are increasing for older adults (2021 Profile of Older Americans, 2022). This is the first study to examine the relationship between marital status and ethnicity (Hispanic vs non-Hispanic) in a sample of aging adults in rural Texas. We found that marital status (currently married vs not married) moderated the relationship between ethnicity (Hispanic vs non-Hispanic) and performance on indices of some neurocognitive functioning. These results provide the field with important information regarding the relationship between marital status and ethnicity on neurocognitive functioning. There was a significant interaction between ethnicity and marital status on overall neurocognitive functioning, rote memory, and long-term processing and memory. More specifically, for non-Hispanic individuals, married individuals had higher overall neurocognitive functioning compared to unmarried individuals, whereas overall neurocognitive functioning for Hispanic individuals did not significantly differ between married and unmarried individuals. In past findings (Gobbens & Remmen, 2019; Monserud, 2019; Parker et al., 2003), Hispanic widowed (vs married) older adults had lower levels of cognition. Based on these results, we would expect being married to result in greater neurocognitive functioning no matter ethnicity; however, it could be postulated that Hispanic (compared to non-Hispanic) individuals receive social support at a higher rate outside the marital relationship because their close-knit social circle also includes members of their extended family (Katiria Perez & Cruess, 2014).

The results in this study are consistent with literature on the Hispanic cultural value of *familism*, a web of relationships that extend beyond the immediate nuclear family. On the contrary, being married for non-Hispanic individuals may be more protective for neurocognitive functioning because their support comes primarily from their spouse. Further, the significant findings of marital status for non-Hispanic individuals on neurocognitive functioning could be due to the non-Hispanic group being predominantly White (94.3%). More specifically, it could be hypothesized based on past literature that if our non-Hispanic sample was mostly Black or Asian, we would not have found differences between the non-Hispanic and Hispanic groups as these racial groups have been found to have greater social networks that extend beyond the immediate family. Overall, these results indicate non-Hispanic individuals who are unmarried are more susceptible to lower neurocognitive functioning than non-Hispanic individuals who are married, which could be assessed as a possible risk factor. However, these results need to be replicated with other samples to increase generalizability, as well as conducted in a longitudinally designed study.

Hispanic individuals had lower neurocognitive functioning scores (rote memory, executive functioning, long-term processing and memory, and visuospatial/visuoconstructive) than non-Hispanic individuals. Past studies have postulated biases might exist with our measurement of neuropsychological assessments for Hispanic individuals (Goodman, 2021), due to many Hispanic individuals endorsing English being their second language and the possibility that Hispanic individuals are not introduced to content (e.g., wording of instructions and word stems) during their education. However, these neurocognitive measures have been validated with a Hispanic population in multiple studies (Goodman, 2021), though to our knowledge, none of these validation studies have been conducted with a rural Hispanic population. It could be hypothesized that the interaction between being Hispanic and living in a rural area results in worse neurocognitive functioning. This is supported by the Lifespan Biopsychosocial Model of Cumulative Vulnerability and Minority Health (Myers, 2009), which states accumulation of stress can result in negative physical and mental health outcomes. Therefore, the Hispanic participants in this study might have lower neurocognitive functioning than non-Hispanic participants due to the combination of ethnicity-related stressors in their environment as well as stressors related to living in rural areas (e.g., lack of access to health care and financial instability; Ziller & Milkowski, 2020).

It is important to highlight the unique context of the sample (i.e., rural aging adults) and how it might influence the implications of our results. Research has highlighted that persons in rural areas have less access to health care, less access to specialty professionals, lower income, and lower rates of insurance coverage (e.g., Creamer et al., 2022; Minden et al., 2008; Morgan et al., 2009; Smith & Trevelyan, 2019). Theories and empirical evidence support our results that Hispanic persons living in rural areas have lower neurocognitive functioning, when compared to non-Hispanic individuals living in rural areas. The Lifespan Biopsychosocial Model of Cumulative Vulnerability and Minority Health (Myers, 2009) provides a theoretical understanding that the greater accumulation of risk factors regarding race/ethnicity/SES-related stressors (e.g., economic hardships, physical deprivation, low

Table 4. Means for Each Level of Marital Status, Hispanic Identity, and Sex on Each Dependent Variable

	Marital status		Hispanic identity		Sex	
Dependent measure	Married	Unmarried	Hispanic	Non-Hispanic	Male	Female
Overall cognitive functioning	84.94	83.47	78.5***	92.11	82.19***	84.92
Rote memory	39.64	40.08	39.8	41.42	39.72**	40.93
Executive functioning	44.68	44.93	44.70***	48.58	46.39	46.62
Long-term processing/memory	11.83	11.84	11.56*	12.28	11.54***	12.00
Visuospatial/constructive memory	13.20	13.14	12.93*	13.54	12.95***	13.29

Notes: ANOVA = analysis of variance.
*$p < .05$. **$p < .01$. *** $p < .001$. Significant difference from other group in respective ANOVA.

status, occupational strain, neighborhood instability, and discrimination; Bulatao, 2004), the greater risk for health problems. Therefore, non-Hispanic individuals living in rural Texas might not experience as many risk factors as Hispanic individuals living in rural Texas, which contributes to better neurocognitive functioning. Further, empirical research has highlighted the combination of vulnerability factors, such as how being a racial minority, sexual and gender minority, and of lower SES, can lead to worse physical outcomes compared to someone who only has one vulnerability (e.g., Streed et al., 2017; Wang & Geng, 2019). Studies that examine the intersections of these vulnerabilities are limited and research is needed in this area to further understand cumulative vulnerabilities. Our research adds to the existing body of literature by presenting important findings that being Hispanic and living in rural Texas results in worse neurocognitive functioning, compared to non-Hispanic individuals living in rural Texas.

The relationship between living in rural areas and marital status on neurocognitive functioning has not previously been explored. This paper helped to fill this gap and provided evidence that being married is a protective factor for neurocognitive functioning, especially for non-Hispanic individuals. This supports past research that has found marital status to be a possible risk/protective factor for neurocognitive functioning (Liu et al., 2019) in an urban population. This is problematic for older adults living in rural areas as research has found that older adults have lower social support than those living in urban areas and rely more on their partners for support (e.g., Ajrouch et al., 2005; Chruściel et al., 2018; Koydemir-Özden, 2010; Melchiorre et al., 2013). Therefore, individuals who are in rural areas and are not married might be even more susceptible to negative outcomes than those unmarried in urban areas.

Clinical Implications

The results of this study provide the field of neuropsychology, neurology, and psychology as a whole, important information regarding identification and testing for neurocognitive functioning in a rural population of Hispanic and non-Hispanic aging adults. These preliminary results highlight the importance of marital status on neurocognitive functioning, particularly for non-Hispanic individuals. Therefore, it could be valuable for health care professionals to assess marital status within non-Hispanic individuals as it could be a risk/protective factor related to neurocognitive functioning in this population. Interestingly, based on our covariates (i.e., income and sex), marital status in non-Hispanic individuals appears to be a robust indicator of neurocognitive functioning no matter the person's income or sex. This is informative as healthcare professionals might have preconceived notions related to income level (i.e., lower socioeconomic status) or sex (i.e., being male) as being more important factors for identifying persons who might need to be screened for neurocognitive impairment than marital status. However, the results support the more robust factor is marital status for non-Hispanic aging adults. Notwithstanding, Hispanic aging adults living in rural areas appear to be more susceptible to lower neurocognitive functioning, regardless of marital status, than non-Hispanic individuals. Therefore, early identification and testing of neurocognitive functioning in rural areas is critical, especially for Hispanic individuals and non-Hispanic individuals who are not married. Utilizing screening of cognitive functioning through primary care physician's offices might be an appropriate avenue, while also aiming to reduce the cumulative stress Hispanic persons living in rural areas experience. Further, these findings have downstream effects on the diagnosing of neurodegenerative disorders, such as AD/ADRD, and early identification could improve outcomes while also preparing the family unit for this neurodegenerative disease, which can affect a person for many years.

Limitations

The results of this study should be interpreted with limitations in mind. First, this was a cross-sectional study, so no causal inferences can be made. Second, we did not examine stressful life experiences, so our hypothesis that the reason Hispanic individuals have lower neurocognitive functioning is due to Hispanic individuals experiencing more life stressors cannot be confirmed in this population. However, a robust amount of research (Bulatao, 2004) has highlighted that Hispanic individuals indeed experience more life stressors, such as economic hardships, physical deprivation, low status, occupational strain, neighborhood instability, and discrimination compared to non-Hispanic individuals. It would be advantageous to investigate lifetime stressors in future studies to understand the relationship between lifetime stressors and neurocognitive functioning in rural populations regardless of ethnicity. Third, we did not distinguish based on why they are unmarried as there could be differences between widows, divorcees, and people who have never been married. Lastly, this study only investigated some aspects of neurocognitive functioning (i.e., rote memory, executive functioning, long-term processing and memory, and visuospatial/visuoconstructive ability). Future studies should investigate other aspects of neurocognitive functioning, such as episodic memory, to better understand whether the results of this study hold for other aspects of neurocognitive functioning.

Conclusion

Within this study, we identified differences in neurocognitive functioning in Hispanic and non-Hispanic individuals living in rural Texas, with Hispanic individuals having lower scores on all measures of neurocognitive functioning. The Lifespan Biopsychosocial Model of Cumulative Vulnerability and Minority Health (Myers, 2009) provides a possible rationale for these results as it postulates that race/ethnicity/SES-related stressors (e.g., economic hardships, physical deprivation, low status, occupational strain, neighborhood instability, discrimination; Bulatao, 2004) result in greater stress and exacerbate the impact of other life stressors. Therefore, the added stress Hispanic persons living in rural areas experience might result in worse neurocognitive functioning. Future studies should aim to reduce stress on Hispanic aging adults living in rural areas to investigate if this mitigates the differences in neurocognitive functioning between Hispanic and non-Hispanic individuals. Lastly, the importance of marital status on neurocognitive functioning for non-Hispanic individuals, but not as much for Hispanic individuals, should not be ignored, and future studies are needed to understand the underlying mechanism of this relationship in rural populations.

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Conflict of Interest

None.

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