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Original Article

Sex differences in subjective cognition among middle-aged and older Hispanic/Latino adults: Findings from the HCHS/SOL and SOL-INCA

Ariana M. Stickel [a,*], Wassim Tarraf [b], Sayaka Kuwayama [c], Ammie Xie [c], Rachel Membreno [a,d], Carolina L. Costa [a], Carlos E.E. Araujo Menendez [a,e], Zvinka Z. Zlatar [f], Krista M. Perreira [g], Haibo Zhou [h], Martha Daviglus [i], Amber Pirzada [i], Paola Filigrana [j], Bonnie E. Levin [k], Linda C. Gallo [a], Hector M. González [c,1], Sarah J. Banks [c,**,1]

[a] Department of Psychology, San Diego State University, San Diego, CA, USA
[b] Institute of Gerontology & Department of Healthcare Sciences, Wayne State University, Detroit, MI, USA
[c] Department of Neurosciences, University of California, San Diego, La Jolla, CA, USA
[d] Department of Psychological & Brain Sciences, Washington University in St. Louis, St. Louis, MO, USA
[e] SDSU/UC San Diego Joint Doctoral Program in Clinical Psychology, San Diego, CA, USA
[f] Department of Psychiatry, University of California, San Diego, La Jolla, CA, USA
[g] Department of Social Medicine, University of North Carolina School of Medicine, Chapel Hill, NC, USA
[h] Department of Biostatistics, University of North Carolina-Chapel Hill, Chapel Hill, NC, USA
[i] Institute for Minority Health Research, University of Illinois at Chicago, College of Medicine, Chicago, IL, USA
[j] Department of Epidemiology & Population Health, Albert Einstein College of Medicine, Bronx, NY, USA
[k] Department of Neurology, University of Miami, School of Medicine, Miami, FL, USA

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ABSTRACT

Introduction: Sex differences in subjective cognitive decline (SCD) exist, yet the extent to which these differences generalize to underrepresented groups is unknown. Therefore, we investigated relationships between sex and SCD among Hispanic/Latino adults.
Method: Participants were 5985 Hispanic/Latino adults from the Study of Latinos - Investigation of Neurocognitive Aging. We performed survey-adjusted linear regressions to test the associations between sex (male/female) with SCD and modifications by cardiovascular disease (CVD) risk, social and language acculturation. SCD was measured using the Everyday Cognition 12-item questionnaire, including executive functioning, memory, language, and visuospatial domains.
Result: Overall, females reported more SCD in language and visuospatial domains. This was less pronounced for 1) language SCD at lower levels of CVD risk, and 2) visuospatial SCD with higher language acculturation.
Discussion: Hispanic/Latina females self-reported more cognitive decline than males, but these differences were less pronounced in the context of lower CVD risk and higher language acculturation.

1. Background

Cognitive changes can be a normal part of the aging process [1], but excess decline may be indicative of a neurodegenerative process. Identifying abnormal cognitive decline early can lead to better treatment and slower cognitive decline which can preserve daily functioning longer as well. Seeking treatment depends on several factors; one of the most critical is an individual's perception of their cognitive decline (also known as subjective cognitive decline; SCD). Importantly, SCD can also be a preclinical marker of future objective cognitive decline and has mixed associations with cognitive functioning among Hispanic/Latino adults [2–4]. Better understanding SCD in Hispanic/Latino populations may help address Alzheimer's disease and related dementia disparities in this community [5].

Several factors might impact SCD. Broadly, sex is one of the factors most commonly shown to impact SCD. Sex is based on biology, and the

* Corresponding author at: San Diego State University, 6367 Alvarado Court, Suite 300, San Diego, CA, 92120.
** Corresponding author at: University of California, San Diego, 9500 Gilman Drive #0841, La Jolla, CA 92093-0949.
E-mail addresses: astickel@sdsu.edu (A.M. Stickel), sbanks@health.ucsd.edu (S.J. Banks).
[1] Co-senior authors

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majority of studies are limited to self-report of binary sex assigned as birth (male, female). Distinct from sex, is gender which exists on a spectrum but is often described and reported in binary terms (men, women) in the existing literature. Given that the two are often conflated in studies on aging [6], we considered both sex and gender differences in SCD. Some studies suggest that women report SCD more than men despite showing more stable cognition in late middle age and early older adulthood [7–9]. However, others have found the opposite association: men report more SCD, [10] and some have found no sex differences [11]. Sex differences in subjective health are important to document, as gender and sex biases often occur in a variety of settings (e.g., females reporting pain but not receiving appropriate treatment) and may be compounded for individuals from underrepresented ethnic and racial groups, underscoring the need to characterize SCD among Hispanic/Latino adults [12,13].

Findings from cross-ethnic comparisons of SCD that include Hispanic/Latino adults are mixed. In the Health and Retirement Study, older Hispanic/Latino adults, as a group, reported less SCD in the presence of low scores on cognitive testing compared to their non-Hispanic/Latino White peers [14]. In contrast, data from the Behavioral Risk Factor Surveillance System suggested that among middle-aged individuals reporting SCD, Hispanic/Latino adults were more likely to report SCD compared to their non-Hispanic/Latino White peers [15]. Furthermore, compared to non-Hispanic White and Black older adults, Hispanic/Latino individuals were more likely to self-report one or more cognitive concerns [16]. Interestingly, Zlatar and colleagues [3] found that, in a convenience sample of Hispanic/Latino older adults, SCD was more closely associated with depressive symptoms than with objective cognitive outcomes, yet more recent work in this population links SCD to objective cognition independent of depressive symptoms [4,16]. For instance, our follow-up work in a larger sample of diverse Hispanic/Latino adults from the Hispanic Community Health Study/Study of Latinos (HCHS/SOL), identified relationships between SCD and objective cognition which were robust to adjustment for depressive symptoms [4].

Few studies have investigated sex differences in SCD within Hispanic/Latino samples. In the Colombian autosomal dominant Alzheimer disease (ADAD) kindred study, cognitively unimpaired females reported more SCD than their male counterparts, regardless of whether they carried the mutation for ADAD [8]. Other factors that tend to differ by sex, such as cardiovascular disease risk and language acculturation (e.g., level of Spanish versus English language use across a variety of settings) [17–19] may also impact SCD. Cardiovascular disease risk factors, especially the presence of multiple cardiovascular disease risk factors, which are common among U.S. Hispanic/Latino adults [17], are associated with increased reports of SCD [18,20]. Acculturation may impact the interpretation of cognitive decline among Hispanic/Latino adults. Although lower acculturation to Anglo-American standards has been associated with lower performance on cognitive testing among Hispanic/Latino adults [21] this may reflect familiarity with existing tests and testing environments rather than true differences in cognitive abilities. Additionally, individuals with higher acculturation (especially English language use) may have increased exposure to information on cognitive aging and dementia risk [22]. Thus, we aimed to compare SCD between male and female Hispanic/Latino adults from various heritage groups. We predicted that females would be more likely to report SCD than males, and this would be exacerbated in the presence of higher cardiovascular disease risk and higher acculturation to Anglo-American standards.

2. Method

Data were from the Hispanic Community Health Study / Study of Latinos (HCHS/SOL; 2008–2011) and the SOL-Investigation of Neurocognitive Aging (SOL-INCA; 2016–2018). The HCHS/SOL is a prospective, probability-sampled cohort study of community-based U.S. adults with diverse Hispanic/Latino backgrounds, aimed at assessing prevalence, incidence, and correlates of cardiovascular and pulmonary disease as well as identifying risk factors for those diseases. Participants of the HCHS/SOL ages 18 to 74 years were recruited from four major metropolitan areas: Bronx, NY; Chicago, IL; Miami, FL; and San Diego, CA. Approximately 4000 individuals were recruited from each area, leading to a total sample of 16,415. The data were collected through interviewer-administered questionnaires and clinical examinations. The SOL-INCA was conducted during the second follow-visit of the HCHS/SOL (Visit 2; roughly 7 years after Visit 1) and aimed to examine cognitive aging among the middle-aged and older Hispanic/Latino adults. The SOL-INCA included 6377 participants ages 50 years and older who returned for HCHS/SOL Visit 2 and completed neurocognitive testing at baseline (Visit 1). To ensure generalizability of results from the SOL-INCA participants to its target population, all statistical analyses account for the complex survey design and sample weights.

2.1. Outcomes

The primary outcome was 10-year subjective cognitive decline (SCD) measured using Everyday Cognition 12-item questionnaire (ECog-12) which was administered in the participant's preferred language [23]. The ECog-12 items were ranked on a Likert-type scales ranging from 1=better or no change, 2=questionable/occasionally worse, 3=consistently a little worse, to 4=consistently much worse. The responses to the ECog-12 were then used to assess SCD in total (global SCD) and by domain–memory, language, visual spatial planning (VSP), and executive function–where the scores for each domain were calculated by averaging the responses across the corresponding items. The breakdown of items by domain can be viewed in Supplemental Table 1.

2.2. Exposure

The primary exposure was sex (male, female).

2.3. Covariates

The covariates included age (measured continuously), education (less than high school, high school or equivalent, more than high school), Hispanic/ Latino background (Dominican, Central American, Cuban, Mexican, Puerto Rican, South American, More than one/other), and field center (Bronx, Chicago, Miami, San Diego). Psychological distress (e.g., symptoms of depression or anxiety) can also influence SCD and objective cognitive function [3,24], but the direct associations between anxious depression and SCD are understudied despite being linked to objective cognition among diverse Hispanic/Latino adults [25]. The combination of depression and anxiety is well-documented among Hispanic/Latino adults; therefore, to capture psychological distress, we categorized participants according to scores on measures of depression and anxiety symptoms [25,26] as: typical anxiety-typical depression, typical anxiety-high depression, high anxiety-typical depression, and high anxiety-high depression, based on binary measures of depression (the Center for Epidemiologic Studies Depression – 10-item; typical depression: <10, high depression: ≥ 10) and anxiety (the 10-item State-Trait Anxiety Inventory; typical anxiety: <20, high anxiety: ≥ 20). Additionally, three measures served as covariates and modifiers. We included two acculturation factors from the Short Acculturation Scale for Hispanics – Language subscale (SASH Language) and – Social subscale (SASH Social) [27]. Framingham CVD 10-year risk score (FRS) was used categorically defined as low ($<10\%$), medium ($10-<20\%$), and high ($\geq 20\%$) [28].

2.4. Analytical subpopulation

Our starting SOL-INCA sample included 6377 participants. Participants with missing values in any of the study covariates (SASH Social: n

= 275, SASH Language: n = 12, FRS: n = 51, Education: n = 19, Hispanic/Latino background: n = 14, Anxious depression: n = 68) were excluded, resulting in the total analytic population of n = 5985. Since missingness was less than 10%, we did not perform multiple imputation of missing data.

2.5. Analytic approach

All analyses outlined below were conducted using Stata 17 (StataCorp LLC, College Station, TX) and accounted for the complex survey design (stratification, clustering) and sampling weights using survey functionality of Stata 17.

First, we report descriptive statistics for the target population. Specifically, we estimated the means and standard deviations for continuous variables and proportions along with the standard errors for categorical variables. We also tested distributional differences for these variables by sex with F-tests for continuous and Chi-squared tests for categorical variables. These descriptive statistics are presented in Table 1 (covariates) and Supplemental Table 2 (ECog-12 outcomes). Weighted correlations among the ECog-12 outcomes were calculated using Pearson correlation coefficients (Supplemental Table 3). (Table 2; Supplemental Table 4 for SEs). To assess potential multicollinearity among the covariates, variance inflation factors (VIFs) were calculated (Supplemental Table 5). As a sensitivity analysis, we adjusted for multiple comparisons across the five outcomes. Adjusted values were computed using the "simes" method implemented in Stata's user contributed "qqvalue" command [29] (Supplemental Table 6).

Next, we used survey linear regressions to compare ECog-12 global and domain scores by sex, with three sets of covariables. The first model (M1) was a crude model, the second model (M2) adjusted for age, education, Hispanic/Latino background, and field center. The third model (M3) additionally adjusted for anxious depression, SASH Social, and SASH Language, and FRS.

Finally, we conducted test of effect modifications to assess whether variables of interest modify the sex differences on the ECog-12 outcomes. The variables of interest included SASH Social, SASH Language, and FRS. Each of the interaction terms was separately entered to the fully adjusted models from earlier analysis (M3) and was evaluated with Wald tests (Table 3). In post-hoc analysis, we estimated and plotted the average marginal means as well as contrasts based on these interaction models to visualize and aid interpretation of the results (Fig. 1: marginal means; Supplemental Fig. 1: contrasts).

As a sensitivity analysis, we replicated the investigations above using survey generalized linear models with gamma distribution and log link, given the right-skewed distribution of the ECog-12 outcomes (Supplemental Tables 7 and 8).

3. Results

3.1. Descriptive characteristics

Descriptive characteristics for the SOL-INCA target population overall and by sex are shown in Table 1. The average age was 63.3 years (SD = 8.2), with over 60% reporting a high school level of education or more. Significant differences between females and males (p-value < 0.05) were found for all variables, except for age. Secondly, females were more likely to have reported elevated depression and anxiety scores. For the SASH Social and Language subscales, females had lower scores, indicating less acculturation to the typical U.S. culture. Females also had lower FRS. The mean and SD of the ECog-12 outcomes for the target population are also presented overall and by sex in Supplemental Table 2. Weighted correlations among the ECog-12 outcomes are presented in Supplemental Table 3.

Table 1
Descriptive statistics of the SOL-INCA target population.

	Male (N = 2128)	Female (N = 3857)	Overall (N = 5985)	P-value
Education (%, SE)				
Less Than High School	35.42	41.06	38.50	0.001
	(1.54)	(1.31)	(1.10)	
High School or equivalent	24.15	19.28	21.49	
	(1.32)	(0.96)	(0.79)	
Greater Than High School	40.43	39.65	40.00	
	(1.59)	(1.18)	(1.02)	
Hispanic/Latino Background (%, SE)				
Dominican	8.62	10.65	9.73	0.008
	(0.99)	(0.84)	(0.80)	
Central American	6.16	7.84	7.08	
	(0.70)	(0.66)	(0.54)	
Cuban	27.97	22.09	24.75	
	(2.21)	(1.78)	(1.82)	
Mexican	33.14	34.75	34.02	
	(2.05)	(1.75)	(1.69)	
Puerto Rican	15.54	15.62	15.58	
	(1.15)	(0.88)	(0.83)	
South American	4.74	5.39	5.10	
	(0.48)	(0.48)	(0.38)	
Other	3.83	3.67	3.74	
	(0.68)	(0.62)	(0.46)	
Field Center (%, SE)				
Bronx	25.38	29.30	27.53	0.007
	(1.76)	(1.72)	(1.53)	
Chicago	14.38	11.81	12.97	
	(1.09)	(0.86)	(0.89)	
Miami	36.26	33.52	34.76	
	(2.55)	(2.22)	(2.24)	
San Diego	23.98	25.37	24.74	
	(2.02)	(1.70)	(1.69)	
Anxious Depression (%, SE)				
Typical Depression and Typical Anxiety	70.20	53.83	61.25	<0.001
	(1.42)	(1.17)	(0.94)	
Typical Depression, High Anxiety	6.97	8.82	7.98	
	(0.75)	(0.73)	(0.52)	
High Depression, Typical Anxiety	9.60	13.03	11.48	
	(1.05)	(0.82)	(0.69)	
High Depression and High Anxiety	13.23	24.32	19.29	
	(1.03)	(0.96)	(0.68)	
FRS (%, SE)				
Low	22.74	59.33	42.74	<0.001
	(1.28)	(1.19)	(0.98)	
Medium	33.39	25.99	30.25	
	(1.46)	(1.10)	(0.92)	
High	41.87	14.68	27.01	
	(1.70)	(0.92)	(1.07)	
Age (M, SD)	62.99	63.52	63.28	0.105
	(7.07)	(8.99)	(8.15)	
SASH Social (M, SD)	2.17	2.10	2.13	0.001
	(0.52)	(0.66)	(0.60)	
SASH Language (M, SD)	1.83	1.63	1.72	<0.001
	(0.87)	(0.99)	(0.95)	

Note 1. All reported values, except for sample size, are weighted.
Note 2. Depression = Center for Epidemiologic Studies Depression summary score; CESD, Typical Depression=typical depression (CESD <10), High Depression=high depression (CESD ≥10), Anxiety=State - Trait Anxiety Inventory summary score; STAI, Typical Anxiety = typical anxiety (STAI<20), High Anxiety=high anxiety (STAI ≥20), FRS=Framingham CVD 10-year risk score, SASH=Short Acculturation Scale for Hispanics, M=Mean, SD=Standard Deviation, SE=Standard Error.
Note 3. Age was measured at SOL-INCA. All other covariates were measured at Visit 1.

3.2. Linear regression analysis

The results from the linear regression analyses are presented in Table 2 (see Supplemental Table 4 for SEs). In the crude models (M1), female sex was associated with higher ECog-12 global scores (indicating

Table 2
Associations between sex and subjective cognitive decline (ECog-12).

	M1	M2	M3
	ECog-12 Memory		
Female	ref	ref	ref
Male	−0.09** [−0.14;−0.03]	−0.07* [−0.13;−0.02]	−0.04 [−0.11;0.02]
	ECog-12 Language		
Female	ref	ref	ref
Male	−0.16*** [−0.21;−0.10]	−0.15*** [−0.20;−0.09]	−0.10** [−0.16;−0.04]
	ECog-12 VSP		
Female	ref	ref	ref
Male	−0.13*** [−0.18;−0.08]	−0.12*** [−0.16;−0.07]	−0.08** [−0.13;−0.02]
	ECog-12 Executive		
Female	ref	ref	ref
Male	−0.02 [−0.07;0.03]	−0.01 [−0.06;0.03]	0.02 [−0.03;0.08]
	ECog-12 Global		
Female	ref	ref	ref
Male	−0.07** [−0.12;−0.03]	−0.06** [−0.11;−0.02]	−0.03 [−0.08;0.02]

Note 1. ECog-12= Everyday Cognition 12-item questionnaire, VSP=Visual Spatial Planning, ref=reference.
Note 2. M1 is a crude model. M2 adjusted for Age, Education, Hispanic/Latino Background, and Field Center. M3 additionally adjusted for Anxious depression, Framingham CVD 10-year risk score, and Short Acculturation Scale for Hispanics – Social and – Language subscales.

Table 3
Associations between ECog-12 and sex – interaction by SASH Social, SASH Language, FRS, and anxious depression.

SASH- Social		
Cognitive Outcome	F (1, 612)	P-value
ECog-12 Memory	0.27	0.60
ECog-12 Language	0.02	0.90
ECog-12 VSP	0.56	0.45
ECog-12 Executive	0.01	0.91
ECog-12 Global	0.02	0.88
SASH- Language		
Cognitive Outcome	F (1, 612)	P-value
ECog-12 Memory	4.02	0.05
ECog-12 Language	1.06	0.30
ECog-12 VSP	6.09	0.01
ECog-12 Executive	2.48	0.12
ECog-12 Global	4.17	0.04
FRS		
Cognitive Outcome	F (2, 611)	P-value
ECog-12 Memory	1.02	0.36
ECog-12 Language	3.55	0.03
ECog-12 VSP	1.92	0.15
ECog-12 Executive	1.75	0.18
ECog-12 Global	2.69	0.07

Note 1. ECog-12= Everyday Cognition 12-item questionnaire, VSP=Visual Spatial Planning, FRS= Framingham CVD 10-year risk, SASH Social=Short acculturation scale for Hispanics.
Note 2. Models were adjusted for Age, Education, Hispanic/Latino Background, Field Center, Anxious depression, Framingham CVD 10-year risk score, and Short Acculturation Scale for Hispanics – Social and – Language subscales.

larger degree of SCD) and higher domain-specific SCD in Memory, Language, and VSP. These results remained largely unchanged when adjusting for the demographic factors (M2). When adjusted for additional covariates in M3, the associations of sex with ECog-12 Global and Memory were attenuated. The associations of sex with ECog-12 Language and VSP were attenuated in effect magnitude but remained statistically significant after further covariate adjustment in M3 (b[95%CI] $_{\text{ECog-12 Language}} = -0.10[-0.16\ -0.04$; b[95%CI], $_{\text{ECog-12 VSP}} = -0.08$ $[-0.13,-0.02]$; ps = < 0.01). Overall, the VIF values do not suggest multicollinearity concerns (Supplemental Table 5). Only one indicator variable (for Cuban background) exhibited a VIF above 5 (VIF=5.17), likely reflecting the geographic concentration of this group at the Miami site. In sensitivity analysis accounting for multiple comparisons, results were consistent (Supplemental Table 6).

3.3. Tests of effect modification

The results from the interaction analysis are shown in Table 3. The modification of sex by SASH Language was significant for ECog-12 VSP (F [1, 612] = 6.09; p-value = 0.01). Specifically, at lower levels of language acculturation, females report more VSP SCD, yet sex-based differences in VSP SCD appeared to be smaller at higher levels of language acculturation (Fig. 1a, Supplemental Fig. 1a). The modification of sex by SASH Language was also significant for ECog-12 Global (F [1, 612] = 4.17; p-value = 0.04). However, the plot of average marginal means along their 95% CIs show that the finding is not strong enough to conclude clear effect modification (Fig. 1a, Supplemental Fig. 1a). Additionally, the interaction between sex and FRS was present (F [2, 611] = 3.55; p-value = 0.03) for the ECog-12 Language outcome. That is, there were sex differences in Language SCD at medium and high levels of CVD risk, but they were not observed in the low level (Fig. 1b, Supplemental Fig. 1b).

3.4. Sensitivity analysis

The results from the sensitivity analysis using the generalized linear models (gamma distribution, log link) are presented in Supplemental Table 7 for the sex association analysis, and in Supplemental Table 8 for the analyses of effect modification. The results were robust across different modeling approaches, including linear and gamma regression.

4. Discussion

We found that females self-reported more SCD compared to males in a large, representative sample of middle-aged and older Hispanic/Latino adults. Sex-related differences in SCD were evident in the language and visuospatial domains. However, these sex-differences were less pronounced in the context of lower cardiovascular disease risk and higher language acculturation, respectively. Our findings underscore the importance of measuring SCD in Hispanic/Latino adults, especially females, and considering factors such as cardiovascular health and language acculturation when doing so.

Compared to previous research findings and consistent with findings from predominantly non-Hispanic/Latino White samples [7,30–32], our results indicated that females reported more SCD compared to males. In particular, we found sex differences in SCD across most cognitive domains, except executive functioning, after accounting for demographic factors. This is notable given that our sample has a wide-range of educational attainment, and lower education has been associated with greater memory complaints [9]. Additionally, depressive-anxious symptoms, acculturative factors, cardiovascular disease risk, and may partially account for these relationships: after accounting for these factors, males only reported lower SCD for language and visual spatial domains relative to females. Interestingly, previous work suggests that self-reported memory complaints or worsening memory was associated with faster objective cognitive decline across several cognitive domains, including visuospatial abilities, when accounting for sex [31]. Additionally, in the same cohort, females reporting SCD exhibited lower scores on objective cognition compared to males [30]. There are sex differences in rates of engagement of certain visuospatial tasks [33], potentially influencing performance and maintenance of visuospatial skills in later life. In contrast, there is more mixed evidence for sex differences on objective language tasks [34,35], and, in the current

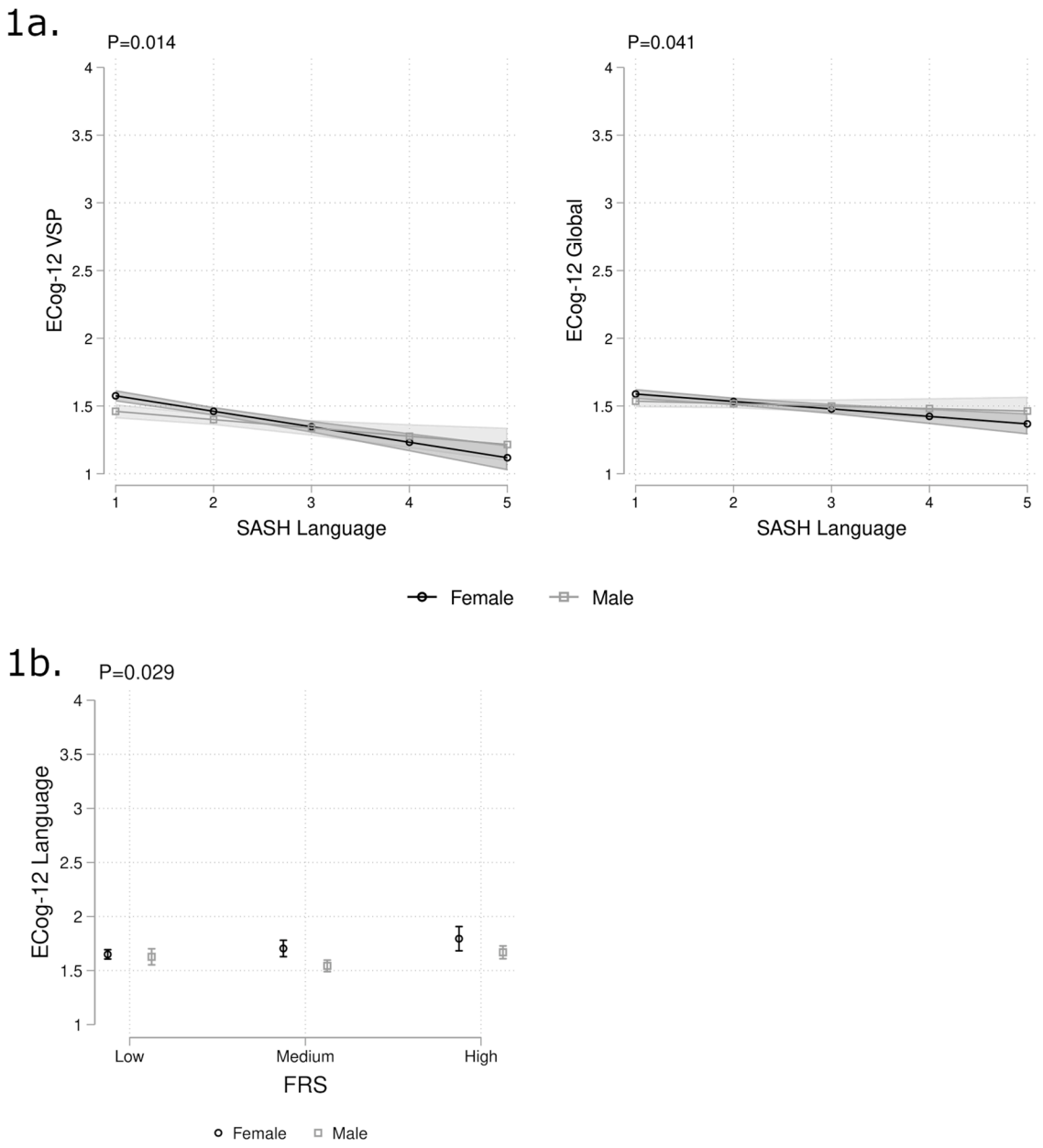

Fig. 1. Sex interactions with (a) SASH Language on ECog-12 VSP and ECog-12 Global and (b) FRS on ECog-12 Language.
Note 1. ECog-12= Everyday Cognition 12-item questionnaire, VSP=Visual Spatial Planning, FRS= Framingham CVD 10-year risk, SASH Social=Short acculturation scale for Hispanics, Note 2. Models adjusted for Age, Education, Hispanic/Latino Background, Field Center, Framingham CVD 10-year risk score, Short Acculturation Scale for Hispanics – Social and – Language subscales, and Anxious depression. Note 5. ECog-12 variables range: 1–4.

study, males reported less decline in language abilities.

It is unclear whether sex-differences in SCD, such as those detected in the present study, are related to sociological differences, biological differences, or a combination of the two. Some have suggested that SCD may be a more sensitive marker for females compared to males, possibly related to sex differences in awareness with females being more aware of subtle cognitive changes. Supporting this notion, self- and informant-reported SCD have been associated with worse verbal memory scores in females compared to males [11]. Another important sex difference in SCD is whether it results in worry: females express worry in the presence of SCD approximately 1.5 to 2.5-times more often than males [7]. Despite this, sex differences in language and visuospatial SCD were maintained (i.e., they were still significant) over and above anxious-depressive symptoms in the present study. Although this may seem contradictory to previous work, the items in our measure of anxious-depressive symptoms did not attempt to survey psychological distress symptoms in the context of subjective cognition. In fact, in our previous work, SCD was linked to objective cognition, particularly for Hispanic/Latino individuals who expressed worries about their cognition [36].

From a biological perspective, age-related declines in estrogen, which are more pronounced in females, influence cognitive abilities including learning, memory, and motor skills [37]. Additionally, hormonal changes during the menopause transition have been associated with increased subjective memory complaints [38,39]. Given that the females in our sample were 50 years and older with the majority being postmenopausal, it is possible that some of them may still be experiencing cognitive fluctuations related to the menopause transition and may be more likely to report SCD. Interestingly, SCD has been linked to Alzheimer's disease and related dementias biomarkers, regardless of sex

[11,40]. Given that estrogen may protect against Alzheimer's disease [41], and we have detected connections between reproductive health history and objective cognition among females in the SOL-INCA cohort [42], reproductive health may be an important factor to consider in future SCD research.

Our study was novel in its consideration of several potential modifiers (acculturation, cardiovascular disease risk) in the relationships between sex and SCD. Strikingly, there was little evidence of modification of the relationships between sex and SCD with two exceptions. First, the SCD gap between males and females was less pronounced at higher levels of language acculturation. Although small in magnitude, this suggests cultural differences in how Hispanic/Latino adults, particularly females, respond to SCD questions on visuospatial abilities. The visuospatial items on the ECog-12 reflect abilities to read a map and help with directions while someone is driving and finding one's way around a familiar place. Lower acculturation has been associated with lower likelihood of driving, and active driving status was linked to better objective cognition scores [43]. Sociological differences in navigation strategies and driving confidence have been documented [44,45] and may influence sex differences in responses to the visuospatial items on the ECog-12. For example, women tend to rely on landmarks more for navigation [45] which may limit map reading skills and can be vulnerable to errors when landmarks change over time. Additionally, Hispanic/Latino individuals have larger gender differences in transportation compared to other racial/ethnic groups: Hispanic/Latina women tend to commute shorter distances and are more likely to use non-automobile transportation modes than Hispanic/Latino men [46]. Taken together, it is important to consider whether sex differences in SCD reflect acculturative differences. In fact, there is evidence of small but present differential item functioning for Hispanic/Latino and Black adults compared to non-Hispanic/Latino White adults in the full ECog for the Visuospatial domain [47].

Cardiovascular disease risk also modified the relationship between sex and SCD. Specifically, at medium and high levels of cardiovascular disease risk language-related SCD was greater among females relative to males, suggesting that females are particularly susceptible to language SCD in the presence of cardiovascular disease risk. Similarly, previous work suggests that females with high cardiovascular disease risk are more susceptible to worse scores on objective cognitive performance and increased cognitive decline, including in language, than males [48,49]. The two items included in the ECog-12 language domain (communicating thoughts in a conversation, understanding spoken directions or instructions) also encompass working memory and executive functioning, cognitive tasks that may be sensitive to the effects of cardiovascular disease risk on brain networks that engage the frontal lobe and/or frontal-subcortical areas) [50]. However, we did not detect a similar modification of the association between sex and executive functioning SCD. The distinction in the language domain specifically, may be related to females greater use of verbal communication in social settings relative to males [51], possibly making them more aware of changes to language with age. Alternatively, differences may be related to menopausal changes in sex hormones that can be associated with cognitive aspects of communication (e.g., verbal fluency) but also physical aspects (e.g., changes to voice) [52,53].

Broadly, the stronger impact of cardiovascular disease risk on SCD among females may be due to various differences in biological (e.g., hormones, genetics), psychosocial (e.g., cultural norms, education), and lifestyle (e.g., social network, caregiving) factors [54]. For example, females are more likely to engage in group exercise [55]. Therefore, in the pursuit of maintaining lower cardiovascular disease risk, social behaviors which can be protective of cognitive aging, may be more likely among females. Alternatively, cardiovascular disease risk in mid- and late-life may be more strongly connected to cognition among females due to hormonal changes (e.g., menopause) [56]. Despite this, our previous work suggests mixed sex differences at the level of the brain: Hispanic/Latina females exhibit more age-related white matter hyperintensities on magnetic resonance imaging, a marker of cerebrovascular damage, yet males have smaller total brain volumes at high cardiovascular risk levels compared to females [57,58]. Interestingly, greater SCD was linked to lower cerebral blood flow in the entorhinal cortex and worse objective memory performance in those with high, but not low, cardiovascular disease risk, after accounting for sex [59]. Future research should examine whether sex modulates the relationships between SCD and cerebral blood flow for those with high cardiovascular disease risk.

There are some limitations to consider. First, as noted above, previous work suggests differential item functioning on the full ECog questionnaire for Hispanic/Latino and Black adults compared to White adults [47]. Although this bias was determined to be minimal, and the associations between ECog scores with cognitive and brain outcomes did not differ by race/ethnicity [47], it may be contributing to our results. In particular, females with lower language acculturation may have higher visuospatial SCD than other groups. Second, we did not examine the concordance between SCD and objective cognitive decline in the current study. Our previous work in the SOL-INCA suggests that SCD is associated with changes (declines) in cognition, particularly for males [36], but it did not include visuospatial or language domains of SCD. Third, certain SCD domains may need to be interrogated further. For example, Drouin and colleagues [32] detected multiple, distinct sex-specific associations between various measures of subjective memory (e.g., memory complaints, concerns, self-efficacy) and objective cognitive decline. Despite this, our choice to use the ECog-12 has the advantage of assessing SCD in multiple domains unlike single-item measures yet balances time burden, increasing the likelihood that this measure might be used in busy clinical settings [60]. Fourth, it is unclear whether the differences between males and females were biologically-based versus influenced by overlapping, but distinct, gender norms. Future studies are needed to disentangle the unique and intersecting roles of sex and gender on SCD. Finally, although we controlled for anxious-depression symptoms, the cut-off for constituting psychological distress may vary by sex and warrants psychometric analysis.

5. Conclusion

In a population-based sample of nearly 6000 Hispanic/Latino adults, females tended to self-report more cognitive decline than males, particularly in language and visuospatial functioning. Notably, higher self-reported SCD among females appeared to be minimized in the context of higher language acculturation and lower CVD risk. Our findings warrant investigations into potential biopsychosocial mechanisms underlying these nuanced relationships between sex and SCD.

Consent statement

All human subjects provided informed consent.

Generative AI statement

AI was not used in the writing of this manuscript.

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CRediT authorship contribution statement

Ariana M. Stickel: Writing – review & editing, Writing – original draft, Supervision, Project administration, Methodology, Conceptualization. **Wassim Tarraf:** Writing – review & editing, Writing – original draft, Methodology, Formal analysis, Data curation, Conceptualization. **Sayaka Kuwayama:** Writing – original draft. **Ammie Xie:** Writing – review & editing. **Rachel Membreno:** Writing – original draft. **Carolina L. Costa:** Writing – review & editing, Writing – original draft. **Carlos E. E. Araujo Menendez:** Writing – review & editing. **Zvinka Z. Zlatar:** Writing – review & editing. **Krista M. Perreira:** Writing – review & editing. **Haibo Zhou:** Writing – review & editing. **Martha Daviglus:** Writing – review & editing. **Amber Pirzada:** Writing – review & editing. **Paola Filigrana:** Writing – review & editing. **Bonnie E. Levin:** Writing – review & editing. **Linda C. Gallo:** Writing – review & editing. **Hector M. González:** Writing – review & editing. **Sarah J. Banks:** Writing – review & editing.

Declaration of competing interest

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Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.tjpad.2026.100637.

Data availability

https://biolincc.nhlbi.nih.gov/studies/hchssol/ (Data used in this project is from the Hispanic Community Health Study/Study of Latinos. It includes non-public and publicly available data. For publicly available data see:)

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