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ORIGINAL ARTICLE

Social capital and health status: longitudinal race and ethnicity differences in older adults from 2006 to 2014

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Abstract

Objectives We examined the longitudinal associations of social capital on self-rated health and differences by race/ethnicity in older adults.

Methods We used Health and Retirement Study, a nationally representative sample of US adults aged ≥ 50 years evaluated every 2 years (2006–2014) (N = 18,859). We investigated the relationship between social capital indicators (neighborhood social cohesion/physical disorder, positive/negative social support) with self-rated health accounting for age, gender, education and stratified by race/ethnicity. We used structural equation multilevel modeling estimating the associations: within-wave and between-persons.

Results We observed between-persons-level associations among social capital indicators and self-rated health. Individuals with overall levels of positive social support and neighborhood social cohesion tended to have overall better self-rated health [correlations 0.21 ($p < 0.01$) and 0.29 ($p < 0.01$), respectively]. For Hispanics, the correlations with self-rated health were lower for neighborhood social cohesion (0.19) and negative social support (− 0.09), compared to Whites (0.29 and − 0.20). African-Americans showed lower correlations of positive social support (0.14) compared to Whites (0.21) and Hispanics (0.28).

Conclusions Interventions targeting social capital are in need, specifically those reinforcing positive social support and neighborhood social cohesion and diminishing neighborhood physical disorder and negative social support of older adults.

Keywords Social capital · Health status · Racial differences · Older adults · Longitudinal · Multilevel

Introduction

In the new Dictionary of Epidemiology of the International Epidemiological Association, social capital has been defined as "the resources—for example, trust, norms, and the exercise of sanctions—available to members of social groups" (Porta 2014). The social group can take different forms, such as a neighborhood, a work place, a voluntary organization or a tightly knit residential community. The salient feature of this definition is that social capital is conceptualized as a group attribute and it follows Putnam's definition of social capital (Putnam 2000). In the Dictionary, social capital is also defined as "the resources—for example, social support, information channels, social credentials—that are embedded within an individual's social networks" and follows Bourdieu's definition of social capital (Bourdieu 2002). This approach conceptualizes social capital as an individual and a group attribute (Porta 2014). Scholars have

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conceptualized social capital into indicators that describe positive expected relationships (e.g., social cohesion and social support) and negative relationships (e.g., neighborhood social disorder understood as violence, graffiti and empty houses) (Porta 2014; Putnam 2000; Bourdieu 2002).

There is a wide body of evidence documenting that social capital is associated with perceived health (Kawachi and Berkman 2000; Murayama et al. 2012; Schaie and Carstensen 2006). Bjornstrom et al. (2013) analyzed data from families and suggested that neighborhood physical disorder is negatively associated with self-rated health (Bjornstrom et al. 2013). Shen et al. (2014) found significant associations between certain aspects of social capital (perceived help and availability of amenities and associations within the community) at both the individual and the community levels, and self-rated health in older adults (Shen et al. 2014). Oksanen et al. (2010) found that a decline in social capital (trust and reciprocity) at an individual level was associated with impairment of self-rated health in adults (Oksanen et al. 2010).

Social capital at the individual and at the group level has been related to racial disparities in health. Neighborhood social cohesion, a group level attribute of social capital, has been postulated as one potential explanation for racial differences in poverty (Quillian and Redd 2006). Higher neighborhood social cohesion has been related to higher racial segregation, which is likely related to differences in one's access to education and employment opportunities (Williams and Collins 2001). Neighborhood social cohesion can determine the availability of resources within a communities' social environment (Williams and Collins 2001) and availability of individual-level sources of social support (do Leal et al. 2011). Social support is crucial since it has been suggested to be a protective factor later in life preserving positive self-rated health. Nonetheless, the benefits of social support have been shown to vary by race/ethnicity. Positive social support has been reported to have a stronger association with self-rated health among African-Americans compared to Whites when there are high levels of stress. That effect modification finding indicates that social capital is a first line of defense that is deployed when this group faces adversity (Sheffler and Sachs-Ericsson 2016). One recent ecological study that examined the association between social trust, an indicator of social capital and rates of late HIV diagnosis across the US found that higher levels of social trust were more strongly related to lower rates of HIV diagnosis for African-Americans compared to Whites (Ransome et al. 2017).

The investigation of self-rated health among aging population is important since it is when chronic conditions are prevalent and life course exposure to stress begins to manifest (Kaplan et al. 1999). Self-rated health is a key predictor of mortality in the population, especially for older adults (Miilunpalo et al. 1997). Indeed, fair self-rated health increases with age (CDC 2018). One key driver of health inequities is that racial/ethnic differences become more pronounced in the aging population (Ferraro and George 2015; Moen et al. 2006), when these groups have lower access to care. African-Americans have significantly higher prevalence rates of late-life cognitive functions, in comorbid diabetes, depression, yet lower use of health services (Wilson et al. 2016; Hawkins et al. 2016). These racial/ethnic inequities are only partially explained by level of education and environmental context (Wilson et al. 2016; Hawkins et al. 2016), which means that other social factors are involved.

Previous studies using nationally representative data of older adults of the US interestingly investigate social indicators and their relation with health outcomes. For example, these studies have investigated the relationship between social engagement and physical and cognitive health over the life course (Nelson et al. 2013), the effects of social integration in health (Ertel et al. 2008) or the relationship between social capital indicators and unretirement (Gonzales and Nowell 2017). This body of work suggests the protective association of social indicators on several health-related aspects. However, we are not aware of any study investigating the relationship of individual and group-level social capital indicators on self-rated health, an important predictor for mortality, in a representative sample of older adults with a life course perspective. Moreover, despite the study of racial/ethnic differences is a widely investigated topic, there is very limited research on racial/ethnic differences in self-rated health over the life course in representative samples of older adults, in association with group- and individual-level social capital indicators. We examined the longitudinal associations of group-level social capital indicators—neighborhood social cohesion and neighborhood physical disorder—and individual-level social capital indicators—positive social support and negative social support—on self-rated health. Then, we conduct effect modification to examine the relationship by race/ethnicity.

Methods

Participants

The Health and Retirement Study (HRS) is a nationally representative study of US adults aged $\geq$ 50 years (Sonnega et al. 2014). The HRS is sponsored by the National Institute on Aging and is conducted by the University of Michigan's Institute for Social Research. HRS provides extensive documentation about their protocol, instrumentation and complex sampling strategy elsewhere (http://hrsonline.isr.umich.edu/). Enrollment was based on a multistage area probability sample of households. Response rates for the core interview are considerably high, with the baseline response rate ranging from 47.4 to 81.3% across study entry cohorts and an average of being

73.0% and re-interview response rates ranging from 68.8 to 92.3% (Sonnega et al. 2014). We used five waves of panel data from 2006 to 2014. Starting in 2006, a random 50% of HRS respondents were selected to receive a Psychosocial and Lifestyle questionnaire that was self-reported every other wave (every 4 years). The other 50% followed the same process but starting in 2008. Thus, two distinct cohorts were formed: The first cohort had three Psychosocial and Lifestyle assessments in years 2006, 2010 and 2014, and the second cohort had two assessments in years 2008 and 2012. We combined both cohorts as one sample with three measurement waves: Wave 1 includes measurements in years 2006 and 2008, wave 2 in years 2010 and 2012 and wave 3 in year 2014. Respondents of the Psychosocial and Lifestyle questionnaire module have sample weights to account for the complex sample design of the study. The weights are a product of three factors: (1) the core of nursing home weights for the given wave; (2) a non-response adjustment factor obtained from a propensity model predicting Psychosocial and Lifestyle responses; (3) a post-stratification adjustment to the weighted HRS sample. More information is available in the HRS website (Health and Retirement Study 2019). For the statistical analyses, weights were scaled to sum up the observed sample size at each wave. The final sample was 18859 individuals. This number indicates the number of participants that had valid data in at least one of the three waves analyzed. Sample size of complete cases of the cohort 1 (measurements at years 2006, 2010 and 2014) per variable is $N = 3890$ for self-rated health, $N = 3566$ for neighborhood social cohesion, $N = 3554$ for neighborhood physical disorder, $N = 3871$ for positive social support and $N = 3868$ for negative social support. For cohort 2 (measurements at 2008 and 2012), sample sizes are $N = 4414$ for self-rated health, $N = 4131$ for neighborhood social cohesion, $N = 4118$ for neighborhood physical disorder, $N = 4401$ for positive social support and $N = 4397$ for negative social support. More details about the sample size per wave are given in "Appendix" and Table 1. HRS was approved by University of Michigan Health Sciences/Behavioral Sciences IRB Protocol: HUM00061128. Informed consent was obtained from all HRS respondents.

Measures

Self-rated health

Self-rated health was used with the question: Would you say your health is excellent, very good, good, fair, or poor? The response options ranged from 1 (excellent) to 5 (poor). We reversed coded the score of this question for better interpretation of the results (higher scores indicating better self-rated health).

Neighborhood social cohesion

In some studies, neighborhood social cohesion and neighborhood physical disorder are examined at the aggregated neighborhood level using multilevel modeling. However, this requires a nested study design with many residents clustered in many neighborhoods, which was not available in this sample. Therefore, this study focuses on people's perceptions of neighborhood social cohesion and neighborhood physical disorder at the individual level. Perceived neighborhood social cohesion was assessed using a four-item scale that was developed and tested for use in two nationally representative studies of older adults (HRS and the English Longitudinal Study of Aging) (Smith et al. 2013). The scale assesses the respondent's perceived level of social cohesion and social trust in his or her neighborhood. Using a seven-point Likert scale, respondents indicated the degree to which they endorsed items such as *I really feel part of this area*. The scores on each item were then summed together (range 4–28), with higher scores reflecting higher perceived neighborhood social cohesion. Cronbach's α for this scale ranges from 0.84 to 0.87.

Neighborhood physical disorder

Four items of the neighborhood physical disorder scale asses the respondent's perceived level of physical disorder in the neighborhood using a seven-point Likert scale. An item example is *People would be afraid to walk alone in this area after dark*. The scores on each item were then summed together. We reversed coded the variable so that the higher scores reflect higher perceived neighborhood physical disorder (range 4–28). Cronbach's α for this scale ranges from 0.75 to 0.85. The neighborhood social capital and physical disorder scales have been previously validated resulting in good psychometric properties (Stafford et al. 2003; Mendes de Leon et al. 2009).

Positive social support

The HRS study evaluated positive social support with a series of questions assessing social integration (number of ties) and the quality of interaction with those social ties (Ha et al. 2017). Separate questions are asked about spouse/partner, children, family and friends. Using a four-point Likert scale (1 a lot, 4 not at all), respondents answer items such as *How much do they really understand the way you feel about things*? Cronbach's α has been evaluated in previous studies (α ranges from 0.82 to 0.84) (Ha et al. 2017). We reversed coded the scales to have a final score where higher scores indicating higher positive social support (the range is 1–10).

Table 1 Descriptive statistics of self-rated health, social capital and demographic variables by wave

	Wave 1		Wave 2		Wave 3	
	N	% or mean (SD*)	*N*	% or mean (SD)	*N*	% or mean (SD)
Age	13,527	66.8 (10.3)	14,191	65.5 (10.6)	6651	67.1 (9.6)
Gender						
Males	5617	45.1%	5896	45.7%	2719	45.8%
Females	7910	54.9%	8295	54.3%	3931	54.2%
US born	12,466	92.6%	12,918	92.2%	6016	91.5%
Foreign born	1049	7.4%	1262	7.8%	633	8.5%
Race/ethnicity						
White	10,692	82.7%	10,474	81.0%	4815	80.5%
Hispanic	787	5.3%	950	5.4%	473	5.7%
African-American	1768	9.5%	2355	10.4%	1159	10.4%
Other	280	2.4%	412	3.2%	204	3.4%
Education						
No degree	2577	16.8%	2199	13.0%	939	11.7%
GED high school diploma**	7445	54.2%	7741	52.9%	3626	52.5%
College degree	2257	18.8%	2802	22.5%	1349	23.3%
Master and professional degrees	1223	10.2%	1402	11.6%	697	12.4%
Self-rated health (*r*)***	13,513	3.2 (1.1)	14,179	3.3 (1.1)	6646	3.2 (1.1)
Neighborhood social cohesion	12,897	22.0 (5.4)	13,599	21.9 (5.4)	6396	21.7 (5.3)
Neighborhood physical disorder (*r*)	12,871	10.1 (3.7)	13,599	10.3 (3.4)	6391	10.1 (3.3)
Positive social support (*r*)	13,451	3.1 (0.5)	14,139	3.1 (0.6)	6628	3.1 (0.6)
Negative social support (*r*)	13,443	1.7 (0.5)	14,130	1.7 (0.5)	6625	1.6 (0.5)

The Health and Retirement Study, US, data from 2006 to 2014

*Standard deviation

**Graduate equivalency degree

***(*r*) Reversed scale. Higher scores indicate higher values of self-rated health, neighborhood physical disorder, positive social support and negative social support

Negative social support

Negative social support was evaluated asking about the demanding nature of relationships (Ha et al. 2017). Separate questions are asked about spouse/partner, children, family and friends. Using a four-point Likert scale (1 a lot, 4 not at all), respondents answer items such as *How often do they make too many demands on you*? Cronbach's α has been evaluated in previous studies (α ranges from 0.73 to 0.76) (Ha et al. 2017). We reversed coded the scales to have a final score where higher scores indicate higher negative social support (range 1–13). More information on the items asked in each social capital indicator is available in "Appendix."

Sociodemographic variables

All covariates included were assessed in 2006. Sociodemographic factors included age, gender (men, women) and educational attainment (no degree, high school diploma or general educational development (GED), 2 years college degree or 4 years college degree, Masters and Professional degrees). We created the race/ethnicity variable combining information from race (White, African-American or other) and from Hispanic origin (Mexican, Hispanic or Other). Final categories were White, African-American, Hispanic and other not specified.

Statistical analysis

First, we quantitatively examined whether there were differences between the individuals from both cohorts across waves so that we could combine these data. We found no significant differences across the cohorts, so we proceeded with the longitudinal analysis. The results of this comparative analysis are available in "Appendix." Second, we performed descriptive statistics of the sample characteristics at baseline and the longitudinal variables (self-rated health and social capital indicators) at every wave. We also performed descriptive statistics stratifying for race/ethnicity for self-rated health and the social capital variables at every wave. Third, we investigated the relationship between social capital indicators (neighborhood social cohesion and neighborhood physical disorder, positive social support and negative social

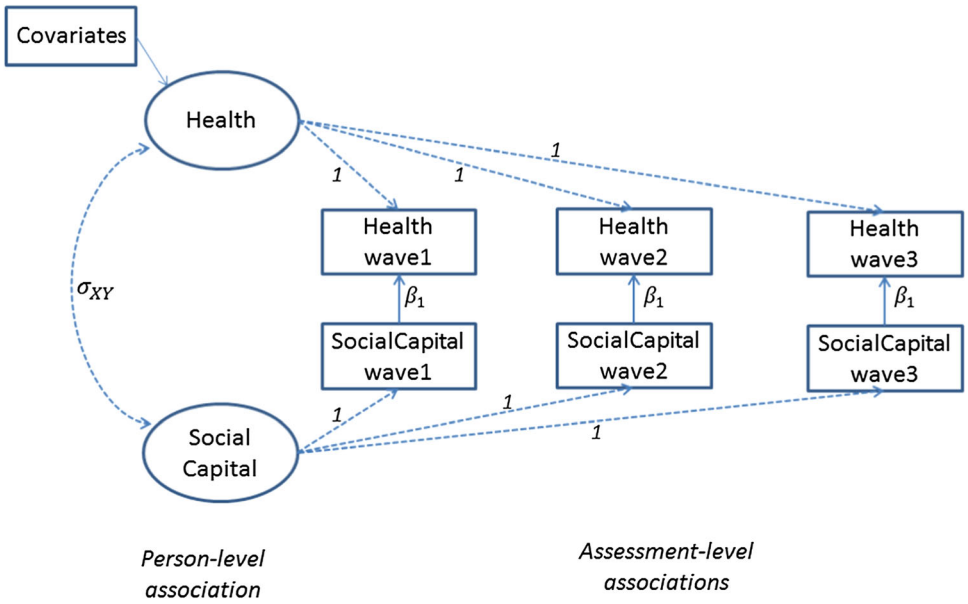

Fig. 1 Structure of the data in the statistical analysis. The Health and Retirement Study, US, data from 2006 to 2014

support) and self-rated health accounting for baseline covariates (age, gender, educational attainment and race/ethnicity), using a multilevel structural equation modeling approach (MSEM). The outcome (self-rated health) and the predictor variable (social capital) were both modeled over time and then related at person (between) and assessment (within) level (Fig. 1). This technique has several strengths. First, FIML (full information maximum likelihood) allows to use all available data in the analysis: Individuals without complete data on self-rated health or social capital indicators are kept in the analyses, assuming missing information to be missing at random. Second, MSEM allows the investigation of the longitudinal effects separating the within-level effects (at the "assessment level") from the between-level effects (at the "person" level) in the same model. The within-level effects represent individual changes at each time—e.g., the influence of social capital at a specific time point on self-rated health within the same individual at the same time point (fixed effects). The between-level effects represent the extent to which people who overall report high levels of the social capital indicators differ in their levels of self-rated health compared to people who overall report low levels on the social capital indicators (random effects). Here, we report both within- and between-level effects. From now on, we will talk about effects within-wave and effects between-persons.

In order to explore the differences by race/ethnicity, we described the study variables by race/ethnicity and we ran the MSEM stratifying by race/ethnicity (Ward et al. 2019). Differences in the associations between social capital indicators and self-rated health across race/ethnicities were assessed by looking at the confidence intervals of their main parameters. (Due to convergence problems, we could not run multi-group analyses for a more formal comparison across races.) MSEM were analyzed using Mplus version 7.4 (Muthén and Muthén 2012), with MLR estimator (maximum likelihood with robust standard errors).

Let Y_{ij} be the value of self-rated health for individual i at wave j, X_{ij} social capital variable and Z_i a person covariate. The random intercept effects for each variable are expressed as u_i^Y and u_i^X, and the residuals at the within-wave level e_{ij}^Y and e_{ij}^X. Time trend is modelled as categorical, including dummy variables for waves 2 and 3 ($W2$ and $W3$), thus wave 1 is the reference category (hence, not assuming any pre-specified trend shape). Given that self-rated health is an ordinal variable with five categories, we modeled it with a probit regression. The random intercepts covariance σ_{YX} indicates the relationship between self-rated health and social capital at the person level, and β_1 estimates the within-wave effects of social capital on self-rated health—already adjusted by their person level

$$\begin{aligned}
&\text{probit}\left(Y_{ij}\right) = \beta_0^Y + \beta_1 X_{ij} + \beta_2^Y W2 \\
&\quad + \beta_3^Y W3 + \beta_4 Z_i + u_i^Y + e_{ij}^Y \\
&X_{ij} = \beta_0^X + \beta_2^X W2 + \beta_3^X W3 + u_i^X + e_{ij}^X \\
&\left(u_i^X, u_i^Y\right) \sim N\left(\begin{bmatrix}0\\0\end{bmatrix}, \begin{bmatrix}\sigma_X^2 & \sigma_{YX}\\ & \sigma_Y^2\end{bmatrix}\right).
\end{aligned}$$

Results

Table 1 indicates that the sample is formed mainly by US born and Whites. The most frequent educational degree was "GED High school diploma," achieved by more than half of the sample. Over time, the trend of self-rated health

and social capital indicators remained stable. Table 2 indicates the descriptive statistics for the main variables of the study by race/ethnicity. We can observe that Hispanics and African-Americans report worse self-rated health, positive social support and neighborhood social cohesion than Whites across waves. These groups also report higher neighborhood social disorder and negative social support than Whites across waves.

The results of the MSEM analysis are shown in Table 3. Being male, White and having a high level of education was associated with better self-rated health. Self-rated health also decreased with age. At the within-wave level, only negative social support showed some relationship between self-rated health and the social capital indicators (e.g., an increment of negative social support above the expected person average at one specific wave is associated with some decrease in self-rated health at the same wave). At the between-persons level, all random intercepts were correlated significantly, ranging from − 0.24 to 0.29. This indicates that individuals with an overall higher level of positive social support and neighborhood social cohesion in all waves tend also to have overall better levels of self-rated health. On the contrary, individuals with an overall higher level of negative social support and neighborhood physical disorder in all waves tend also to have overall worse levels of self-rated health.

Table 4 shows the results of the multilevel structural equation models stratifying for race/ethnicity. At the between-persons level, for African-Americans the positive relationship between neighborhood social cohesion and self-rated health was stronger ($r = 0.19_{\text{Hispanic}}$, $0.39_{\text{African-American}}$ and 0.29_{Whites}). The negative correlation between neighborhood physical disorder and self-rated health was similar for all race/ethnicities ($r = -0.25_{\text{Hispanic}}$, $-0.33_{\text{African-American}}$ and -0.25_{Whites}). For African-Americans, the correlation between positive social support and self-rated health was weaker ($r = 0.28_{\text{Hispanic}}$, $0.14_{\text{African-American}}$ and 0.21_{Whites}) compared to Whites. For negative social support, Hispanics showed a weaker correlation ($r = -0.09_{\text{Hispanic}}$, $-0.19_{\text{African-American}}$ and -0.20_{Whites}). Nevertheless, the confidence intervals of the correlation estimates across races show overlap (see "Appendix" and Table 2). Since the samples for Hispanics and African-Americans are very small compared to Whites, we consider that correlation differences larger than 0.1 hints toward the existence of real but moderate (not large) differences across race/ethnicity (according to Cohen, for this range of correlation values, a difference of 0.1 can be considered a small effect size) (Cohen 1988).

Table 2 Descriptive statistics of self-rated health and social capital variables by race/ethnicity

	Whites Mean (SD*)	Hispanics Mean (SD)	African-Americans Mean (SD)	*p* value**
Wave 1				
Self-rated health (*r****)	3.3 (1.1)	2.6 (1.1)	2.8 (1.1)	< 0.01
Neighborhood social cohesion	22.4 (5.1)	20.4 (6.3)	19.8 (6.1)	< 0.01
Neighborhood physical disorder (*r*)	9.8 (3.5)	11.5 (4.5)	11.7 (4.3)	< 0.01
Positive social support (*r*)	3.1 (0.5)	3.1 (0.5)	3.1 (0.6)	0.674
Negative social support (*r*)	1.6 (0.5)	1.8 (0.5)	1.8 (0.6)	< 0.01
Wave 2				
Self-rated health (*r*)	3.3 (1.1)	2.8 (1.1)	2.9 (1.1)	< 0.01
Neighborhood social cohesion	22.3 (5.1)	20.4 (6.0)	19.0 (6.1)	< 0.01
Neighborhood physical disorder (*r*)	10.1 (3.2)	11.1 (3.7)	12.0 (3.8)	< 0.01
Positive social support (*r*)	3.1 (0.5)	3.1 (0.6)	3.1 (0.6)	0.228
Negative social support (*r*)	1.6 (0.5)	1.7 (0.5)	1.8 (0.6)	< 0.01
Wave 3				
Self-rated health (*r*)	3.3 (1.0)	2.7 (1.0)	2.9 (1.0)	< 0.01
Neighborhood social cohesion	22.2 (5.0)	20.1 (6.6)	18.8 (5.9)	< 0.01
Neighborhood physical disorder (*r*)	9.8 (3.1)	11.0 (3.9)	11.9 (3.8)	< 0.01
Positive social support (*r*)	3.1 (0.5)	3.1 (0.6)	3.1 (0.6)	0.947
Negative social support (*r*)	1.6 (0.4)	1.7 (0.5)	1.8 (0.5)	< 0.01

The Health and Retirement Study, US, data from 2006 to 2014

*Standard deviation

**Robust tests of equality of means

***(*r*) Reversed scale. Higher scores indicate higher values of self-rated health, neighborhood physical disorder, positive social support and negative social support

Table 3 Results from multilevel models for the association of social capital indicators and self-rated health

	Neighborhood social cohesion		Neighborhood physical disorder		Positive social support		Negative social support	
	B (SE)*	*p* value	B (SE)	*p* value	B (SE)	*p* value	B (SE)	*p* value
Fixed effects for self-rated health								
Wave 1 (ref)								
Wave 2	− 0.15 (0.02)	< 0.01	− 0.15 (0.02)	< 0.01	− 0.15 (0.02)	< 0.01	− 0.16 (0.02)	< 0.01
Wave 3	− 0.40 (0.02)	< 0.01	− 0.40 (0.02)	< 0.01	− 0.39 (0.02)	< 0.01	− 0.42 (0.03)	< 0.01
Age	− 0.03 (0.00)	< 0.01	− 0.02 (0.00)	< 0.01	− 0.03 (0.00)	< 0.01	− 0.03 (0.00)	< 0.01
Gender								
Males (ref)								
Females	− 0.04 (0.11)	0.08	− 0.09 (0.03)	< 0.01	0.01 (0.03)	0.63	− 0.09 (0.03)	< 0.01
Race								
Whites (ref)								
Hispanics	− 0.52 (0.06)	< 0.01	− 0.55 (0.06)	< 0.01	− 0.61 (0.06)	< 0.01	− 0.56 (0.06)	< 0.01
African-Americans	− 0.49 (0.04)	< 0.01	− 0.53 (0.04)	< 0.01	− 0.64 (0.04)	< 0.01	− 0.55 (0.04)	< 0.01
Others	− 0.38 (0.09)	< 0.01	− 0.39 (0.09)	< 0.01	− 0.46 (0.10)	< 0.01	− 0.42 (0.10)	< 0.01
Education								
No degree (ref)								
GED high school diploma**	0.67 (0.04)	< 0.01	0.71 (0.04)	< 0.01	0.72 (0.04)	< 0.01	0.71 (0.04)	< 0.01
College degree	1.24 (0.05)	< 0.01	1.27 (0.05)	< 0.01	1.31 (0.05)	< 0.01	1.30 (0.05)	< 0.01
Master and professional degrees	1.59 (0.06)	< 0.01	1.61 (0.06)	< 0.01	1.66 (0.06)	< 0.01	1.66 (0.06)	< 0.01
Social capital indicator***	0.00 (0.00)	0.70	0.01 (0.00)	0.08	0.02 (0.03)	0.50	− 0.19 (0.04)	< 0.01
Fixed effects for social capital indicators								
Intercept	21.88 (0.05)	< 0.01	10.18 (0.04)	< 0.01	3.13 (0.01)	< 0.01	1.68 (0.01)	< 0.01
Wave 1 (ref)								
Wave 2	− 0.17 (0.06)	< 0.01	0.32 (0.04)	< 0.01	0.00 (0.01)	0.72	− 0.03 (0.00)	< 0.01
Wave 3	− 0.38 (0.08)	< 0.01	0.15 (0.05)	0.01	− 0.01 (0.01)	0.16	− 0.07 (0.01)	< 0.01
Random effects								
Residual variance social capital indicator	14.03 (0.29)		7.04 (0.13)		0.11 (0.00)		0.08 (0.00)	
Variance random intercept self-rated health	2.40 (0.07)		2.41 (0.07)		2.40 (0.07)		2.36 (0.07)	
Variance random intercept social capital indicator	14.01 (0.29)		4.96 (0.12)		0.18 (0.00)		0.14 (0.00)	
Correlation random intercepts (self-rated health and social capital indicator)	0.29 (0.01)	< 0.01	− 0.24 (0.02)	< 0.01	0.21 (0.02)	< 0.01	− 0.17 (0.02)	< 0.01

The Health and Retirement Study, US, data from 2006 to 2014

*Beta coefficient, standard errors

**Graduate equivalency degree

***Each model examines the relation of one social capital indicator with self-rated health. The scales that are reversed are the same as in the descriptive statistics

Discussion

We examined the longitudinal effects of social capital on self-rated health in a nationally representative sample of aging individuals. We observed between-persons-level associations among social capital indicators and self-rated health, which means that participants who overall reported high levels of social capital differed in their levels of self-rated health compared to people who overall reported low levels of social capital. Furthermore, we examined whether any longitudinal associations were different across race/ethnicity. We anticipated that the relationship between social capital and self-rated health would vary by race/ethnicity. The results in the descriptive statistics show different values for Hispanics and African-Americans compared to Whites, with Whites having better self-rated

Table 4 Results from multilevel models for the association of social capital indicators and self-rated health by race/ethnicity

	Neighborhood social cohesion*		Neighborhood physical disorder		Positive social support		Negative social support	
	B (SE)**	*p* value	B (SE)	*p* value	B (SE)	*p* value	B (SE)	*p* value
Whites								
Fixed effects for self-rated health								
Wave 1 (ref)								
Wave 2	− 0.19 (0.02)	< 0.01	− 0.20 (0.02)	< 0.01	− 0.20 (0.02)	< 0.01	− 0.20 (0.02)	< 0.01
Wave 3	− 0.49 (0.03)	< 0.01	− 0.49 (0.03)	< 0.01	− 0.49 (0.03)	< 0.01	− 0.49 (0.03)	< 0.01
Social capital indicator	0.00 (0.00)	0.76	0.01 (0.01)	0.01	0.02 (0.04)	0.61	− 0.11 (0.05)	0.03
Fixed effects for social capital indicators								
Intercept	22.36 (0.05)	< 0.01	9.85 (0.04)	< 0.01	3.12 (0.01)	< 0.01	1.64 (0.01)	< 0.01
Wave 1 (ref)								
Wave 2	− 0.07 (0.06)	0.28	0.33 (0.05)	< 0.01	0.00 (0.01)	0.52	− 0.03 (0.00)	< 0.01
Wave 3	− 0.23 (0.08)	0.01	0.14 (0.06)	0.01	− 0.01 (0.01)	0.30	− 0.07 (0.01)	< 0.01
Random effects								
Residual variance social capital indicator	11.83 (0.29)		6.07 (0.14)		0.09 (0.00)		0.07 (0.00)	
Variance random intercept self-rated health	2.84 (0.10)		2.88 (0.10)		2.86 (0.10)		2.83 (0.10)	
Variance random intercept social capital indicator	13.10 (0.28)		4.72 (0.12)		0.18 (0.00)		0.13 (0.00)	
Correlation random intercepts	0.29 (0.02)	< 0.01	− 0.25 (0.02)	< 0.01	0.21 (0.02)	< 0.01	− 0.20 (0.02)	< 0.01
Hispanics								
Fixed effects for self-rated health								
Wave 1 (ref)								
Wave 2	0.11 (0.07)	0.15	0.11 (0.07)	0.16	0.11 (0.07)	0.16	0.09 (0.08)	0.23
Wave 3	0.00 (0.10)	0.99	− 0.01 (0.09)	0.94	− 0.01 (0.10)	0.92	− 0.03 (0.09)	0.74
Social capital indicator	0.01 (0.01)	0.33	0.01 (0.01)	0.39	− 0.02 (0.09)	0.86	− 0.12 (0.11)	0.28
Fixed effects for social capital indicators								
Intercept	20.44 (0.25)	< 0.01	11.46 (0.19)	< 0.01	3.13 (0.02)	< 0.01	1.77 (0.02)	< 0.01
Wave 1 (ref)								
Wave 2	− 0.11 (0.31)	0.74	− 0.34 (0.23)	0.15	0.02 (0.03)	0.47	− 0.05 (0.02)	0.02
Wave 3	− 0.75 (0.40)	0.06	− 0.48 (0.29)	0.10	− 0.01 (0.04)	0.70	− 0.14 (0.03)	< 0.01
Random effects								
Residual variance social capital indicator	23.11 (1.58)		11.49 (0.69)		0.18 (0.01)		0.14 (0.01)	
Variance random intercept self-rated health	1.35 (0.19)		1.38 (0.19)		1.38 (0.19)		1.34 (0.18)	
Variance random intercept social capital indicator	14.37 (1.40)		4.64 (0.47)		0.14 (0.01)		0.11 (0.01)	
Correlation random intercepts	0.20 (0.07)	< 0.01	− 0.25 (0.05)	0.04	0.28 (0.06)	< 0.01	− 0.09 (0.07)	0.20
African-Americans								
Fixed effects for self-rated health								
Wave 1 (ref)								
Wave 2	− 0.02 (0.04)	0.69	− 0.01 (0.04)	0.85	− 0.01 (0.04)	0.80	− 0.03 (0.04)	0.53
Wave 3	− 0.07 (0.05)	0.17	− 0.06 (0.05)	0.22	− 0.07 (0.05)	0.15	− 0.09 (0.05)	0.06
Social capital indicator	0.00 (0.00)	0.31	− 0.02 (0.01)	0.01	0.24 (0.06)	< 0.01	− 0.22 (0.05)	< 0.01
Fixed effects for social capital indicators								
Intercept	19.76 (0.17)	< 0.01	11.74 (0.12)	< 0.01	3.15 (0.01)	< 0.01	1.81 (0.01)	< 0.01
Wave 1 (ref)								
Wave 2	− 0.75 (0.21)	< 0.01	0.28 (0.15)	0.07	− 0.04 (0. 03)	0.03	0.00 (0.02)	0.81

Table 4 (continued)

	Neighborhood social cohesion*		Neighborhood physical disorder		Positive social support		Negative social support	
	B (SE)**	*p* value	B (SE)	*p* value	B (SE)	*p* value	B (SE)	*p* value
Wave 3	− 1.02 (0.26)	< 0.01	0.23 (0.18)	0.22	− 0.02 (0.02)	0.48	− 0.05 (0.02)	< 0.01
Random effects								
Residual variance social capital indicator	31.01 (0.96)		13.83 (0.49)		0.22 (0.01)		0.20 (0.01)	
Variance random intercept self-rated health	0.58 (0.06)		0.57 (0.06)		0.55 (0.06)		0.57 (0.06)	
Variance random intercept social capital indicator	5.39 (0.71)		1.81 (0.48)		0.12 (0.01)		0.10 (0.01)	
Correlation random intercepts	0.39 (0.07)	< 0.01	− 0.33 (0.07)	0.01	0.14 (0.07)	0.03	− 0.19 (0.04)	< 0.01

The scales that are reversed are the same as in the descriptive statistics

The Health and Retirement Study, US, data from 2006 to 2014

*All models are adjusted for age, gender and level of education. The category others for race/ethnicity has been excluded from this analysis, since the percentage of this category is very low

**Beta coefficient, standard errors

health and higher values of neighborhood social cohesion, and lower levels of neighborhood physical disorder and negative social support. The multilevel structural equation models showed small-size differences in the associations between social capital and self-rated health at the between-persons level, which were stronger in African-Americans and Whites for neighborhood social cohesion and negative social support and was stronger in Hispanics for positive social support. However, we could not confirm these differences in correlations as statistically different, given the wide confidence intervals for Hispanics and African-Americans, being both race/ethnicity groups largely underrepresented compared to Whites.

The slightly higher correlation between overall levels of positive social support and overall levels of self-rated health in Hispanics suggests that this group may be having very strong relationships with their counterparts. These relationships seem to have positive effects on their perceived health. However, in Whites and African-Americans, the relationships we observe between negative social support and self-rated health suggest these relationships can be too demanding as well. Some relationships can involve excessive demands being placed on group members to provide support to others (Portes 2014; Villalonga-Olives and Kawachi 2017). This has been previously reported, suggesting that there are collectives that place too demanding relationships and higher expectations, which makes the networks stressful (Browne-Yung et al. 2013). These results should be read considering the baseline and follow-up levels of self-rated health and social capital indicators by race/ethnicity. The distribution of the exposure and the outcome is of critical importance (Keyes et al. 2012). In our study, Hispanics and African-Americans have lower socioeconomic status than Whites and we observe that social capital can contribute to a racial disparity in the outcome. An intervention targeting Hispanics and African-Americans to reduce their perception of negative social support and the burden of too demanding social relationships and to reduce the exposure to neighborhoods with physical disorders allocating resources to those environments to revitalize neighborhoods could potentially reduce disparities in health (Ward et al. 2019).

Associational densities and social capital have been reported to be higher in regions that tend to have more homogeneous populations (Rupasingha et al. 2006). Racially heterogeneous societies are also culturally diversified, and this may have a negative impact on social capital formation (Rupasingha et al. 2006). The relationship between social capital and ethnic diversity suggests that localities with greater ethnic fragmentation are less connected socially (Alesina and Ferrara 2005). We suggest that in neighborhoods with very low socioeconomic backgrounds, the mix with people from another community and a different race/ethnicity can even turn into a detrimental force if the mix is between people with low socioeconomic backgrounds. By contrast, if there are bridging connections that explicitly cut across socioeconomic and power differentials and those two groups share economic and cultural resources, we expect to find better health outcomes (Daly 2000).

We found that the association between social capital indicators and self-rated health exists mostly at the between-persons level. At the within-wave level, only African-Americans showed a relevant relationship of

positive and negative social support with self-rated health. This suggests that, when planning policy interventions, short-term interventions would have less impact than long-term interventions. To observe a change in self-rated health, the intervention target should be at the community level, which can potentially strengthen social capital among individuals. In the suggestion, multilevel social capital interventions have been put forth within the previous literature on social capital, where the authors suggest that impactful interventions should be designed to have an effect at different levels (e.g., multilevel interventions) (Wind and Komproe 2012; Villalonga-Olives et al. 2018).

This study had several limitations. Hispanics and African-Americans were largely underrepresented groups compared to Whites, making the examination of racial/ethnic differences difficult. Aggregated neighborhood-level indicators were not available in the study. This study focuses on people's perceptions of neighborhood social cohesion and neighborhood physical disorder. Finally, social support scales have been analyzed separately. Positive and negative social support are highly correlated per wave (around 0.5). Thus, their effects cannot be interpreted as their "unique contribution" among all the social capital scores. Among the strengths, the data came from a large, prospective, nationally represented sample of US adults aged $\geq$ 50 years. Also, using multilevel structural equation modeling it was possible to separate the within-wave-level effects and between-persons-level effects. This strategy is fundamental to understand how both variables relate over time and, consequently, design suitable interventions.

We suggest that future research in this area develop, implement and test field experiments of potential health benefits of policy and public health interventions that build social capital among individuals and communities (Putnam et al. 2003; Rothstein and Stolle 2003). The construction and reinforce of social capital at different levels are crucial for the self-rated health of older adults and, probably, the population as a whole. Future studies should examine mediators that are on the pathway between social capital and self-rated health for Whites, Hispanics and African-Americans and observe if these mediators differ.

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Compliance with ethical standards

Conflict of interest All authors declare that they have no conflict of interest.

Ethical approval The study got ethical approval and complied with ethical standards. IRB: HRS was approved by University of Michigan Health Sciences/Behavioral Sciences IRB Protocol: HUM00061128.

Informed consent Informed consent was obtained from all HRS respondents.

Appendix

Confidence interval estimation of parameters relating social capital indicators with health status, stratified by race.

Questions used to collect the social capital information.

Race	Parameter	Neighborhood social cohesion		Neighborhood physical disorder		Negative social support		Positive social support	
		Estimate (SE)	95% CI	Estimate (SE)	95% CI	Estimate (SE)	95% CI	Estimate (SE)	95% CI
White	B (level 1)	0.00 (0.00)	− 0.01; 0.01	0.01 (0.01)	0.00; 0.02	− 0.11 (0.05)	− 0.22; − 0.01	0.02 (0.05)	− 0.07; 0.11
	corr (level 2)	0.29 (0.02)	0.25; 0.32	− 0.25 (0.02)	− 0.28; − 0.22	− 0.20 (0.02)	− 0.24; − 0.17	0.21 (0.02)	0.17; 0.24
Hispanic	B (level 1)	0.01 (0.01)	− 0.01; 0.02	0.01 (0.01)	− 0.01; 0.04	− 0.12 (0.11)	− 0.34; 0.10	− 0.02 (0.08)	− 0.18; 0.15
	corr (level 2)	0.20 (0.07)	0.06; 0.33	− 0.25 (0.08)	− 0.41; − 0.09	− 0.09 (0.07)	− 0.24; 0.05	0.28 (0.06)	0.16; 0.39
African-Americans	B (level 1)	0.00 (0.00)	0.00; 0.01	− 0.02 (0.01)	− 0.03; 0.00	− 0.22 (0.05)	− 0.31; − 0.13	0.24 (0.06)	0.12; 0.35
	corr (level 2)	0.39 (0.07)	0.26; 0.53	− 0.33 (0.07)	− 0.47; − 0.19	− 0.19 (0.04)	− 0.27; − 0.10	0.14 (0.07)	0.02; 0.27

Level 1: effects within waves. Level 2: person-level correlations (random intercepts)

Confidence intervals estimated assuming normal distribution approximation

Neighborhood social cohesion: *I really feel part of this area*, *If you were in trouble*, *there are lots of people in this area who would help you*, *Most people in this area can be trusted*, and *Most people in this area are friendly*.
Neighborhood Physical Disorder: *People would be afraid to walk alone in this area after dark*, *Vandalism and graffiti are a big problem in this area*, *This area is always full of rubbish and litter*, *There are many vacant or deserted houses or storefronts in this area*.
Positive Social Support: *How much do they really understand the way you feel about things*? *How much can you rely on them if you have a serious problem*? *How much can you open up to them if you need to talk about your worries*?
Negative Social Support: *How often do they make too many demands on you*? *How much do they criticize you*? *How much do they let you down when you are counting on them*?

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