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Associations between perceived neighborhood environment and cognitive function among middle-aged and older women and men: Hispanic Community Health Study/Study of Latinos Sociocultural Ancillary Study

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INTRODUCTION

Socio-ecological [1] and lifecourse models [2] emphasize the role of environmental factors on health outcomes, suggesting that living in neighborhoods with favorable environments (e.g., low social disorder and crime, and strong social ties) may contribute to better cognitive

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CONFLICT OF INTEREST STATEMENT

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health [3]. Therefore, neighborhood environments, or the characteristics that inform perceptions of these environments, are attractive targets for promoting cognitive health because as people age their ability to move across neighborhoods tends to decline [4, 5]. Perceived neighborhood environments, as proxies for neighborhood-derived psychosocial stressors, may play a role in shaping cognitive health through lifestyle [6], cardiovascular [4], and/or psychological pathways [5, 7].

Evidence indicates that perceptions of one's neighborhood environment are more strongly associated with various health outcomes including overall well-being [8], walking [9], and sedentary time [10] than objective measures, regardless of age or race/ethnicity. However, only a few studies [11-14] have examined the associations between perceived neighborhood environment and cognitive function, and results have been inconsistent. Some studies have reported associations between favorable perceived neighborhood environment and better cognitive function in older Hispanic immigrants [11], as well as older non-Hispanic white and African Americans [12], but other studies report null associations in older Non-Hispanic white women [13] and older Japanese adults [14]. Most of these studies on the association between perceived neighborhood environment and cognitive function had samples of older non-Hispanic whites and African Americans. To date, replication studies from large samples of middle-aged and older Hispanics/Latinos have not been conducted. This is despite the fact that Hispanics/Latinos living in the U.S. tend to experience earlier onset of progressive declines in cognitive abilities [15] such as verbal learning and memory, and executive function. The current study addresses this gap in the literature.

Using data from the Hispanic Community Health Study/Study of Latinos (HCHS/SOL) and its Sociocultural Ancillary Study (SCAS), we examined the cross-sectional associations between perceived neighborhood environment and cognitive function among middle-aged and older Hispanic/Latino women and men. A potential reason for the discrepancies reported across previous studies of perceived neighborhood environment and cognition in other race/ethnic groups [11-14] is that associations between perceived neighborhood environment and cognitive function have not been examined by gender. This is particularly important given there exists an extensive body of research documenting that gender differences exist in the impact of the perceived neighborhood environment on health outcomes among non-Hispanic white and African American adults [16-23]. For example, among women but not men, better perceived neighborhood environment has been associated with higher physical activity [16, 22], longer telomere length [21], and lower risk of coronary artery calcification [17], incident depression [18-20], and cardiovascular disease [23].

Thus, based on evidence of stronger associations of perceived neighborhood environment on vascular and metabolic risk factors among women compared to men, coupled with the known sex differences in cognitive function that exist in the HCHS/SOL cohort [24] (i.e., women had higher cognitive scores with the exception of verbal fluency, regardless of key confounders), we hypothesized that more favorable perceived neighborhood environment measures (i.e., higher neighborhood social cohesion, lower neighborhood problems, and higher safety from crime) would each be associated with higher cognitive function among women but not among men. Given that middle-aged and older Hispanics/Latinos are one of

the fastest growing segments of the U.S. population [25], there is an urgent need for identifying potentially modifiable factors to promote cognitive health and successful aging in this population [1].

METHODS

Study Design and Analytic Sample

The HCHS/SOL is a multicenter population-based study of cardiovascular diseases and related chronic conditions among adults ages 18–74 years at baseline (2008–2011) of Cuban, Central American, Dominican, Mexican, Puerto Rican, South American, and other/more than one Hispanic/Latino backgrounds [26-28]. Study enrollment (N= 16,415) was conducted from selected households in four U.S. metropolitan areas (i.e., Bronx, NY; Chicago, IL; Miami, FL; and San Diego, CA). The purpose of the SCAS is to examine associations of multiple sociocultural and psychosocial factors with cardiovascular disease and metabolic syndrome prevalence in Hispanics/Latinos. The conceptual framework of the SCAS is based on the Reserve Capacity [29] and Lifespan Biopsychosocial Models [30], which highlight the role of resources and stressors as pathways underlying socioeconomic and ethnic influences on health outcomes. Those HCHS/SOL participants who consented to be contacted for future studies were eligible to participate in the SCAS (2009–2010) [28], which had a 72.6% participation rate. The SCAS sample (N= 5,313) is representative of the HCHS/SOL cohort, although individuals from higher socioeconomic strata were less likely to participate [28]. The HCHS/SOL was approved by the Institutional Review Boards of all sites. All participants provided written informed consent.

The inclusion criteria for this study was defined as SCAS participants eligible to complete neurocognitive assessments because they were ages 45 and older at baseline (n= 3,278). We excluded 171 participants with self-reported history of stroke or heart attack because they are more likely to have cognitive impairment or dementia [31, 32]; if we included these conditions in our analyses, results would be more difficult to interpret within the theoretical framework of perceived neighborhood environment and cognition. We also excluded participants with missing data on any of the cognitive function measures (n= 136), any of the neighborhood environment measures (n= 89), or any of the study covariates (n= 87). The final analytic sample of the current study is comprised of 2,846 participants (1,812 women and 1,034 men). Compared to our analytic sample, excluded HCHS/SOL participants ages 45 and older were more likely to be of higher income (p= 0.002) but did not significantly differ by gender, education, language preference, or field site.

Study Measures

Cognitive Function—Trained interviewers administered cognitive tests in the preferred language of the participant (English or Spanish). Verbal learning and memory were assessed using the Brief Spanish-English Verbal Learning Test (B-SEVLT) [33, 34]. During 3 consecutive trials, the interviewer read all words included in a 15-item list (i.e., list A) and asked the participant to recall them. After reading a distractor list, the interviewer asked participants to recall as many words from list A as possible to assess free-recall post-interference. Verbal learning is the sum of the items correctly recalled from list A across the

3 learning trials (range: 0–45) and memory is the sum of the number of items correctly recalled post-interference (range: 0–15). Verbal fluency was assessed through an adapted version of the Word Fluency Test of the Multilingual Aphasia Examination [35, 36]. Participants were asked to generate as many words as possible in 60 seconds that began with the letter *F* (first trial) and the letter *A* (second trial). Verbal fluency score is the sum of the correctly generated words across trials (range: 0–50). Processing speed was assessed using the Wechsler Adult Intelligence Scale-Revised Digit Symbol Substitution Subtest [37]. Participants were asked to write the corresponding symbol for each digit based on the provided key. Processing speed score is the sum of the correctly identified symbols in 90 seconds (range: 0–83). To measure global cognitive function, a composite score was calculated by summing the z-scores (i.e., [individual value - mean value] /SD) for performance across the four cognitive tests (i.e., verbal learning, memory, verbal fluency, and processing speed). Across all tests, higher scores represent better cognitive function.

Perceived Neighborhood Environment—In the SCAS, perceived neighborhood environment data were collected via interviewer-administered questionnaires originally developed for use in the Multi-Ethnic Study of Atherosclerosis [38]. Neighborhood was defined to the participants as “the area around where you live and around your house. It may include places you shop, religious or public institutions, or a local business district. It is the general area around your house where you might perform routine tasks, such as shopping, going to the park, or visiting with neighbors.”

A 7-item scale [38] was used to assess participants’ perceptions of the neighborhood physical environment (i.e., neighborhood problems) related to disorder including excessive noise, heavy traffic or speeding cars, lack of access to adequate food shopping, lack of parks or playgrounds, trash and litter, no or poorly maintained sidewalks, and violence. Participants indicated the seriousness of each item based a scale ranging from *1* = “very serious problem” to *4* = “not really a problem.” All items were reverse-coded and a total score (range: 7–28) was computed by summing item scores for participants who answered all 7-items (Cronbach’s alpha = 0.79 in our sample). Construct validity of the perceived neighborhood problems measure has been shown in a sample of U.S. Hispanic/Latino adults [39].

Sampson’s Social Cohesion 5-item scale [40] was used to assess perceived neighborhood social cohesion (i.e., social environment characterized by presence of trusting relationships and connection to one’s neighbors). Participants indicated their extent of agreement with each statement based on a scale ranging from *1* = “strongly agree” to *5* = “strongly disagree.” Sample items include: “People around here are willing to help their neighbor” and “People in this neighborhood can be trusted.” Three items were reverse-coded. A total score (range: 5–25) was derived by summing item scores for participants who answered all 5-items (Cronbach’s alpha = 0.68 in our sample). Previous research has shown sufficient reliability, internal consistency, and construct validity for U.S. Hispanics/Latinos [38, 39].

To assess perceived neighborhood safety from crime, participants were asked, “How safe from crime do you consider your neighborhood to be?” Response ranged from *1* = “very

safe" to *5* = "not at all safe" and were reverse-coded. Previous research has shown sufficient reliability and internal consistency for Hispanic/Latino adults [39].

Lower neighborhood problems, higher neighborhood social cohesion, and higher neighborhood safety from crime scores represent more favorable perceived neighborhood environments (with the referent category representing least favorable environments). Given that a major goal of our work was to replicate and extend prior studies of the perceived neighborhood environment, health, and cognition in samples of other race/ethnic groups to Hispanics/Latinos [12, 14, 17-19, 22], neighborhood variables were treated as categorical. In these studies, reasons for categorizing the perceived neighborhood environment measures include the potential presence of non-linear relationships, among others, which make categorization a better fit to capture a fine gradation of predictor-outcome associations. Thus, perceived neighborhood problems and social cohesion scores were categorized into quintiles (of roughly equal size based on the distribution of the overall sample). Perceived neighborhood safety from crime was categorized as low (responses= 1–2), medium (response= 3), and high (responses= 4–5) since it was assessed based on a single item.

Covariates—Covariates included self-reported age, Hispanic/Latino background, language preference for baseline examination, field site, years lived in neighborhood, annual household income, education, physical activity, and depressive symptoms. Physical activity in a typical week was assessed using the Global Physical Activity Questionnaire [41] and categorized according to adherence to the 2008 US Guidelines for meeting high or medium activity levels [41]. Adherence included high activity (i.e., >300 minutes/week of moderate-intensity physical activity, or >150 minutes/week of vigorous activity, or combination of both) and medium activity (i.e., 150–300 minutes/week of moderate-intensity activity, or 75–150 minutes/week of vigorous-intensity physical activity, or combination of both). Lack of adherence included low activity (i.e., activity beyond baseline but <150 min/week of moderate-intensity physical activity, or <75 minutes/week of vigorous-intensity activity, or combination of both) and inactivity (i.e., no activity beyond baseline activities of daily living). Depressive symptoms were ascertained with the 10-item version of the Center for Epidemiologic Studies Depression scale [42]. Covariates were selected based on prior empirical studies and because, in preliminary bivariate analyses, they were associated with either the neighborhood environment features in our sample and/or cognitive function.

Statistical Analysis

All analyses were conducted separately among women and men as it has been consistently documented that perceptions of the neighborhood environment are differently associated with health outcomes in women compared to men [16-23]. Descriptive statistics (i.e., percentages and means with standard errors) were generated to characterize women and men of our target population based on study covariates. Differences in participant characteristics by each perceived neighborhood environment measure were examined among women and men using F-tests for continuous variables and chi-square tests for categorical variables. Adjusted linear regression models were used to examine the associations between each perceived neighborhood environment measure and cognitive function in women and men. *P*-values were computed to examine linear trends across categories of neighborhood

perceptions. Model 1 adjusted for sociodemographic characteristics (i.e., age, Hispanic/Latino background, language preference, field site, years lived in neighborhood, annual household income, and education). Model 2 additionally adjusted for depressive symptoms. Further adjustment for physical activity did not change our results (data not shown); thus, physical activity was not considered a confounder in the current study.

All reported values were weighted to account for the complex study design (except sample size which is unweighted). Weights were trimmed to limit precision losses and calibrated to the 2010 Census characteristics by age, sex, and Hispanic/Latino background in each field site's target population. Data management was performed using SAS 9.4 software (SAS Institute, Cary, NC) and statistical analyses were performed using Stata software Release 15 (Stata Corp LP, College Station, TX). All significance tests were two-sided and significance level was defined as 5%.

RESULTS

Characteristics of Target Population

The mean age of women and men was estimated to be 56 years of age and the target population was predominantly of Mexican background (Table 1). Most women (51.7%) and men (46.7%) reported less than $20,000 as the annual household income, and most women (86.5%) and men (83.4%) reported Spanish as the preferred language for the baseline examination. Women and men lived in their current neighborhood for 10 and 9 years on average, respectively. Approximately, 12.4% of women and 13.9% of men exhibited low mental status as defined as a score of 4 or below on the Six Item Screener. In bivariate analyses, women and men living in neighborhoods with the least favorable levels of perceived neighborhood problems and safety from crime were more likely to report lower annual household income and had higher depressive symptoms (Supplementary Tables 1 and 2). Among women, but not men, all of the perceived neighborhood environment measures were associated with global cognitive function.

Associations between Perceived Neighborhood Environment and Cognitive Function

Women in the lowest quintile of perceived neighborhood problems (vs. highest quintile) had higher global cognition (β: 0.61, 95% CI: 0.16, 1.05), verbal learning (B: 1.28, 95% CI: 0.20, 2.36), and memory (B: 0.71, 95% CI: 0.22, 1.21) (Model 1; Table 2). After additional adjustment for depressive symptoms, the associations between the lowest quintile of perceived neighborhood problems with higher global cognition and memory persisted (Model 2: β: 0.48, 95% CI: 0.03, 0.94; and B: 0.60, 95% CI: 0.11, 1.09, respectively) but not with verbal learning. We also observed associations between the third quintile of perceived neighborhood problems (vs. highest quintile) and higher processing speed in Models 1 and 2 (Model 1: B: 2.40, 95% CI: 0.46, 4.33; and Model 2: B: 2.19, 95% CI: 0.24, 4.14, respectively). There was evidence of a linear trend in the associations of perceived neighborhood problems with verbal learning and memory in Model 1 (p-trend= 0.045 and 0.021, respectively) but not in any of the final models.

Women in the highest quintile of perceived neighborhood social cohesion (vs. lowest quintile) had lower verbal fluency (B: −1.85, 95% CI: −3.65, −0.05) and processing speed (B: −1.78, 95% CI: −3.51, −0.04) (Mode1; Table 2). After additional adjustment for depressive symptoms, the association of the highest quintile of perceived neighborhood social cohesion with lower verbal fluency (B: −2.00, 95% CI: −3.83, −0.16) and processing speed (B: −2.11, 95% CI: −3.87, −0.36) remained significant; and, the highest quintile of perceived neighborhood social cohesion became significantly associated with lower global cognition (β: −0.56, 95% CI: −1.02, −0.09) and verbal learning (B: −1.01, 95% CI: −2.00, −0.03). In Model 2, there was evidence of a linear trend in the aforementioned associations of perceived neighborhood social cohesion with global cognition, verbal learning, verbal fluency, and processing speed among women (p-trend= 0.004, 0.015, 0.006, and 0.009, respectively). Finally, there were no associations between perceived neighborhood safety from crime and cognitive function among women. Among men, we observed no associations between any of the perceived neighborhood environment measures and cognitive function regardless of adjustments (Table 3).

DISCUSSION

To our knowledge, this is the most comprehensive examination of associations between perceived neighborhood environment and cognitive function among middle-aged and older Hispanic/Latino women and men. Our results revealed that women living in neighborhoods with the lowest perceived problems (versus highest) had higher global cognition and memory, regardless of sociodemographic characteristics and depressive symptoms. Unexpectedly, we also found that women living in neighborhoods with the highest perceived social cohesion (versus lowest) had lower global cognition, verbal learning, verbal fluency, and processing speed. No associations were observed of perceived neighborhood environment and cognitive function among men. Our findings support results from previous research [16-23] on the associations between perceived neighborhood environment and health outcomes among women but not men, and extend these results to include cognitive function as an additional health outcome of interest. The present study also highlights the complexity of these relationships when considering socio-demographic, behavioral, and psychological variables particularly among Hispanic/Latina women.

Among women, as hypothesized, we found that the most favorable level of perceived neighborhood problems (first quintile) was associated with better global cognitive function and memory in the fully adjusted model. Overall, such finding is consistent with theories positing that adverse neighborhood conditions can act as psychosocial stressors that are associated with worst mental health outcomes [43]. It is consistent with a study reporting an association between lower perceived neighborhood disorder and lower cognitive decline over time in older African-American adults [12] and a study reporting that living in more advantaged neighborhoods (based on objective assessments) is associated with better cognitive function in older non-Hispanic white women [44]. There were no significant linear trends in the neighborhood problems-cognition associations. Most significant associations were only present when comparing the highest to the lowest quintiles, which may be partly due to low variability across neighborhoods since communities with a high proportion of Hispanics/Latinos were oversampled in HCHS/SOL [46].

Surprisingly, among women, the most favorable level of perceived neighborhood social cohesion (i.e., fifth quintile) was associated lower global cognition, verbal learning, verbal fluency, and processing speed scores. There was evidence of significant linear trends in the neighborhood social cohesion-cognition associations, where cognitive function scores decreased as social cohesion was higher. This unexpected direction may simply suggest that women with better cognitive function have greater capacity to comprehensively assess and develop nuanced understandings of the quality of social relations in their neighborhood. Alternatively, it may be that neighborhood social cohesion may not promote collective resources and actions but rather serve as a stressor in neighborhoods of lower socioeconomic status [45, 46]. In fact, inconsistent findings have been reported across previous studies [47] with a study reporting an association between better perceived neighborhood social climate and better cognitive function [11] but other studies [13, 14] reporting no associations. These inconsistent findings across studies may be due, in part, to the cross-sectional design of the available studies, cross-cultural differences in the samples used, and/or differences in the measures employed to assess the neighborhood environment. Longitudinal research on the associations between perceived neighborhood problems and social cohesion with changes in cognitive function particularly among women is warranted.

Overall, the null associations in men but not women suggest that perceptions of one's neighborhood environment may play a greater role in shaping cognitive function among women compared to men; a possibility that may be related to gender differences in neighborhood-based activities and/or social relationships. For example, compared to men, women tend to report larger social network size [48-50] and seek more social support outside of their family [49, 50] which may result in better quality of social relations with their neighbors. Alternatively, a potential explanation for the largely null findings observed among men is that they had lower cognitive function scores (compared to women) which could contribute to lower ability to ascertain and report nuances in their neighborhood environment. However, it is important to note that although we describe some statistically significant associations present for women and not men, post hoc analyses showed that only the association between perceived neighborhood social cohesion and processing speed had a significant interaction term (p-interaction= 0.038) in the fully adjusted model. Future research with a larger sample size is needed to confirm such finding.

Additionally, the lack of associations between perceived neighborhood safety from crime and cognitive function in women and men were may reflect that these associations operate through multiple indirect pathways rather than directly as examined in the current study. For example, higher perceived neighborhood safety from crime has been associated with higher levels of neighborhood-based walking [51] which in turn is associated with increased opportunities for social engagement with neighbors [51], an important protective factor for cognitive function [52]. In the present study, however, there was no evidence of bivariate associations between perceived neighborhood safety from crime and adherence to the 2008 U.S. physical activity guidelines in either women or men. More work is needed investigating the complex interplay of perceived neighborhood safety from crime and associated healthy behaviors that may relate to the cognitive function of middle-aged and older Hispanics/Latinos.

This study has several limitations that need to be considered when interpreting our results, particularly the cross-sectional nature of our study. Not only do findings from this cross-sectional study require additional confirmation, longitudinal research is also needed to examine direction and mediators of these associations [3]. While empirical studies have demonstrated that adverse neighborhood environments (assessed using objective measures) are associated with faster rates of cognitive decline [53, 54], there is a need for research on the associations between perceived neighborhood environment and cognitive decline. Such focus on cognitive trajectories will help to address some of the limitations of this cross-sectional study. Moreover, future studies are needed to examine the role of early life neighborhood context on cognitive function by applying a lifecourse approach [55]. Further, to date, it remains unknown whether depressive symptoms are a mediator of the associations between perceived neighborhood environment and cognitive function (as opposed to being a confounder). Thus, longitudinal research examining depressive symptoms as a mediator of the neighborhood-cognition associations is warranted [56]. Interestingly, we found strong bivariate associations between worse perceptions of the neighborhood environment and higher depressive symptoms among women and men, which will be relevant to consider in future research. Although consideration of physical activity may be important in the associations examined in the current study (because it could be either a confounder or mediator of the associations), adding physical activity to our final model did not change our findings. Potential reasons for this unexpected finding is the lack of bivariate association between neighborhood activity and physical activity in our study and that physical activity (objectively assessed) is not associated with cognitive function in our sample [57]. Another limitation of our study is that perceived neighborhood safety from crime was assessed using a single question, while it has been shown to have statistical validity [39], this limitation may nonetheless have affected our findings. While response bias [58] is another potential limitation of our study, e.g., participants with worse cognitive function may report poorer rating of their neighborhood, the combined relatively young age and low prevalence of lower mental status in our cohort may lessen this possibility. Finally, Hispanics/Latinos living in suburban or rural areas were not included in the HCHS/SOL study and our cohort is not representative of those populations. Nevertheless, most of the U.S. Hispanic/Latino population lives in urban areas [59] (including those sampled in the HCHS/SOL). An important strength of this study is that we included a diverse cohort of middle age and older U.S. Hispanics/Latinos and we highlight the importance of exploring gender differences in the associations between perceived neighborhood features and cognitive function. Additionally, we employed well-recognized and validated measures to assess various perceived neighborhood environmental features, and validated tests of cognitive function (both as individual test items and as a measure of global cognitive function). Future studies should examine whether Hispanic/Latino background moderates the neighborhood–cognition associations and whether objective neighborhood environment measures (e.g., green spaces, crime rates, and sociocultural environment) are associated with cognitive function among Hispanics/Latinos. We were able to adjust our models by duration of exposure to the neighborhood environment (approximately 9 years on average) which is important to consider when investigating relationships between neighborhood environments and individual health.

CONCLUSION

This study provides cross-sectional evidence suggesting that lower levels of perceived neighborhood problems (as a proxy for neighborhood-derived psychosocial stressors) is associated with higher global cognitive function and memory scores among middle-aged and older Hispanic/Latina women but not among men. Future research should include longitudinal measures and consider mechanistic pathways to aim to better understand the role of perceived neighborhood environment on cognitive function among middle-aged and older Hispanics/Latinos. A better understanding of these associations is warranted given the need to identify public health approaches that may aid in the promotion of cognitive health among Hispanics/Latinos, an understudied yet rapidly growing segment of the U.S. population [25] at increased risk for developing early onset of cognitive impairment [15].

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Table 1.

Characteristics of study population: Women and Men

	Women (n= 1,812)	Men (n= 1,034)
	N (%) or Mean (SE)	
Age		
Mean Age in Years	56.5 (0.4)	56.1 (0.3)
Hispanic/Latino Background		
Dominican	198 (11.3%)	78 (8.4%)
Central or South American	315 (12.8%)	177 (12.1%)
Cuban	265 (24.3%)	223 (32.9%)
Mexican	703 (31.3%)	339 (27.6%)
Puerto Rican	307 (19.4%)	197 (17.4%)
Other/ More than one Background	24 (1.0%)	20 (1.6%)
Annual Household Income		
<$20,000	939 (51.7%)	480 (46.7%)
$20,000—$50,000	595 (28.2%)	393 (35.3%)
>$50,000	107 (8.0%)	116 (12.9%)
Not Reported	171 (12.1%)	45 (5.1%)
Education		
<High School	726 (39.4%)	391 (36.8%)
High School	376 (19.0%)	250 (22.2%)
>High School	710 (41.6%)	393 (41.0%)
Language Preference		
Spanish	1603 (86.5%)	878 (83.4%)
English	209 (13.5%)	156 (16.7%)
Neighborhood Residence		
Mean Years Living in Neighborhood	9.8 (0.6)	9.1 (0.4)
Field Center		
Bronx	441 (30.7%)	241 (24.9%)
Chicago	425 (10.8%)	267 (13.0%)
Miami	460 (35.0%)	311 (40.2%)
San Diego	486 (23.5%)	215 (21.9%)
Adherence to 2008 US Physical Activity Guidelines[a]		
No	860 (51.2%)	333 (35.7%)
Yes	952 (48.8%)	701 (64.3%)
Depressive Symptoms		
Mean CES-D 10[b]	8.9 (0.2)	7.1 (0.2)
Perceived Neighborhood Environment		
Quintiles (Q) Neighborhood Problems		
Q1 (Low; range: 0-7)	274 (17.5%)	143 (15.4%)
Q2 (range: 8-9)	417 (25.0%)	206 (22.3%)
Q3 (range: 10-11)	346 (17.8%)	195 (17.2%)

	Women (n= 1,812)	Men (n= 1,034)
Q4 (range: 12-14)	375 (19.9%)	251 (23.6%)
Q5 (High, less favorable; range: 15-28)	400 (19.8%)	239 (21.4%)
Quintiles Neighborhood Social Cohesion		
Q1 (Low; less favorable; range:0-13)	375 (20.3%)	238 (22.0%)
Q2 (range: 14-15)	394 (20.7%)	216 (18.9%)
Q3 (range: 16-17)	426 (24.0%)	221 (22.2%)
Q4 (range: 18-19)	356 (18.5%)	186 (17.6%)
Q5 (High; range: 20-25)	261 (16.6%)	173 (19.3%)
Categories Safety from Crime		
Low	485 (22.6%)	270 (26.0%)
Medium	970 (57.0%)	513 (46.4%)
High	357 (20.4%)	251 (27.6%)
Cognitive Function		
Mean Global Cognition (z-score)	0.3 (0.1)	−0.4 (0.1)
Mean Verbal Learning	23.4 (0.3)	21.3 (0.2)
Mean Memory	8.5 (0.1)	7.6 (0.1)
Mean Verbal Fluency	18.6 (0.4)	18.5 (0.3)
Mean Processing Speed	35.2 (0.6)	33.7 (0.5)
Low Mental Status[c]		
SIS ≤4	213 (12.4%)	152 (13.9%)

Notes: Values in parentheses are standard errors. Sample size is unweighted and all other reported values are weighted to represent the target Hispanic/Latino population.

Q= Quintile; SIS= Six-Item Screener.

[a] Physical activity levels were assessed using the Global Physical Activity Questionnaire (GPAP) and were categorized according to the 2008 US Guidelines for meeting high or medium activity levels.

[b] Depressive symptoms were assessed using the 10-item Center for Epidemiologic Studies Depression Scale (CES-D-10).

[c] Low mental status was categorized based on as a score of 4 or below on the Six-Item Screener (SIS).

Table 2.

Associations between perceived neighborhood environment and cognitive function among women (n = 1,812)

	Global Cognition β (95% CI)	Verbal Learning B (95% CI)	Memory B (95% CI)	Verbal Fluency B (95% CI)	Processing Speed B (95% CI)
Neighborhood Problems[a]					
Model 1					
Q1 (Low)	0.61 (0.16, 1.05) **	1.28 (0.20, 2.36) *	0.71 (0.22, 1.21) **	0.87 (−0.63, 2.38)	1.90 (−0.23, 4.02)
Q2	0.17 (−0.28, 0.62)	0.47 (−0.45, 1.39)	0.31 (−0.18, 0.80)	−0.13 (−1.77, 1.50)	0.43 (−1.50, 2.36)
Q3	0.37 (−0.03, 0.77)	0.09 (−0.97, 1.16)	0.23 (−0.23, 0.70)	1.23 (0.00, 2.46) *	2.40 (0.46, 4.33) *
Q4	0.44 (−0.07, 0.94)	0.44 (−0.53, 1.41)	0.30 (−0.22, 0.81)	1.58 (−0.74, 3.94)	1.77 (−0.29, 3.83)
Q5 (High)	0.00 (ref)	0.00 (ref)	0.00 (ref)	0.00 (ref)	0.00 (ref)
p-trend	*0.064*	*0.045*	*0.021*	*0.989*	*0.298*
Model 2					
Q1 (Low)	0.48 (0.03, 0.94) *	0.93 (−0.11, 1.96)	0.60 (0.11, 1.09) *	0.72 (−0.87, 2.31)	1.54 (−0.65, 3.73)
Q2	0.04 (−0.41, 0.48)	0.10 (−0.80, 0.99)	0.19 (−0.28, 0.65)	−0.29 (−1.98, 1.40)	0.06 (−1.92, 2.04)
Q3	0.30 (−0.10, 0.69)	−0.11 (−1.16, 0.93)	0.17 (−0.30, 0.64)	1.15 (−0.11, 2.40)	2.19 (0.24, 4.14) *
Q4	0.40 (−0.11, 0.92)	0.34 (−0.61, 1.29)	0.26 (−0.25, 0.78)	1.54 (−0.82, 3.90)	1.67 (−0.41, 3.75)
Q5 (High)	0.00 (ref)	0.00 (ref)	0.00 (ref)	0.00 (ref)	0.00 (ref)
p-trend	*0.229*	*0.192*	*0.060*	*0.828*	*0.546*
Neighborhood Social Cohesion[b]					
Model 1					
Q1 (Low)	0.00 (ref)	0.00 (ref)	0.00 (ref)	0.00 (ref)	0.00 (ref)
Q2	0.09 (−0.31, 0.48)	0.45 (−0.55, 1.45)	0.28 (−0.21, 0.77)	−0.02 (−1.39, 1.35)	−0.89 (−2.83, 1.04)
Q3	0.10 (−0.40, 0.59)	−0.14 (−1.11, 0.83)	0.03 (−0.47, 0.52)	0.82 (−1.29, 2.94)	0.27 (−1.61, 2.16)
Q4	−0.30 (−0.74, 0.15)	−0.08 (−0.98, 0.81)	−0.04 (−0.61, 0.52)	−1.42 (−2.87, 0.04)	−1.77 (−3.74, 0.19)
Q5 (High)	−0.44 (−0.90, 0.01)	−0.71 (−1.68, 0.26)	−0.07 (−0.63, 0.48)	−1.85 (−3.65, −0.05) *	−1.78 (−3.51, −0.04) *
p-trend	***0.015***	*0.077*	*0.478*	*0.009*	*0.025*
Model 2					
Q1 (Low)	0.00 (ref)	0.00 (ref)	0.00 (ref)	0.00 (ref)	0.00 (ref)
Q2	0.00 (−0.39, 0.39)	0.22 (−0.77, 1.21)	0.21 (−0.28, 0.69)	−0.13 (−1.53, 1.27)	−1.15 (−3.06, 0.76)
Q3	0.03 (−0.47, 0.54)	−0.32 (−1.27, 0.63)	−0.03 (−0.53, 0.47)	0.74 (−1.44, 2.92)	0.08 (−1.84, 2.00)
Q4	−0.44 (−0.89, 0.01)	−0.48 (−1.38, 0.41)	−0.18 (−0.72, 0.37)	−1.61 (−3.12, −0.11) *	−2.21 (−4.22, −0.21) *
Q5 (High)	−0.56 (−1.02, −0.09) *	−1.01 (−2.00, −0.03) *	−0.17 (−0.74, 0.39)	−2.00 (−3.83, −0.16) *	−2.11 (−3.87, −0.36) *
p-trend	*0.004*	*0.015*	*0.273*	*0.006*	*0.009*
Neighborhood Safety from Crime[c]					
Model 1					
Low	0.00 (ref)	0.00 (ref)	0.00 (ref)	0.00 (ref)	0.00 (ref)
Medium	0.26 (−0.07, 0.58)	0.42 (−0.28, 1.11)	0.11 (−0.24, 0.47)	0.95 (−0.35, 2.24)	0.92 (−0.58, 2.43)
High	0.01 (−0.40, 0.42)	0.21 (−0.75, 1.17)	0.10 (−0.42, 0.61)	−0.18 (−1.47, 1.12)	−0.47 (−2.30, 1.35)
p-trend	*0.965*	*0.663*	*0.713*	*0.790*	*0.612*

	Global Cognition	Verbal Learning	Memory	Verbal Fluency	Processing Speed
	β (95% CI)	**B (95% CI)**	**B (95% CI)**	**B (95% CI)**	**B (95% CI)**
Model 2					
Low	0.00 (ref)	0.00 (ref)	0.00 (ref)	0.00 (ref)	0.00 (ref)
Medium	0.18 (−0.14, 0.51)	0.20 (−0.47, 0.86)	0.04 (−0.31, 0.39)	0.88 (−0.48, 2.24)	0.72 (−0.81, 2.24)
High	−0.06 (−0.48, 0.36)	0.01 (−0.97, 0.98)	0.03 (−0.51, 0.57)	−0.24 (−1.59, 1.11)	−0.67 (−2.53, 1.20)
p-trend	*0.779*	*0.989*	*0.923*	*0.726*	*0.483*

Note: Sample size is unweighted and all other values are weighted. Q = Quintiles.

[a] Perceived neighborhood problems' score range according to quintile and sample size: Q1: 0-7 (n = 274); Q2: 8-9 (n = 417); Q3: 10-11 (n = 346); Q4: 12-14 (n = 375); Q5: 15-28 (n = 400).

[b] Perceived neighborhood social cohesion's score range according to quintile and sample size: Q1: 5.0-13.0 (n = 375); Q2: 14-15 (n = 394); Q3: 16-17 (n = 426); Q4: 18-19 (n = 356); Q5: 19-25 (n = 261).

[c] Perceived neighborhood safety categories' sample size: Low: 483; Medium: 964; High: 355.

Model 1: Age, Hispanic/Latino background, language preference, field site, years living in neighborhood, annual household income, and education.

Model 2: Model 1 + depressive symptoms.

* $p<0.05$

** $p<0.01$

*** $p<0.001$

Table 3.

Associations between perceived neighborhood environment and cognitive function among men (n = 1,034)

	Global Cognition β (95% CI)	Verbal Learning B (95% CI)	Memory B (95% CI)	Verbal Fluency B (95% CI)	Processing Speed B (95% CI)
Neighborhood Problems[b]					
Model 1					
Q1 (Low)	0.07 (−0.57, 0.71)	0.34 (−1.27, 1.95)	0.07 (−0.63, 0.77)	0.18 (−1.49, 1.85)	−0.33 (−3.39, 2.74)
Q2	0.17 (−0.35, 0.69)	−0.06 (−1.43, 1.32)	0.37 (−0.18, 0.92)	0.18 (−1.11, 1.47)	0.85 (−1.78, 3.47)
Q3	−0.08 (−0.61, 0.46)	−0.15 (−1.49, 1.19)	−0.02 (−0.63, 0.60)	−0.27 (−1.77, 1.24)	−0.30 (−2.68, 2.07)
Q4	0.30 (−0.16, 0.76)	0.85 (−0.31, 2.00)	0.23 (−0.35, 0.81)	0.01 (−1.35, 1.37)	1.76 (−0.50, 4.03)
Q5 (High)	0.00 (Ref)	0.00 (Ref)	0.00 (Ref)	0.00 (Ref)	0.00 (Ref)
p-trend	*0.992*	*0.901*	*0.726*	*0.763*	*0.636*
Model 2					
Q1 (Low)	−0.18 (−0.83, 0.46)	−0.21 (−1.85, 1.43)	−0.19 (−0.86, 0.49)	−0.16 (−1.86, 1.66)	−1.31 (−4.41, 1.80)
Q2	−0.06 (−0.58, 0.46)	−0.56 (−1.91, 0.79)	0.14 (−0.42, 0.69)	−0.13 (−1.45, 1.18)	−0.05 (−2.77, 2.66)
Q3	−0.25 (−0.76, 0.26)	−0.53 (−1.86, 0.80)	−0.19 (−0.81, 0.42)	−0.50 (−1.95, 1.03)	−0.98 (−3.39, 1.43)
Q4	0.18 (−0.26, 0.62)	0.57 (−0.55, 1.69)	0.11 (−0.46, 0.68)	−0.16 (−1.53, 1.15)	1.27 (−0.98, 3.53)
Q5 (High)	0.00 (Ref)	0.00 (Ref)	0.00 (Ref)	0.00 (Ref)	0.00 (Ref)
p-trend	*0.398*	*0.390*	*0.650*	*0.882*	*0.249*
Neighborhood Social Cohesion					
Model 1					
Q1 (Low)	0.00 (Ref)	0.00 (Ref)	0.00 (Ref)	0.00 (Ref)	0.00 (Ref)
Q2	0.01 (−0.44, 0.46)	0.32 (−0.72, 1.37)	0.02 (−0.51, 0.55)	−0.13 (−1.40, 1.15)	−0.43 (−2.89, 2.02)
Q3	0.13 (−0.32, 0.58)	0.95 (−0.24, 2.13)	0.02 (−0.53, 0.58)	0.02 (−1.22, 1.27)	−0.22 (−2.52, 2.07)
Q4	−0.09 (−0.56, 0.39)	−0.02 (−1.07, 1.03)	−0.39 (−1.04, 0.26)	0.38 (−0.98, 1.74)	−0.25 (−3.00, 2.49)
Q5 (High)	−0.15 (−0.72, 0.42)	0.24 (−1.17, 1.65)	0.16 (−0.77, 0.45)	−0.55 (−2.12, 1.01)	−1.26 (−3.96, 1.43)
p-trend	*0.528*	*0.928*	*0.323*	*0.732*	*0.469*
Model 2					
Q1 (Low)	0.00 (Ref)	0.00 (Ref)	0.00 (Ref)	0.00 (Ref)	0.00 (Ref)
Q2	−0.07 (−0.50, 0.36)	0.16 (−0.85, 1.17)	−0.07 (−0.59, 0.55)	−0.24 (−1.49, 1.02)	−0.75 (−3.21, 1.71)
Q3	0.03 (−0.41, 0.48)	0.75 (−0.42, 1.91)	−0.09 (−0.64, 0.47)	−0.11 (−1.34, 1.12)	−0.60 (−2.97, 1.77)
Q4	−0.23 (−0.70, 0.24)	−0.30 (−1.34, 0.74)	−0.54 (−1.19, 0.10)	0.19 (−1.18, 1.56)	−0.79 (−3.59, 2.00)
Q5 (High)	−0.28 (−0.88, 0.32)	−0.02 (−1.49, 1.55)	−0.30 (−0.91, 0.32)	−0.72 (−2.36, 0.92)	−1.75 (−4.54, 1.04)
p-trend	*0.289*	*0.762*	*0.152*	*0.580*	*0.289*
Neighborhood Safety from Crime					
Model 1					
Low (Worst)	0.00 (Ref)	0.00 (Ref)	0.00 (Ref)	0.00 (Ref)	0.00 (Ref)
Medium	0.09 (−0.32, 0.49)	0.30 (−0.77, 1.36)	−0.08 (−0.55, 0.39)	0.28 (−0.87, 1.44)	0.57 (−1.17, 2.30)
High	0.11 (−0.41, 0.63)	0.42 (−0.96, 1.79)	−0.15 (−0.70, 0.39)	−0.24 (−1.79, 1.32)	1.90 (−0.32, 4.12)
p-trend	*0.679*	*0.552*	*0.577*	*0.767*	*0.094*
Model 2					
Low (Worst)	0.00 (Ref)	0.00 (Ref)	0.00 (Ref)	0.00 (Ref)	0.00 (Ref)

	Global Cognition	Verbal Learning	Memory	Verbal Fluency	Processing Speed
	β (95% CI)	B (95% CI)	B (95% CI)	B (95% CI)	B (95% CI)
Medium	0.01 (−0.37, 0.40)	0.15 (−0.89, 1.18)	−0.16 (−0.62, 0.30)	0.18 (−0.95, 1.31)	0.31 (−1.37, 2.00)
High	0.00 (−0.51, 0.51)	0.20 (−1.17, 1.56)	−0.27 (−0.82, 0.27)	−0.39 (−1.92, 1.15)	1.53 (−0.75, 3.81)
p-trend	*0.991*	*0.777*	*0.324*	*0.621*	*0.189*

Note: Sample size is unweighted and all other values are weighted. Q = Quintiles.

[a]Perceived neighborhood problems' score range according to quintile and sample size: Q1: 0-7 (n = 143); Q2: 8-9 (n = 205); Q3: 10-11 (n = 194); Q4: 12-14 (n = 249); Q5: 15-28 (n = 238).

[b]Perceived neighborhood social cohesion's score range according to quintile and sample size: Q1: 5.0-13.0 (n = 236); Q2: 14-15 (n = 216); Q3: 16-17 (n = 221); Q4: 18-19 (n = 185); Q5: 19-25 (n = 171).

[c]Perceived neighborhood safety categories' sample size: Low: 268; Medium: 511; High: 250.

Model 1: Age, Hispanic/Latino background, language preference, field site, years living in neighborhood, annual household income, and education.

Model 2: Model 1 + depressive symptoms.

*$p<0.05$

**$p<0.01$

***$p<0.001$