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# Race and Ethnicity Differences in Walking and Associations with Neighborhood Perceptions among Older Adults in California

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## Abstract

This paper estimates differences in walking and associations of walking with neighborhood perceptions among older adults in California. We analyzed the restricted-use California Health Interview Survey data merged with the American Community Survey data. Walking at least 10 minutes for leisure in the last 7 days and number of minutes walked were regressed on perceived neighborhood social cohesion scale (PNSCS) and neighborhood socioeconomic characteristics. We estimated ordinary least squares regression models. We found that positive neighborhood perceptions were significantly ( $p < 0.05$ ) associated with walking among older Hispanic and Asian adults. Older Hispanic adults with above median PNSCS report that they walk 6.3 percentage points more than Non-Hispanic White adults. Older adults' perceptions of their neighbors and neighborhoods are positively correlated with walking. Policymakers can consider ways to improve neighborhood perceptions and relationships to help increase walking among minority older adults especially in low SES neighborhoods.

## Keywords

Health behaviors, walking, neighborhood perception, social cohesion, minority older adults

### *What this paper adds*

- Association between neighborhood perception and walking controlling for neighborhood SES
- Examined this association further by above and below median neighborhood SES levels
- Compared different racial and ethnic groups in California

### *Applications of study findings*

- Neighborhood perception was positively and significantly associated with walking controlling for neighborhood socioeconomic characteristics
- This association was more prominent among older Asian and Hispanic adults living in low SES neighborhoods
- Future research can further examine this association among different ethnic communities

## Background

Walking is “among the most cost-effective and accessible means of exercise” (Notthoff & Carstensen, 2014) and is also one of the most popular aerobic physical activities of older adults (National Center for Disease Prevention and Health Promotion, Division of Nutrition, Physical Activity, and Obesity, 2012). Mobility is essential for “active aging” and is significantly associated with overall quality of life among older adults (Groessl et al., 2019; Motl & McAuley, 2010; Webber et al., 2010). However, many older adults are not physically active and physical activity level varies by racial/ethnic groups.<sup>1</sup> Some of the common mechanisms cited in

previous studies for racial and ethnic differences in physical activity levels were socioeconomic status, education attainment, income, acculturation, as well as a neighborhood's social and physical environment (Bungum et al., 2011;

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Dergance et al., 2005; He & Baker, 2005; K. Li & Wen, 2013; Pampel et al., 2010; Saffer et al., 2015; Scholes & Bann, 2018; Willey et al., 2010).

Furthermore, there are different reasons cited in the literature that explain how neighborhood characteristics in racial and ethnic minority communities can be associated with social support and physical activity including walking (Alvarez & Levy, 2012; Bond Huie et al., 2002; Walton, 2016). Even though some racial and ethnic minority communities tend to have poor amenities and socioeconomic characteristics, social support mechanisms in these communities could help negate that (Eschbach et al., 2004).

In this study, we focus on California, one of the most diverse states with a high share of foreign-born population, which could influence neighborhoods. A case study that examined the changes in Southern California neighborhoods in the last 50 years highlighted how immigrant inflow can influence the neighborhoods through differences in social distance (Hipp & Boessen, 2012). Hipp and Boessen (2012) found that the inflow of immigrants could influence residential instability and demographic and cultural composition of the neighborhood but not necessarily have a negative impact on neighborhood home values or unemployment (Hipp & Boessen, 2012).

## Relevant Literature

Several studies examined associations between neighborhood characteristics and physical activity participation among older adults, such as walkability of neighborhood (Barnett et al., 2017; Chudyk et al., 2017; Herbolsheimer et al., 2020; Mooney et al., 2017). Another line of literature has examined the social environment. Older adults who perceive their neighbors to be helpful and their neighborhoods to be safe tend to report better health (Cain et al., 2018). A community-based study in a historically African American neighborhood indicated that prosocial behavior was positively and significantly linked with physical activity (Moore et al., 2020). On the other hand, older adults who perceive their neighborhoods as less safe tend to engage in less activities (Gallagher et al., 2010). Furthermore, weak social networks and social activities have been found to be associated with limited mobility among community-dwelling older adults (Yeom et al., 2008).

Several studies have examined associations of neighborhood characteristics with health-related behaviors and health outcomes (Bjornstrom et al., 2013; Chudyk et al., 2017). However, there is limited evidence on minority older adults and specifically how neighborhood perception is related to other observable neighborhood characteristics. A strand of the literature demonstrate that associations between neighborhood social cohesion and health promoting behaviors like physical activity may vary by race and ethnicity and by other neighborhood socioeconomic characteristics (W. Li et al., 2017; Ory et al., 2016; Yi et al., 2016). Using the National Health Interview Survey (NHIS) data, Yi et al. (2016) found

that neighborhood social cohesion and physical activity was significantly correlated for non-Hispanic White and Hispanic adults but not among other groups like non-Hispanic Asian American or Black adults (Yi et al., 2016). Li et al. (2015) found that older Asian adults walked more than older White adults. These investigators found that social cohesion (index of three questions on how respondents perceive of neighbors as trustworthy, willing to help each other, and get along well) was significantly correlated with more minutes of walking among older Asian adults (Y. Li et al., 2015).

Building on the previous literature that documents a positive association between neighborhood perceptions and physical activity among older adults, this study also confirms the association with walking among minority older adults. Moreover, given that socioeconomic status is commonly cited as a significant factor that drives racial/ethnic differences in physical activity levels, we further examined the role of neighborhood perception separately by neighborhood socioeconomic characteristics and whether this varies by race and ethnicity.

We investigate the relationship between neighborhood perceptions (neighborhood is safe, can trust neighbors, neighbors get along, and neighbors help each other) and walking for leisure among minority older adults. This paper contributes to the literature by documenting how neighborhood socioeconomic characteristics and older adults' neighborhood perceptions are associated with walking in the California Health Interview Survey (CHIS) data. We analyze the pattern of walking among minority older adult groups and examine whether neighborhood perceptions influence walking differentially, controlling for the neighborhood socioeconomic characteristics.

## Data and Methods

### Data

We use cross-sectional CHIS data, the largest health survey with a representative sample of the state's population. Each survey wave sample includes over 20,000 adults from approximately 58 counties. The response rate of CHIS ranged from 40%–47% among adults from 2011 to 2017 (conditional upon screening).<sup>2</sup> Interviews were conducted in English and multiple other languages, such as Spanish, Korean, Vietnamese, and Chinese (Cantonese and Mandarin).<sup>3</sup> The sample for our analysis includes individuals 65 years and older. We combine cross-sectional CHIS data from 2011 to 2017 ( $n = 52,764$ ). The distribution of different race and ethnic groups was as follows: Hispanic ( $n = 5,572$ ), non-Hispanic Asian ( $n = 3,343$ ), non-Hispanic Black ( $n = 2,282$ ), and non-Hispanic White ( $n = 39,894$ ) older adults.<sup>4</sup> To control for neighborhood socioeconomic characteristics, we merged the restricted-use CHIS data with the American Community Survey (ACS) data at the Census tract level.<sup>5</sup> We used the CHIS replicate weights to obtain valid variance estimates and weights to account for sample selection

probabilities. We used the STATA SVYSET command to conduct the analysis.

## Measures

**Dependent Variables.** We examined two dependent variables assessing walking for leisure. The first variable assessed whether the respondent walked for leisure at least 10 minutes in the past 7 days (0 if none, and 1 if walked at least 10 min). The second variable was the number of minutes walked on average for leisure in the past 7 days (including 0). In the CHIS data, there were two relevant physical activity variables (walking for leisure and walking for transport for at least 10 minutes in the past 7 days).<sup>6</sup> This paper focused on leisure-time walking because it was positively and significantly associated with perceptions of neighborhood safety and social cohesion among adults in California (Babey et al., 2018).<sup>7</sup> The 10 minute threshold is as written in the original CHIS question and there is no question in the data that asks about the minutes walked overall.<sup>8</sup>

**Main Explanatory Neighborhood Variables.** We assessed neighborhood perceptions using four questions. Three of the questions were adapted in CHIS from the neighborhood collective efficacy scale (Sampson et al., 1997). These questions used a four-category *strongly agree (4)...* to *strongly disagree (1)* Likert response scale and asked if (1) people in the neighborhood are willing to help each other, (2) people in the neighborhood do not get along,<sup>9</sup> and (3) people in the neighborhood can be trusted. The fourth question asked about how often the respondent feels safe in the neighborhood, with answers *all the time (4)*, *most of the time (3)*, *some of the time (2)*, or *none of the time (1)*. We added together the four questions to create the perceived neighborhood social cohesion scale (PNSCS). The scale score ranged from 3 to 16, with a higher score indicating a more positive perception about the neighborhood. Internal consistency reliability of the scale was 0.625.

Following Roux et al. (2001), we created a neighborhood socioeconomic score (NSES) for the census tracts with data from the ACS using the following variables: the median household income, median value of housing units, percent of household income from interest, dividend or net rental income, education (% of adults 25 and older who completed high school and % of adults who completed college) and employment (% of those 16 and older employed in executive, managerial, or professional specialty occupations) (Diez Roux et al., 2001). We calculated a z-score for each variable per Census tract by subtracting it from the average across all Census tracts in the CHIS data and dividing by the standard deviation. For each Census tract, we combined the z-score of the variables to obtain the neighborhood socioeconomic score (NSES) and merged it with CHIS data. The correlation between the PNSCS and NSES was 0.12 ( $p < 0.05$ ).

**Other Independent Variables.** The survey included a question about Hispanic or Latino ethnicity and another question on how one would describe oneself (as White, Asian, etc.). We created race and ethnicity dummy variables for Hispanic, and non-Hispanic Asian, White, and Black adults (Omitted reference category was White adults). We created dummy variables for each category of education from less than high school degree, high school degree, some college education, vocational education, to college degree and above (high school degree was the omitted reference category). Marital status was coded as married, never married, and other (divorced, separated, widowed, etc.), with married as the omitted reference category. We also controlled for demographic characteristics such as age, gender, citizenship, years lived in the United States, and whether English was the primary language spoken at home. Because access to health care may influence health behaviors, we control for whether the respondent has any health insurance coverage, has had any doctor visits in the past year, and self-rated global health (Hays et al., 2015).<sup>8</sup>

## Methods

We estimate ordinary least squares and linear probability models with year fixed effects to evaluate the associations of neighborhood perceptions with walking. We first estimate the following model<sup>10</sup> to examine how the PNSCS is associated with the probability of leisure walking and minutes walked controlling for the NSES and other demographic characteristics.

$$Walk_{it} = \beta_0 + \beta_1 Z_{t-1} + \beta_2 PNSCS_{it} + \beta_3 X_{it} + \delta_t + \varepsilon_{it}$$

$PNSCS_{it}$  is perceived neighborhood social cohesion scale for individual  $i$  and year  $t$ , and  $Z_{t-1}$  is a neighborhood socioeconomic score at  $t-1$ . We use the lagged neighborhood socioeconomic score to account for potential lagged effects on walking.  $X_{it}$  is a vector of individual-level variables (age, race, education attainment, gender, primary language spoken at home is English, citizenship, years lived in the United States, marital status, health insurance coverage, went to see a doctor in the past year, and self-reported global health).  $\delta_t$  indicates year fixed effects (binary variables). The primary coefficient of interest is  $\beta_2$ , which represents the association between the neighborhood perception score and walking among older adults after controlling for the neighborhood socioeconomic characteristics and individual-level characteristics.

We examine whether disparities in walking among older adults vary by neighborhood perceptions by estimating the baseline model separately for those with below and above the sample median PNSCS.<sup>11</sup> Furthermore, to analyze if PNSCS has heterogeneous effects on walking depending on the neighborhoods' socioeconomic characteristics, we first split the sample by median NSES and for each low and high NSES

group, and estimate the regression model separately by below and above the median PNSCS. To determine differences in walking among different racial and ethnic groups related to neighborhood perceptions and characteristics, we compare the coefficients on the racial and ethnic groups from above and below the median PNSCS score among higher and lower than median NSES groups.

## Results

In our analysis sample, 65% are White, 19% are Hispanic, 11% are Asian, and 6% are Black older adults. As seen in Table 1, 61% of older adults in California walked at least 10 minutes and for 20 minutes on average for leisure in the past 7 days when they walked.<sup>12</sup> As shown in Figure 1, older adults with a more positive perception of the neighborhoods were more likely to report in the survey that they walked except for Black adults. Older adults who live in neighborhoods with above median NSES report walking more than those who live in below median NSES neighborhoods, except for Asian adults. In our sample, Asian adults were most likely to report walking for leisure, while Black adults were the least likely to report that they walked.

The main effect regression results in Table 2<sup>13</sup> show positive but insignificant associations between walking and PNSCS, controlling for other demographic characteristics and NSES. A one-point increase in PNSCS was associated with a 0.07 percentage point increase in the likelihood of walking. Older Hispanic adults were more likely to report walking than older White adults and tended to walk about 4

minutes longer. Similar association was found for older Asian and Black adults in terms of number of minutes walked. NSES was significantly and positively associated with walking.

Figure 2 also provides support for positive association between the PNSCS, and minutes walked, controlling for NSES and other demographic variables. As PNSCS increases, the minutes walked (predicted means) also increases for all older adults (although the average minutes walked differs across groups) after controlling for other individual-level characteristics as well as NSES.

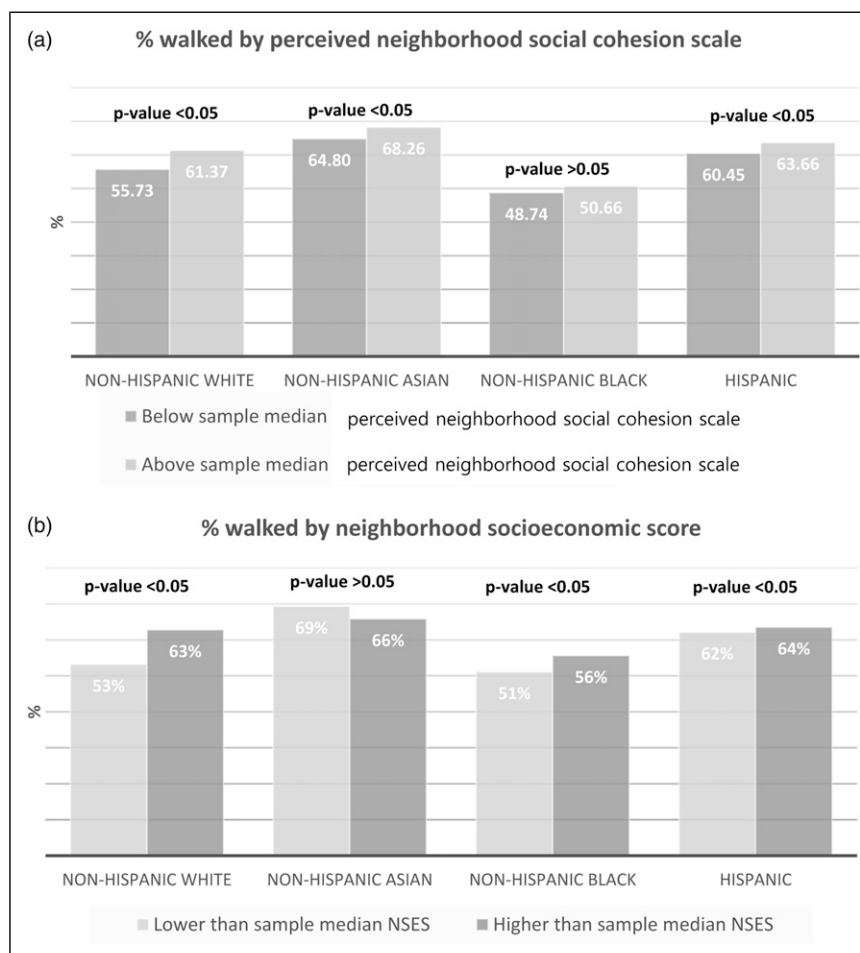
Among those scoring above the median PNSCS, older Hispanic and Asian adults tended to walk more often and longer than older White adults (Table 3). Older Hispanic adults with above median PNSCS (having a more positive perception of neighbors) report that they walk 6.3 percentage points more than White adults. A similar pattern holds true for the minutes walked variable. Older Hispanic adults with above median PNSCS walk 5.7 minutes (27.8%) more on average than White adults ( $\chi^2 = 5.18$ ,  $p = 0.0056$ ). Older Asian adults with above median PNSCS walk 5.04 minutes (24.6%) more on average than older White adults ( $\chi^2 = 3.74$ ,  $p = 0.0237$ ).

To investigate whether the relationship between PNSCS and walking varied differently by NSES, the baseline model was estimated separately by above and below median PNSCS among those who live in high and low NSES neighborhoods. As shown in Table 4 Panel B, older Hispanic and Asian adults are more likely to walk and tend to walk more and longer than White adults when they have above median PNSCS and

**Table 1.** Summary statistics.

Variables	Mean or %	Standard deviation	N
% Walked at least 10 minutes in the past 7 days	61%	0.49	51,982
Number of times walked in the past 7 days	2.96	4.18	51,917
Average minutes walked in the past 7 days	20.48	31.90	51,906
PNSCS (Perceived Neighborhood Social Cohesion scale)	12.05	1.02	52,797
NSES (Neighborhood socioeconomic status score)	0.68	3.63	52,507
Asian (non-Hispanic)	11%	0.31	52,764
Black (non-Hispanic)	6%	0.24	52,764
Hispanic	19%	0.39	52,764
White (non-Hispanic)	65%	0.48	52,764
Male	44%	0.50	52,764
Age	74.39	7.23	52,764
College and beyond	31%	0.46	52,764
Citizen	74%	0.44	52,764
Speak primarily English only	71%	0.46	52,764
Married	57%	0.50	52,764
Has health insurance coverage	99%	0.09	52,764
Estimated PROMIS global physical health score	48.10	9.39	52,764
Visited a doctor's office in the past year	92%	0.27	52,764

Data: California Health Interview Survey (2011–2017) and American Community Survey data (2010–2016) for neighborhood socioeconomic score variable. We used the CHIS replicate weights to obtain valid variance estimates and weights to account for sample selection probabilities.



**Figure 1.** Percentage of older adults who walked by perceived neighborhood social cohesion scale (PNSCS) and neighborhood socioeconomic status score (NSES). Panel A: By perceived neighborhood social cohesion scale (PNSCS), Panel B: By neighborhood socioeconomic score (NSES) score. Data: CHIS 2011–2017 data (All other variables) and Census ACS 2010–2016 data (for neighborhood SES score). We used the CHIS replicate weights to obtain valid variance estimates and weights to account for sample selection probabilities.

reside in neighborhoods with below median NSES ( $p < 0.05$ ). The magnitude of the Hispanic coefficient was larger than in Table 3. Older Hispanic adults who live in low SES neighborhoods and have above median perception on the neighbors and neighborhoods are 10.6 percentage points (17.4%) more likely to walk and walk 10.4 minutes (50.8%) more on average than White adults. Similarly, older Asian adults who live in low NSES neighborhoods and have above median perception on the neighbors and neighborhoods are 12.4 percentage points (20.3%) more likely to report walking and walk 11.2 minutes (54.7%) more on average than White adults.

As shown in Panel A of Table 4, neighborhood perception does not have a significant association with walking for older Hispanic and Asian adults who live in high NSES neighborhoods. However, older Black adults who live in high NSES neighborhoods and have above median perception on the neighbors and neighborhoods

report walking 6.5 percentage points (10.7%) less on average than White adults (but the chi-square test result was not significant). In summary, results from Table 4 show that the impact of having positive perception of neighborhoods is more pronounced among older Hispanic and Asian adults who live in neighborhoods with low NSES, but this association is not seen among Black adults. This positive link between perceived neighborhood social cohesion and walking is not found among high SES neighborhoods, indicating differential effects of perceived neighborhood social cohesion by neighborhood socioeconomic characteristics.

## Discussion

Given the race and ethnicity disparities in walking among older adults and the importance of neighborhood trust and safety, it is important to understand the mechanisms. It is also

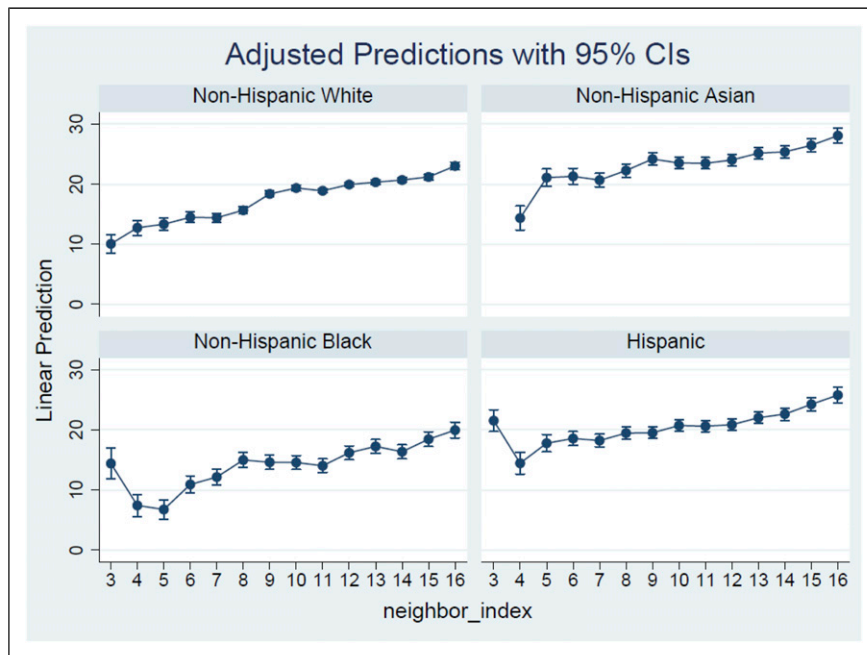
**Table 2.** Regression results for associations of walking with race and ethnicity, perceived neighborhood social cohesion scale and neighborhood socioeconomic score.

	Walked (binary)	Standardized coefficients (walked)	Minutes walked per week (including 0)	Standardized coefficients (minutes walked per week)
Asian	0.012 (0.019)	0.008 <i>p</i> -value: 0.529	2.701** (1.031)	0.026*** <i>p</i> -value: 0.009
Black	-0.01 (0.012)	-0.005 <i>p</i> -value: 0.392	1.631*** (0.542)	0.012*** <i>p</i> -value: 0.003
Hispanic	0.045*** (0.014)	0.035*** <i>p</i> -value: 0.001	3.867*** (0.743)	0.045*** <i>p</i> -value: 0.000
Perceived neighborhood social cohesion scale (PNSCS)	0.0007 (0.003)	0.003 <i>p</i> -value: 0.803	0.20** (0.077)	0.013*** <i>p</i> -value: 0.009
Neighborhood socioeconomic score (NSES)	0.006*** (0.001)	0.047*** <i>p</i> -value: 0.000	0.454*** (0.061)	0.051*** <i>p</i> -value: 0.000
Observations	50,767	50,767	50,696	50,696
R-squared	0.069		0.0502	

Data: CHIS 2011–2017 data (All other variables) and Census ACS 2010–2016 data (for neighborhood SES score).

Standard errors in parentheses (\*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ ).

Note. Controlling for demographic characteristics, health-related variables (health insurance coverage, whether or not visited a doctor's office in the past year, PROMIS health score based on self-reported health) and year fixed effects. We used the CHIS replicate weights to obtain valid variance estimates and weights to account for sample selection probabilities.

**Figure 2.** Predicted mean minutes walked for race/ethnic subgroups by perceived neighborhood social cohesion scale (PNSCS) from OLS regressions.

Data: CHIS 2011–2017 data (All other variables) and Census ACS 2010–2016 data (for neighborhood SES score)

Note: Controlling for demographic characteristics, NSES, and year fixed effects. We use the CHIS replicate weights to obtain valid variance estimates and the final weights to account for sample selection probabilities.

important to examine the results taking into account the characteristics of minority population in California. Since 2014, the share of Hispanic adults surpassed the share of White adults in California (Krogstad & Noe-Bustamante, 2021). California has the largest share of non-Hispanic multiracial Black residents in the country (Tamir, 2021).

California is one of the four states (AZ, CA, NM, and TX) with the largest share of Mexican origin (Brown & Lopez, 2013).

About one-third of Asian adults living in the U.S. reside in California, which is the largest in the country (Budiman & Ruiz, 2021). The top 10 cities in the U.S. with the highest

**Table 3.** Regression results: Race and ethnic differences in walking for leisure by above and below the median perceived neighborhood social cohesion scale (PNSCS).

	Walked			Minutes walked		
	PNSCS ≥ median	PNSCS < median	χ <sup>2</sup> test	PNSCS ≥ median	PNSCS < median	χ <sup>2</sup> test
Asian	0.02 (0.027)	0.0007 (0.0314)	0.30 [0.7429]	<b>5.039***</b> <b>(1.864)</b>	-0.831 (1.937)	<b>3.74</b> <b>[0.0237]</b>
Black	-0.031 (0.025)	0.02 (0.0292)	0.99 [0.3705]	1.454 (1.814)	1.878 (1.764)	0.7 [0.497]
Hispanic	<b>0.063***</b> <b>(0.022)</b>	0.0176 (0.0269)	<b>4.51</b> <b>[0.0109]</b>	<b>5.728***</b> <b>(1.797)</b>	0.73 (1.623)	<b>5.18</b> <b>[0.0056]</b>

Data: CHIS 2011–2017 data (All other variables) and Census ACS 2010–2016 data (for neighborhood SES score).

Standard errors in parentheses (\*\*\* p < 0.01, \*\* p < 0.05, \* p < 0.1). We report a χ<sup>2</sup> test (with p-value in [brackets]) for the equality of coefficients between groups. Note. Controlling for demographic characteristics, NSES and year fixed effects. We used the CHIS replicate weights to obtain valid variance estimates and weights to account for sample selection probabilities.

**Table 4.** Regression results: Factors associated with walking by high and low PNSCS in high and low NSES neighborhoods

Panel A	High NSES neighborhood (above sample median NSES)					
	Walked			Minutes walked		
	PNSCS ≥ median	PNSCS < median	χ <sup>2</sup> test	PNSCS ≥ median	PNSCS < median	χ <sup>2</sup> test
Asian	-0.011 (0.031)	-0.042 (0.038)	0.65 [0.5214]	<b>3.07*</b> <b>(1.752)</b>	0.894 (2.425)	1.6 [0.2011]
95% confidence interval	[-0.072, 0.051]	[-0.117, 0.033]		[-0.363, 6.503]	[-3.860, 5.648]	
Black	<b>-0.065*</b> <b>(0.039)</b>	-0.008 (0.042)	1.43 [0.2404]	-0.743 (2.44)	1.934 (3.597)	0.19 [0.8263]
95% confidence interval	[-0.141, 0.0109]	[-0.091, 0.075]		[-5.54, 4.049]	[-5.117, 8.986]	
Hispanic	0.018 (0.029)	0.033 (0.038)	0.56 [0.5725]	2.212 (2.019)	-0.749 (2.068)	0.67 [0.5142]
95% confidence interval	[-0.04, 0.076]	[-0.041, 0.106]		[-1.75, 6.17]	[-4.802, 3.303]	
Panel B	Low NSES neighborhood (below sample median NSES)					
	Walked			Minutes walked		
	PNSCS ≥ median	PNSCS < median	χ <sup>2</sup> test	PNSCS ≥ median	PNSCS < median	χ <sup>2</sup> test
Asian	<b>0.124**</b> <b>(0.052)</b>	0.068 (0.051)	<b>3.73</b> <b>[0.0241]</b>	<b>11.229**</b> <b>(4.578)</b>	-2.65 (3.16)	<b>3.36</b> <b>[0.0348]</b>
95% confidence interval	[0.0218, 0.227]	[-0.031, 0.167]		[2.256, 20.201]	[-8.84, 3.547]	
Black	-0.005 (0.032)	0.028 (0.038)	0.28 [0.753]	3.137 (4.218)	0.679 (1.722)	0.35 [0.7015]
95% confidence interval	[-0.069, 0.058]	[-0.046, 0.101]		[-5.13, 11.404]	[-2.696, 4.055]	
Hispanic	<b>0.106**</b> <b>(0.033)</b>	0.012 (0.037)	<b>5.25</b> <b>[0.005]</b>	<b>10.372***</b> <b>(3.184)</b>	-0.438 (2.703)	<b>5.32</b> <b>[0.005]</b>
95% confidence interval	[0.0416, 0.170]	[-0.061, 0.085]		[4.131, 16.6144]	[-5.737, 4.861]	

Data: CHIS 2011–2017 data (All other variables) and Census ACS 2010–2016 data (for neighborhood SES score).

Standard errors in parentheses (\*\*\* p < 0.01, \*\* p < 0.05, \* p < 0.1). We report a χ<sup>2</sup> test (with p-value in [brackets]) for the equality of coefficients between groups.

Note. Controlling for other demographic characteristics, and year fixed effects. We used the CHIS replicate weights to obtain valid variance estimates and weights to account for sample selection probabilities.



share of Asian American residents were all from California in 2019, and all 10 cities were located in San Francisco Bay area and Greater Los Angeles area (Spoer et al., 2021).<sup>14</sup> Korean, Filipino, and Chinese Americans in California showed lower levels of residential segregation compared to other Asian ethnic groups (Vietnamese and Filipino) but showed higher levels of segregation than White adults (Walton, 2016).

We found that Asian adults tended to walk more than other race and ethnic subgroups. Additionally, significant associations between perceived neighborhood social cohesion and walking among older adults were found in the current study. However, for all race and ethnicity groups, the likelihood of walking and minutes walked was associated positively with perception of neighbors and neighborhoods (Figure 2).

The results of this study suggest that having a more positive perception of the neighborhood and neighbors (indicated by above sample median perceived neighborhood social cohesion scale) is positively associated with the likelihood of walking and how long older adults walk, especially for older Hispanic and Asian adults living in low SES neighborhoods in California. Older Hispanic and Asian adults living in below median NSES neighborhoods with positive perception of neighbors and neighborhoods (trustworthy neighbors, neighbors get along, helpful neighbors, and safe neighborhoods) were significantly more likely to walk and walk longer than White older adults living in low SES neighborhoods. The positive and significant association between walking and PNSCS among older Asian adults living in low SES neighborhoods is in line with previous research. As Walton (2012) found, it is possible that the negative effects of low socioeconomic characteristics and resources in the neighborhood could be mitigated through social cohesion among Asian residents living in non-Asian neighborhoods (Walton, 2012).

The finding that having a more positive perception on neighbors and neighborhoods could matter more for older Hispanic adults could be driven by factors that influence differences in walkability perceptions. For instance, Adkins et al. (2019) found that walkability perceptions of Mexican American adults in Tucson, Arizona were more responsive than other race and ethnic subgroups to the influence of social environment (including social interaction, social cohesion, and community identity) (Adkins et al., 2019). The researchers found that traditional built environment attributes were frequently mentioned when pedestrians in predominantly non-Hispanic White locations were asked about walkability of the neighborhood. In contrast, Hispanic/Latino pedestrians cited social environment (whether positive or negative) in a neighborhood as elements of walkability in the area (Adkins et al., 2019). Similarly, Brown et al. (2011) focused on community-dwelling older Hispanic adults in Miami, Florida and found that Hispanic adults living in neighborhoods with high perceived neighborhood climate scores were 2.57 times more likely to walk at least one block than older Hispanic adults living in bottom half of perceived neighborhood climate scores (Brown et al., 2011).

To examine whether total minutes walked yielded similar results, we created another dependent variable multiplying the average number of times walked for at least 10 minutes (quantity) by the average number of minutes walked for at least 10 minutes (frequency) when walked for leisure in the past 7 days. Similar results were found for older minority adults where older adults with above median PNSCS and live in low NSES neighborhoods walk for a longer total duration.<sup>15</sup> However, PNSCS was not positively associated with older Black adults whether or not they live in high or low SES neighborhoods. Older Black adults reported walking less (total duration in minutes) than White adults, but the difference was rather small when they have above median PNSCS and live in low SES neighborhoods. Older Black adults with above median PNSCS walk less than those with below PNSCS. This finding is similar to the results from Li et al. (2017) where neighborhood perceptions were not associated with higher frequencies of moderate-to-high intensity activities and exercise activities among Black urban women (W. Li et al., 2017).

Different programs and community-based interventions that aim to improve health and physical activity levels of older adults document the importance of the neighborhood and social connections among neighbors. Findings from a study that examined the effects of community-based physical activity and social connectedness intervention called "Choose to Move" program for older adults (above 60) in 26 urban locations across British Columbia also highlight the importance of social connection with neighbors in physical activity levels among older adults (Franke et al., 2021). The program involved several different components such as one-on-one consultation with an activity coach, as well as having regular motivational meetings with other program participants discussing their experiences and share resources (Franke et al., 2021). The study found that after 6 months, older adults physical activity levels were significantly higher than at baseline and also improved social isolation and loneliness (Franke et al., 2021). What seemed to be common across these different intervention studies and findings were the importance of neighborhood perception and social connectedness and how these could be improved with different community programs.<sup>16</sup>

## Conclusions

This study investigates the association between neighborhood perception (based on how safe one felt in the neighborhood, trust neighbors, get along with neighbors, and neighbors are willing to help each other) and walking among older adults in the CHIS data. Findings from this study indicate that older Hispanic and Asian adults' walking patterns were more influenced by positive perceptions of their neighborhoods, especially among those who live in low SES neighborhoods.

There are several limitations to this study. First, this study does not aim to examine a causal relationship with a cross-

sectional design. The results and associations from the results might be driven by reverse causality or a third factor (Herbolsheimer et al., 2020a; Wallmann-Sperlich et al., 2014).<sup>17</sup> Second, given that the variable on walking asks about the information from the past 7 days, it is difficult to know whether this is a typical walking pattern or not. Third, the data did not have information or data on walkability of the neighborhoods such as cracked sidewalks, connected sidewalks, and proximity to neighborhood resources, which could influence walking behavior. Fourth, the regression results have a relatively low R-squared. Another limitation of our study is that the internal consistency reliability measure for the PNSCS was 0.625. Future research can consider incorporating more data on walkability of the neighborhoods that can be used as another determinant for walking among older adults.<sup>18</sup> Also, future study can expand the analysis by incorporating the multi-level structure of the data and by conducting various missing data imputation methods and compare the results.

Findings from the study suggest that efforts to improve perception of one's neighbors and neighborhoods could influence the likelihood of walking and the minutes walked by older adults living in low SES neighborhoods. Policymakers may want to consider policies and interventions that can help improve the perceptions of neighbors and neighborhoods in terms of social cohesion and trust, which is found to have significant positive associations with walking among older adults, and especially among older Hispanic and Asian adults in low SES neighborhoods. Furthermore, when designing policy interventions, it would be important to consider the different ethnic neighborhood contexts in California, which may vary by different subgroups within race and ethnicity.<sup>19</sup>

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### Supplementary Material

Supplementary material for this article is available online.

### Notes

1. Findings from the three leading national surveys (National Health and Nutrition Examination Survey, Behavioral Risk Factor Surveillance System, and National Health Interview Survey) on health behaviors consistently indicated that Non-Hispanic Black and Hispanic adults report lower levels of physical activity compared to Non-Hispanic White adults (Keadle et al., 2016).
2. For more information: <https://healthpolicy.ucla.edu/chis/design/Pages/methodology.aspx>
3. For more information: <https://healthpolicy.ucla.edu/chis/design/Pages/data-quality7.aspx>
4. As we move forward in the paper, we will refer to Black adults for non-Hispanic Blacks, Asian adults for non-Hispanic Asians, and White adults for non-Hispanic Whites. We only focus only on older adults (65 and older).
5. Descriptive statistics table of the observations matched with the census tract data is available in [Supplement Appendix Table I](#).
6. Both variables are derived from the question that asks about walking for leisure at least 10 minutes during the past 7 days. For the exact wording of the questionnaire, please check <https://healthpolicy.ucla.edu/chis/design/Documents/2017%20Questionnaires%20and%20Topics%20List/10.3.2019%20Updated%20Files/CHIS%202017%20ADULT.pdf>
7. Unlike walking for transport, walking for leisure did not decline significantly by age among adults in California (Babey et al., 2018). Although Babey et al. (2018) found in analysis of the CHIS data that walking for transportation did not vary by neighborhood social cohesion or feeling safe in a neighborhood, neighborhood characteristics could play a significant role in walking for transport. For instance, Yun (2019) found that walking for transport was positively related to environmental characteristics like walkability, urbanization, land use mix-diversity and accessibility, walking amenities, and bicycle lanes. Walking for leisure was associated with neighborhood employment/income level, nearness to public transportation/bus stops, and social cohesion. (Please see: Yun, H. Y. (2019). Environmental Factors Associated with Older Adult's Walking Behaviors: A Systematic Review of Quantitative Studies. *Sustainability* 2019, 11(12), 3253. <https://doi.org/10.3390/SU11123253>)
8. The 10-minute cutoff is used to measure the physical activity surveys such as the World Health Organization's Global Physical Activity Questionnaire and the National Health Interview Survey (Yi et al., 2016). Please see Microsoft Word - GPAQ\_Analysis\_Guide.doc (who.int)

9. For consistency, we used an inverse category for “Get along with neighbors” variable (All other items/questionnaires for PNSCS are phrased positively). This question was not asked in 2011.
10. We also estimated the models separately using each single item (binary indicators) of feeling safe, trust, get along, and help and found positive and significant associations with help, trust variables and walking but negative and significant associations with feeling safe in the neighborhood and walking (results shown in [Supplement Appendix Table III](#)).
11. We also ran analogous regression for the NSES following the approach of Blanco et al. (2019). Chi-square results show insignificant difference between coefficients, unlike [Table 3](#). Results available upon request.
12. Please see [Supplement Appendix Table II](#) for descriptive statistics on walking variables by race and ethnicity.
13. We also include the results with interaction terms with race and perceived neighborhood social cohesion scale in [Supplement Appendix Table IV](#).
14. Asian residents living in California are diverse in terms of their countries of origins, mostly from East, South, and Southeast Asia ([Gong et al., 2021](#)).
15. Results available upon request.
16. According to a focus group study of 18 older adults (65 and older) in Northwest England, not only was it important to have a physical space for older adults, but also the social space within the physical environment was the most influential. Such social environment helped build support among older adults and cross-cultural relationships were effective and influential in helping older adults engage in exercise ([Hartley & Yeowell, 2015](#)). Furthermore, a similar community-based intervention in Hong Kong for families (not just for older adults) called the “Learning Families Project” found that neighborhood perception and trust among neighbors could be improved through such intervention programs. This paper also used a similar perceived neighborhood social cohesion scale as ours and had multiple programs within the community interventions such as day camps various activities and workshops, and age-appropriate learning programs such as craft, yoga, exercise, and healthy eating classes. Although this study did not focus particularly on older adults, that participants in the intervention group reported significantly higher levels of trust and closeness of neighborhood compared to the control group ([Shen et al., 2017](#)).
17. For instance, it is possible that walking can improve neighborhood social cohesion and perception and older adults who walk more frequently might be more likely to have positive perceptions of their neighborhoods.
18. Another possibility is to consider using an open-source software in order to develop spatial indicators ([Boeing et al., 2022](#)). For more information please see: Boeing, G., Higgs, C., Liu, S., Giles-Corti, B., Sallis, J. F., Cerin, E., Lowe, M., Adlakha, D., Hinckson, E., Moudon, A. V., Salvo, D., Adams, M. A., Barrozo, L. V., Bozovic, T., Delclòs-Alió, X., Dygrýn, J., Ferguson, S., Gebel, K., Ho, T. P., ... Arundel, J. (2022). Using open data and open-source software to

develop spatial indicators of urban design and transport features for achieving healthy and sustainable cities. *The Lancet Global Health*, *10*(6), e907–e918. [https://doi.org/10.1016/S2214-109X\(22\)00072-9](https://doi.org/10.1016/S2214-109X(22)00072-9)

19. Previous studies have suggested different ways to improve neighborhood perception, social cohesion, and leisure walking among older adults such as neighborhood senior centers, inter-generational community centers, and other community service organizations to provide a social space and environment for older adults to interact with neighbors, service providers, and volunteers as well as offer organized group social and physical activities in the neighborhood ([Choi et al., 2015](#); [Kim et al., 2020](#)).

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