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Perceived Neighborhood Social Cohesion and Subsequent Health and Well-Being in Older Adults: An Outcome-Wide Longitudinal Approach

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Abstract

Background: Growing research documents associations between neighborhood social cohesion with better health and well-being. However, other work has identified social cohesion's "dark side" and its ability to promote negative outcomes. It remains unclear if such diverging findings are attributable to differences in study design, or other reasons. To better capture its potential heterogeneous effects, we took an outcome-wide analytic approach to examine perceived neighborhood social cohesion in relation to a range of health and well-being outcomes.

Methods: Data were from 12,998 participants in the Health and Retirement Study—a large, diverse, prospective, and nationally representative cohort of U.S. adults age >50. Multiple regression models evaluated if social cohesion was associated with physical health, health behavior, psychological well-being, psychological distress, and social well-being outcomes. All models adjusted for sociodemographics, personality, and numerous baseline health and well-being

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characteristics. To evaluate the effects of change in cohesion, we adjusted for prior social cohesion. Bonferroni correction was used to account for multiple testing.

Results: Perceived neighborhood social cohesion was not associated with most physical health outcomes (except for reduced risk of physical functioning limitations and better self-rated health) nor health behavior outcomes (except for more binge drinking). However, it was associated with numerous subsequent psychosocial well-being (i.e., higher: positive affect, life satisfaction, optimism, purpose in life, mastery, health mastery, financial mastery; reduced likelihood of infrequent contact with friends) and psychological distress outcomes (i.e., lower depression, hopelessness, negative affect, loneliness) over the 4-year follow-up period.

Conclusions: With further research, these results suggest that perceived neighborhood social cohesion might be a valuable target for innovative policies aimed at improving well-being.

Keywords

outcome-wide epidemiology; public health; perceived neighborhood social cohesion; social cohesion; older adults; health and well-being

INTRODUCTION

A growing body of research suggests that higher neighborhood social cohesion is associated with better health and well-being outcomes. Social cohesion is characterized by: 1) the perceived degree of connection among neighbors, 2) the willingness of neighbors to intervene for the common good, 3) degree to which residents feel they belong to the area, 4) as well as the amount of trust that is shared among neighbors.¹ Neighborhood social cohesion is distinct from individual-level social networks and support because it characterizes the whole community and impacts the entire neighborhood, regardless of an individual's characteristics.^{2,3} It has been linked to a range of better health behaviors (increased physical activity, increased use of preventive health services, healthier sleep),⁴⁻⁸ and better biologic functioning (reduced cardiometabolic risk and coronary artery calcification),^{9,10} reduced risk of age-related conditions (cardiovascular events and stroke),^{11,12} and reduced risk of mortality.¹³⁻¹⁶ Yet, a recent review also highlights how more cohesive relationships can sometimes be associated with worse health and well-being outcomes (e.g. more smoking, drinking, and depressive symptoms)—¹⁷ depending on the social context. Social cohesion thus does not necessarily imply beneficial or harmful relations to health outcomes and may simply act as an “amplification system.”

Several hypothesized mechanisms illustrate how neighborhood social cohesion might both promote and harm health and well-being. Neighborhood social cohesion may promote health by:^{3,15} 1) increased diffusion of information about health (e.g., where to acquire affordable fruits and vegetables); 2) collective ability to advocate for resources (e.g., organize and lobby for medical navigators who help patients navigate health systems); 3) social and psychological support (e.g., emotional support in times of distress); 4) maintenance of healthy norms through informal social control (e.g., reinforcing norms that certain behaviors (e.g., not smoking) is desirable and the norm). However, neighborhood social cohesion also has a “dark side” and can promote negative health outcomes by:^{17,18} 1) excessively straining

group members by “requiring” them to provide support to others, 2) restricting freedom because of excessive informal control, 3) excluding out-group members, 4) “down-leveling” norms so that individuals trying to break free from negative group norms are penalized, and 5) facilitating the “contagion” of unhealthy behaviors from negative role models and community leaders.¹⁷ As an illustrative example of neighborhood social cohesion’s dualistic nature on health outcomes, close neighbors can be a source of emotional and social support for one another, yet if the exchange of support occurs in social contexts where there is smoking and/or excessive consumption of unhealthy foods and alcohol, the impact of neighborhood social cohesion on health and well-being outcomes may be both positive and negative.

The underlying reasons for diverging past results remain unclear, but might be due to truly diverging results (as described in the theories and example just described), or due to methodological differences (e.g., 1) different study designs (e.g., cross-sectional vs. longitudinal data), 2) different populations, 3) control for different numbers and types of confounders, 4) key underlying moderators that have not been addressed, 5) because effects are different on different outcomes, and 6) the use of a wide array of different measures of the exposure (e.g., social cohesion vs. social capital measures which are related but distinct constructs, measures of neighborhood social cohesion that are aggregated together by neighborhood vs. individual-level perceptions of neighborhood social cohesion).

Further, we build upon past neighborhood social cohesion research by using a complementary measure that shifts the focus from the group-level to the individual-level. Most neighborhood social cohesion research has focused on an aggregated group-level measure of neighborhoods and there are several benefits to this approach. However, there are also several benefits to examining neighborhood cohesion at the individual-level and triangulating findings. For example, the contours of a neighborhood are often difficult to identify and are typically identified by researchers that use census tract-, census-block, or Zip-code data; these artificially drawn boundaries often differ from a resident’s perception of his or her own neighborhood boundaries.^{1,2} Thus, misidentifying neighborhoods and clustering together study participants who do not consider themselves neighbors, could skew results. Additionally, some past work has observed that neighborhood-level social cohesion has poor inter-resident agreement among inhabitants of the same neighborhood.^{2,19} Further, aggregated neighborhood-level data would have required a larger number of study participants in each neighborhood than was available in our sample. Additionally, due to privacy concerns, researchers are unable to publish results use data more granular than broad geographic regions when using the dataset that we used (i.e., the Health and Retirement Study). On the basis of conceptual grounds, practical limitations, and the merits of supplementing one type of focus (group-level) with another justifiable focus (individual-level) that could help triangulate findings, we named our exposure *perceived* neighborhood social cohesion to indicate that we were evaluating neighborhood social cohesion at the individual-, rather than the group-level.

To better understand the association between perceived neighborhood social cohesion with health and well-being outcomes from a more holistic point of view, we used a new outcome-wide analytic approach,^{20,21} and performed analyses to examine whether positive change in

perceived neighborhood social cohesion was associated with better subsequent health and well-being across 35 separate outcomes in a large, prospective, and nationally representative sample of older adults. This outcome-wide analytic approach is particularly advantageous for exposures like perceived neighborhood social cohesion, because it is equipped to holistically capture potential heterogeneous effects across a range of outcomes using a standardized: 1) study design, 2) population, 3) set of covariates, and 4) exposure. Further, by controlling for perceived neighborhood social cohesion in the prior wave, this adjustment allows researchers to ask a different question that is particularly important in this era of translational research, how might *changes* in perceived neighborhood social cohesion (“incidence”) affect subsequent health and well-being outcomes. This question allows us to better estimate the health and well-being outcomes we might expect to observe if perceived neighborhood social cohesion was intervened upon via policies.^{20,21}

METHODS

Study Population

Data were from the Health and Retirement Study (HRS) which is a prospective and nationally representative panel study of U.S. adults (aged >50 years). It surveys participants every two years and starting in 2006, HRS study staff randomly selected 50% of HRS participants and began visiting them for enhanced face-to-face (EFTF) interviews. The other 50% of study participants were assessed in the following wave (2008).²² After the EFTF interview, HRS study staff left a self-administered psychosocial questionnaire,²³ which participants completed and returned by mail to HRS. The response rate for this questionnaire was 88% in 2006 and 84% in 2008.²³ We combined data from both timepoints and considered 2006/2008 as the wave prior to the exposure for the current study; this was the wave in which covariates were measured, so that all covariates were assessed prior to the exposure.^{20,21} The primary exposure variable was perceived neighborhood social cohesion, which was assessed in the next available wave four years later (2010/2012); in the present study we only included those participants who responded in this wave. Further, all the outcomes were assessed four years later in 2014/2016. The present study used de-identified and publicly available data, thus the IRB at the Harvard T.H. Chan School of Public Health exempted it from review.

Measures

Perceived Neighborhood Social Cohesion.—This exposure variable was assessed using a 4-item scale that was developed and tested in two nationally representative studies of older adults (the English Longitudinal Study of Ageing and HRS).²³ The items were derived from widely used neighborhood social cohesion scales that were previously validated.^{4,19,24,25} It assessed the extent to which participants perceived their neighborhoods as trusting and socially cohesive. On a 7-point Likert scale, study participants indicated the degree to which they endorsed these four items: 1) “I really feel part of this area,” 2) “If you were in trouble, there are lots of people in this area who would help you,” 3) “Most people in this area can be trusted,” and 4) “Most people in this area are friendly.” The negatively worded items were reverse coded, so that higher scores reflected higher levels of cohesion and then they were all averaged together (Cronbach’s $\alpha = 0.86$). Following HRS protocol,

scores were only calculated if participants completed 2 items. Finally, to examine threshold effects, we created tertiles based on the distribution of perceived neighborhood social cohesion scores in the sample.

Covariates.—Covariates included: sociodemographic factors (age, sex, race/ethnicity (White, Black, Hispanic, Other), marital status (married/not married), income (<\$50,000, \$50,000 – \$74,999, \$75 000–\$99,999, \$100,000), total wealth (quintiles of the score distribution in this sample), educational attainment (no degree, GED/high school diploma, college degree), employment (yes/no), health insurance (yes/no), geographic region (Northeast, Midwest, South, West)), religious service attendance (none, <1x a week, 1 more per week), personality factors (openness, conscientiousness, extraversion, agreeableness, neuroticism), and childhood abuse (yes/no). Additionally, to reduce the likelihood of reverse causation, we also controlled for prior values of all the outcomes variables in our models (in 2006/2008).²⁰ The HRS guides and appendix (Supplementary Text 1) provide additional information about each of these covariate assessments.^{22,23,26,27} Further, to evaluate *changes* in perceived neighborhood social cohesion (conditional on the past), we controlled for perceived neighborhood social cohesion in the prior wave (2006/2008).²⁸

Outcomes.—We considered 35 outcomes in 2014/2016 (t_2), including dimensions of physical health factors (all-cause mortality, number of chronic conditions, diabetes, hypertension, stroke, cancer, lung disease, arthritis, overweight/obesity, physical functioning limitations, cognitive impairment, chronic pain, and self-rated health), health behaviors (binge drinking, smoking, physical activity, and sleep problems), psychological well-being (positive affect, life satisfaction, optimism, purpose in life, mastery, health mastery, and financial mastery), psychological distress (depression, depressive symptoms, hopelessness, negative affect, and perceived constraints) and social factors (loneliness, living with spouse/partner, frequency of contact with: children, other family, or friends—each assessed separately). The HRS guides (and Supplementary Text 1) provide further details about each assessment

Statistical Analysis

We examined each outcome in separate models, adjusting for all covariates. For each binary outcome with a prevalence of <10%, we ran logistic regression models. For each binary outcome with a prevalence 10%, we ran generalized linear models with a log link and Poisson distribution; we used this method for non-rare outcomes (i.e., 10%) in order to enhance the interpretability of our results. People intuitively interpret relative risks, and odds ratios generated from logistic regression approximate relative risks when the prevalence of an outcome is <10%. However, as the prevalence of an outcome rises above 10%, the odds ratio that are generated by logistic regression deviate progressively further and further away from relative risks and readers often misinterpret findings.

Finally, for each continuous outcome, we ran linear regression models. For each continuous outcome measure, we standardized each outcome (mean=0, standard deviation=1) so their effect size could be interpreted as a standard deviation change in the outcome. In our tables,

we marked multiple p-value cutoffs because this is an active and evolving area of research, and readers can decide which values to interpret: $p < 0.05$, $p < 0.01$, or a Bonferroni correction to account for multiple testing ($p = 0.05/35$ outcomes = $p < 0.001$).

We used an outcome-wide analytic approach, which features several analytic decisions not widely used in disciplines outside of biostatistics and causal inference. Thus, we further summarize the analyses here. First, if covariates are assessed at the same timepoint as the exposure (2010/2012), it remains unclear if the covariates are confounders or mediators; thus, we adjust for covariates in the prior wave (2006/2008) which helps reduce this worry and also allows for a very rich set of control variables to help address confounding. Second, we adjust for all outcome variables in the prior wave (2006/2008) in each model to reduce potential reverse causality. We also further adjust for a wide range of other covariates to adjust for potential confounding variables. Third, to evaluate “*change*” in perceived neighborhood social cohesion we adjust for perceived neighborhood social cohesion in the prior wave (2006/2008). This helps us “hold constant” prior levels of perceived neighborhood social cohesion. Those who are in the highest perceived neighborhood social cohesion tertile in prior wave (2006/2008) and continue being in that group in the baseline wave (2010/2012) contribute to the final estimate. However, the estimate produced from this analysis also corresponds to people in our sample who were in the lowest perceived neighborhood social cohesion tertile in 2006/2008 and move to the highest perceived neighborhood social cohesion tertile in 2010/2012. The model effectively assumes that the coefficient for the highest perceived neighborhood social cohesion tertile is constant across past perceived neighborhood social cohesion levels (i.e. no interaction between past and current perceived neighborhood social cohesion). Thus, based on our model we are able to evaluate how *change* in perceived neighborhood social cohesion (between 2006/2008 and 2010/2012), is associated with subsequent health and well-being outcomes (at 2014/2016; see Supplementary Text 2 for proof). Controlling for prior perceived neighborhood social cohesion levels (2006/2008) also has several other advantages including, helping reduce risk of reverse causality by “removing” the potential accumulating effects that perceived neighborhood social cohesion might have already had on health and well-being outcomes in the past (“prevalent exposure”), and allowing us to instead focus on the effects of *change* in perceived neighborhood social cohesion (“incident exposure”) on outcomes.

Secondary analyses.—We ran several secondary analyses. First, we re-analyzed all the models using only complete-cases. Next, to evaluate how similar our results were to past research, we re-analyzed all models using a reduced list of covariates (e.g., sociodemographic factors) which are more conventionally controlled for in the social and behavioral sciences (e.g., sociodemographic factors). This analytic approach asks a different question: what are the potential long-term cumulative effects that perceived neighborhood social cohesion has on the outcomes. Third, to evaluate the robustness of our results, we conducted E-value analyses to assess the minimum strength of association (on the risk ratio scale) that an unmeasured confounder would have to have with the both the exposure and outcome, to explain away any associations that we observed.³⁹ Fourth, we re-analyzed the fully adjusted models and removed participants with any history of a given condition at

baseline (e.g., for lung disease analyses, removed participants with any history lung disease of lung disease).

Multiple imputation.—Because multiple imputation often provides a more flexible approach for obtaining estimates of association than most other methods of handling missing data, we imputed all missing exposure, covariate, and outcome data using an imputation by chained equations procedure (and generated five datasets).^{29–32} When imputing, we used an inclusive as opposed to restrictive use of auxiliary items for each variable with missing data,³³ and estimates of models were multiple imputation estimates derived using the combining rules defined by Little and Rubin.³⁴ Analyses were conducted in Stata version 15.1 (StataCorp, College Station, Texas).

RESULTS

At the wave in which the covariates were assessed (prior wave), the average age of respondents was 66 years old (SD = 10) and they were primarily women (59%), married (67%), with a high school education (55%). Table 1 describes the distribution of covariates by tertiles of perceived neighborhood social cohesion. Table S1 describes the change in perceived neighborhood social cohesion from the prior wave to the baseline wave.

Over the 4-year follow-up period, there was little or no evidence of association between perceived neighborhood social cohesion and most physical health outcomes, including: number of chronic conditions, diabetes, hypertension, stroke, cancer, heart disease, lung disease, arthritis, overweight/obesity, and chronic pain. However, there were some curvilinear associations where people in the middle tertile of neighborhood cohesion (versus people in the lowest tertile), conditional on prior perceived neighborhood social cohesion, had better health (i.e., a 15% reduced risk of mortality (95% confidence interval [CI] for RR: 0.74, 0.98, 8% reduced risk of physical functioning limitations (95%, CI: 0.85, 1.00), and 11% reduced risk of cognitive impairment (95%, CI: 0.81, 0.98). However, there was no association for these health outcomes when comparing the highest versus lowest tertile of perceived neighborhood social cohesion. When considering health behaviors, participants in the highest tertile of perceived neighborhood social cohesion (versus lowest tertile), conditional on prior perceived neighborhood social cohesion, subsequently had 43% increased risk of binge drinking (95%, CI: 1.08, 1.87), but there was no association with smoking, physical activity, or sleep problems (Table 2).

Perceived neighborhood social cohesion was associated with nearly all of the psychological well-being, psychological distress, and social well-being factors. For example, those in the highest tertile of perceived neighborhood social cohesion (compared to those in the lowest tertile) conditional on prior perceived neighborhood social cohesion, subsequently reported higher life satisfaction ($\beta=0.15$, 95% CI: 0.11, 0.20) and mastery ($\beta=0.13$, 95% CI: 0.06, 0.19), as well as a lower negative affect ($\beta=-0.17$, 95% CI: -0.25 , -0.09) and loneliness ($\beta=-0.21$, 95% CI: -0.28 , -0.13). Finally, those in the highest perceived neighborhood social cohesion tertile also had 22% reduced risk of depression (95%, CI: 0.67, 0.90; Table 2).

Additional Analyses

We conducted several additional analyses. First, when comparing results from complete-case analyses versus results from the main multiply imputed analyses—results were very similar (Table S2). Second, conventionally-adjusted covariate models generally showed results that were stronger than the fully adjusted models, and are in line with past work (Table S3). Finally, we calculated E-values and they suggested that a few of the observed associations were at least moderately robust to unmeasured confounding (Table 3). For example, an unmeasured confounder would have to be associated with both perceived neighborhood social cohesion and life satisfaction by risk ratios of 1.57 each (above and beyond the large range of covariates already adjusted for) to explain away the association; further, to shift the CI to include the null, an unmeasured confounder would have to be associated with both perceived neighborhood social cohesion and life satisfaction by risk ratios of 1.44. Fourth, removing anyone with history of a given condition at baseline in the fully adjusted physical health models, resulted in estimates that displayed larger magnitudes of association between the exposure and outcomes (Table S3).

DISCUSSION

Summary of Findings

In a prospective and nationally representative sample of U.S. adults aged >50, we observed that higher baseline perceived neighborhood social cohesion, conditional on prior perceived neighborhood social cohesion, was not associated with most of the physical health outcomes in a graded manner (e.g., number of chronic conditions, diabetes, hypertension, stroke, cancer, heart disease, lung disease, arthritis, overweight/obesity, or chronic pain) nor most of the health behaviors (smoking, physical activity, sleep). However, there was evidence for an association with increased binge drinking. Further, perceived neighborhood social cohesion, conditional on prior perceived neighborhood social cohesion, was associated with nearly all of the psychosocial outcomes (e.g., higher life satisfaction and lower hopelessness). For some outcomes (i.e., mortality, physical functioning limitations, and cognitive impairment) we observed curvilinear associations where people in the middle tertile of perceived neighborhood cohesion (versus people in the lowest tertile), had reduced risk of these outcomes—but this association was not apparent when comparing people in the highest versus lowest tertile. All results were maintained after robust control for a wide range of potential confounders including sociodemographic, physical health, behavioral, psychological, and social factors at baseline—as well as control for perceived neighborhood social cohesion (and all the outcomes) in the prior wave.

Results in the Context of Past Research

By controlling for perceived neighborhood social cohesion in the prior wave, we were able to evaluate *changes in* perceived neighborhood social cohesion (conditional on prior perceived neighborhood social cohesion) which “differences out” the potential accumulating effects that past perceived neighborhood social cohesion has on health over the life course. From a public health or intervention perspective, these are the types of results that are often of more relevance and interest. Our results both converge and diverge with past work that has evaluated associations between the “prevalence” of neighborhood social cohesion with

health and well-being outcomes. For example, in line with past research, we observed that “incident” neighborhood social cohesion was associated with better psychosocial outcomes. Although more research with different methods are needed, our results extend past findings by providing preliminary evidence of what outcomes we might observe if perceived neighborhood social cohesion was intervened upon. We also observed that perceived neighborhood social cohesion was associated with higher levels of binge drinking. These results are in line with some previous reports that bring light to the potential “dark side” of social cohesion,¹⁷ but not other reports.^{5,6,35,36} Methodologically, the underlying reasons for diverging results between our study and past studies may stem from a variety of sources including differences in: 1) study design (e.g., cross-sectional vs. longitudinal), 2) measurement of the outcome (some studies evaluated specific cardiovascular conditions, while others used composite measures), 3) measurement of the exposure, 4) sample (our study sample consists of an older population than many past studies), 5) key underlying moderators, 6) covariate control, 7) control for prior perceived neighborhood social cohesion. Our secondary analyses addressed the last two points and we observed that when controlling for a conventional set of covariates, that included only sociodemographic factors, the magnitude of associations between perceived neighborhood social cohesion with health and well-being outcomes was stronger.

Further, our findings illustrate how perceived neighborhood social cohesion could simultaneously influence health and well-being in both positive and negative directions; these findings mirror the patterns observed in other social factors, like retirement, which have both positive and negative effects on outcomes.^{37,38} When interpreting the pattern of our outcome-wide analyses results through the same lens, a plausible scenario is that perceived neighborhood social cohesion might foster neighborhoods that provide emotional and social support for its members, thus enhancing psychosocial health, but also provide contexts for the sharing of unhealthy behaviors such as the consumption of excessive alcohol. Such dueling mechanisms with opposite effects on mechanistic biopsychosocial pathways to health may cancel each other out, ultimately resulting in no substantive change in some physical health outcomes or curvilinear effects in others (i.e. mortality, physical functioning limitations, cognitive impairment).

There are at least three further reasons why we might have observed a lack of association between perceived neighborhood social cohesion and physical health outcomes. First, an array of social forces, beyond neighborhood social cohesion, converge to powerfully pattern and influence the trajectory of people’s physical health over the life-course (e.g., developmental and life-course perspective factors, socioeconomic stratification, discrimination, workplace factors, social networks, religious organization, civic groups, etc). The average age of respondents in our study was 66 years (SD = 10), thus these social forces might have already exerted a powerful influence on people’s bodies by the time they are 66 years old, and a 4-year follow-up period might not be long enough to evaluate the effect that perceived neighborhood social cohesion alone might have on physical health outcomes. Second, unlike most prior studies on this topic, we controlled for a much larger array of covariates in an attempt to isolate the unique effect of perceived neighborhood social cohesion on outcomes. When controlling for this robust array of covariates we did not observe associations with physical health outcomes, but we did see stronger effect estimates

with physical health outcomes when only controlling for conventional covariates (Table S3). Thus, the robust array of covariates we controlled for might help explain the null physical health findings we observed. Third, although data on incidence of chronic conditions was captured by HRS, causes of death were not. Therefore, a study participant could have been free of heart disease their entire life but died suddenly from heart disease and such information was not officially captured. HRS collects information about some causes of death but the categories do not map cleanly onto the chronic condition categories that we evaluated; thus, we did not create composite variables capturing both incidence-of-disease and death-due-to-disease (see Supplementary Text 3 for further details).

Limitations and Strengths

Our study had several limitations. In some studies, neighborhood social cohesion is examined at the aggregated neighborhood-level using multi-level modeling. However, this requires a nested study design with many residents clustered in many neighborhoods, which was not available in our sample. Thus, our study focused on people's *perceptions* of their neighborhood's social cohesion at the individual-level. Self-report bias and common method bias are both potential limitations, as both perceived neighborhood social cohesion and all the outcomes were self-reported. However, we controlled for a wide range of psychosocial variables (N=22) that could potentially dampen the potential effects of self-report and common method bias (e.g., Big-5 personality factors, dimensions of psychological distress (e.g., depressive symptoms, hopelessness) and well-being (e.g., optimism positive affect)). Moreover, we controlled for baseline outcomes, which itself largely (though not entirely) reduces this problem since the associations are then effectively with *changes* in the psychological outcome, rather than cross-sectional associations in which these issues are indeed more problematic. Future studies, should use objectively assessed physical and behavioral health outcomes to help address these limitations. Confounding by unmeasured variables and reverse causality is a major concern in most observational research. However, control for a large range of variables, the prospective nature of our data, and results from E-value analyses helps attenuate these concerns.

Our study also has a number of strengths including the use of a prospective and diverse dataset. Additionally, we used a nationally representative dataset of people aged >50, which reduces the risk of selection bias. The study also adjusted for prior values of the exposure, covariates, and outcomes which allowed us to evaluate "incident exposure" rather than "prevalent exposure." This focus on incidence provides evidence for a different question that is often of more interest to policy-makers.^{28,39,40}

Conclusion

To adequately meet the needs of our rapidly growing older adult population, a comprehensive and multidisciplinary effort is needed. Although important, focusing too much attention and resources at individual-level interventions and policies diverts limited resources away from key stressors and resilience factors that emerge at higher levels (e.g., neighborhood level). If research continues documenting positive associations between perceived neighborhood social cohesion and healthier psychosocial outcomes, a potential next step is to test whether policy interventions that bolster the social infrastructure and

cohesion of neighborhoods translate into better psychosocial outcomes. However, it would also be important to examine the feasibility of changing social cohesion and its effects compared to other possible community-level interventions; further, caution and attention is needed to track and manage the potential “dark side” of perceived neighborhood social cohesion. Such studies may demonstrate novel and scalable methods of population-health interventions that enhance the well-being of our rapidly growing older adult population.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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RESEARCH HIGHLIGHTS

- We took an outcome-wide approach to evaluate if changes in:
- Perceived neighborhood cohesion are associated with health and well-being outcomes
- We observed few associations with physical health or health behavior outcomes
- However, did observe associations with psychological and social outcomes

Table 1.

Characteristics of Participants at Baseline by Tertiles of Perceived Neighborhood Social Cohesion
(N=12,696)^{a,b}

Participant Characteristics	Perceived Neighborhood Social Cohesion					
	Tertile 1 (n=4,212)		Tertile 2 (n=4,587)		Tertile 3 (n=3,897)	
	%	Mean (SD)	%	Mean (SD)	%	Mean (SD)
<i>Sociodemographic factors</i>						
Age (yr; range: 46–99)		64.9 (9.9)		65.8 (9.8)		68.1 (9.8)
Female (%)	58.3		55.8		62.5	
Race/Ethnicity (%)						
White	61.7		78.2		83.1	
Black	22.7		11.0		8.2	
Hispanic	12.4		7.9		6.9	
Other	3.1		2.8		1.8	
Married (%)	60.8		69.4		70.9	
Annual Household Income (%)						
<\$50,000	62.9		50.3		53.9	
\$50,000–\$74,999	15.1		17.7		16.2	
\$75,000–\$99,999	9.2		11.2		9.9	
\$ 100,000	12.8		20.8		20.0	
Total Wealth (%)						
1st Quintile	29.6		16.9		13.1	
2 nd Quintile	22.8		19.4		17.9	
3rd Quintile	18.3		19.7		22.2	
4th Quintile	16.9		21.5		21.8	
5th Quintile	12.4		22.5		24.9	
Education (%)						
< High School	21.4		12.7		15.2	
High School	54.6		53.9		55.5	
College	24.0		33.5		29.2	
Employed (%)	42.8		45.1		38.5	
Health Insurance (%)	93.1		95.5		96.6	
Geographic Region (%)						
Northeast	14.4		15.4		15.2	
Midwest	24.8		27.2		29.0	
South	40.6		39.4		38.3	
West	20.2		19.1		17.4	
Childhood Abuse (%)	8.4		6.8		5.8	
<i>Physical Health</i>						
Diabetes (%)	21.5		15.9		15.2	
Hypertension (%)	55.5		52.4		52.2	
Stroke (%)	6.2		5.0		6.5	

Participant Characteristics	Perceived Neighborhood Social Cohesion					
	Tertile 1 (n=4,212)		Tertile 2 (n=4,587)		Tertile 3 (n=3,897)	
	%	Mean (SD)	%	Mean (SD)	%	Mean (SD)
Cancer (%)	12.8		14.0		13.5	
Heart Disease (%)	21.0		20.5		18.9	
Lung Disease (%)	8.7		7.9		6.5	
Arthritis (%)	59.7		55.9		57.1	
Overweight/Obesity (%)	75.9		72.0		68.3	
Physical Function Limitations (%)	24.5		17.4		15.8	
Cognitive impairment (%)	18.1		11.1		12.4	
Chronic Pain (%)	37.7		32.9		29.5	
Self-Rated Health (range: 1–5)		3.1 (1.1)		3.3 (1.0)		3.5 (1.0)
Health Behaviors						
Binge Drinking (%)	13.3		15.2		11.9	
Smoking (%)	16.2		12.0		9.9	
Frequent Physical Activity (%)	72.6		77.3		80.4	
Sleep Problems (%)	45.0		39.5		38.4	
Religious Service Attendance (%)						
Never	26.7		23.6		21.4	
<1x/week	32.7		34.8		29.5	
1x/week	40.6		41.6		49.1	
Psychological Well-Being						
Positive Affect (range: 1–5)		3.4 (0.8)		3.6 (0.7)		3.8 (0.7)
Life Satisfaction (range: 1–7)		4.7 (1.5)		5.1 (1.4)		5.5 (1.3)
Optimism (range: 1–6)		4.2 (0.9)		4.5 (0.9)		4.8 (0.9)
Purpose in Life (range: 1–6)		4.4 (0.9)		4.7 (0.9)		4.9 (0.8)
Mastery (range: 1–6)		4.9 (0.8)		4.8 (1.0)		5.0 (1.1)
Health Mastery (range: 1–10)		7.0 (2.3)		7.3 (2.2)		7.8 (2.1)
Financial Mastery (range: 1–10)		6.9 (2.8)		7.3 (2.4)		8.0 (2.3)
Psychological Distress						
Depression (%)	18.2		10.7		7.8	
Depressive Symptoms (range: 0–8)		1.7 (2.1)		1.2 (1.8)		0.9 (1.6)
Hopelessness (range: 1–6)		2.7 (1.3)		2.2 (1.2)		2.0 (1.1)
Negative Affect (range: 1–5)		1.8 (0.7)		1.6 (0.6)		1.5 (0.5)
Perceived Constraints (range: 1–6)		2.4 (1.2)		2.1 (1.1)		1.8 (1.0)
Social Factors						
Loneliness (range: 1–3)		1.6 (0.6)		1.4 (0.5)		1.3 (0.4)
Living with Spouse/Partner (%)	65.2		72.9		73.4	
Contact Children <1x/week (%)	29.3		24.6		20.9	
Contact Other Family <1x/week (%)	49.4		49.6		44.9	
Contact Friends <1x/week (%)	40.2		34.8		27.8	
Personality						
Openness (range: 1–4)		2.9 (0.6)		3.0 (0.5)		3.1 (0.5)

Participant Characteristics	Perceived Neighborhood Social Cohesion					
	Tertile 1 (n=4,212)		Tertile 2 (n=4,587)		Tertile 3 (n=3,897)	
	%	Mean (SD)	%	Mean (SD)	%	Mean (SD)
Conscientiousness (range: 1–4)		3.3 (0.5)		3.4 (0.5)		3.5 (0.4)
Extraversion (range: 1–4)		3.1 (0.6)		3.2 (0.5)		3.4 (0.5)
Agreeableness (range: 1–4)		3.5 (0.5)		3.5 (0.5)		3.6 (0.4)
Neuroticism (range: 1–4)		2.2 (0.6)		2.0 (0.6)		1.9 (0.6)

^a This table was created based on non-imputed data

^b All variables in Table 1 were used as covariates and assessed in the pre-baseline wave (t0;2006/2008)

Perceived Neighborhood Social Cohesion and Subsequent Health and Well-being (Health and Retirement Study [HRS]: N=12,998)^{a,b,c,d}

Table 2.

	Perceived Neighborhood Social Cohesion			
	Tertile 1 (n=4,343) (Reference)	Tertile 2 (n=4,683) RR/OR/ β (95% CI)	Tertile 3 (n=3,972) RR/OR/ β (95% CI)	p-trend
Physical Health				
All-cause mortality	1.00	0.85 (0.74, 0.98) [*]	0.91 (0.79, 1.06)	0.12
Number of chronic conditions	0.00	-0.01 (-0.04, 0.02)	-0.02 (-0.06, 0.01)	0.13
Diabetes	1.00	0.97 (0.89, 1.05)	0.98 (0.89, 1.08)	0.56
Hypertension	1.00	0.99 (0.94, 1.05)	0.99 (0.93, 1.05)	0.71
Stroke	1.00	0.91 (0.80, 1.04)	0.88 (0.76, 1.02)	0.07
Cancer	1.00	1.03 (0.93, 1.13)	1.04 (0.93, 1.16)	0.52
Heart disease	1.00	0.96 (0.89, 1.04)	0.98 (0.89, 1.07)	0.50
Lung disease	1.00	1.03 (0.90, 1.18)	1.03 (0.90, 1.19)	0.61
Arthritis	1.00	1.00 (0.95, 1.06)	0.99 (0.93, 1.05)	0.80
Overweight/obesity	1.00	1.00 (0.95, 1.06)	0.99 (0.93, 1.05)	0.79
Physical functioning limitations	1.00	0.92 (0.85, 1.00) [*]	0.92 (0.84, 1.00)	0.04 [*]
Cognitive impairment	1.00	0.89 (0.81, 0.98) [*]	0.98 (0.89, 1.09)	0.35
Chronic pain	1.00	0.95 (0.89, 1.02)	0.93 (0.86, 1.01)	0.07
Self-rated health	0.00	0.04 (0.00, 0.09)	0.07 (0.01, 0.11) ^{**}	0.004 ^{**}
Health Behaviors				
Binge drinking	1.00	1.34 (1.05, 1.71) [*]	1.43 (1.09, 1.87) [*]	0.004 ^{**}
Smoking	1.00	1.02 (0.72, 1.46)	1.16 (0.81, 1.67)	0.52
Frequent physical activity	1.00	1.01 (0.96, 1.07)	1.01 (0.95, 1.08)	0.68
Sleep problems	1.00	0.99 (0.91, 1.07)	0.92 (0.84, 1.01)	0.13
Psychological Well-being				
Positive affect	0.00	0.06 (0.02, 0.10) ^{**}	0.17 (0.12, 0.21) ^{***}	<0.001 ^{***}
Life satisfaction	0.00	0.09 (0.04, 0.13) ^{**}	0.15 (0.11, 0.20) ^{***}	<0.001 ^{***}
Optimism	0.00	0.08 (0.04, 0.12) ^{**}	0.12 (0.05, 0.19) ^{**}	0.003 ^{**}

	Perceived Neighborhood Social Cohesion				p-trend
	Tertile 1 (n=4,343) (Reference)	Tertile 2 (n=4,683) RR/OR/β (95% CI)	Tertile 3 (n=3,972) RR/OR/β (95% CI)		
Purpose in life	0.00	0.06 (0.03, 0.10) **	0.12 (0.07, 0.18) ***	<0.001 ***	
Mastery	0.00	0.05 (0.00, 0.10) *	0.13 (0.06, 0.19) **	0.001 **	
Health mastery	0.00	0.03 (-0.02, 0.08)	0.11 (0.05, 0.16) **	0.002 **	
Financial mastery	0.00	0.10 (0.06, 0.14) ***	0.18 (0.12, 0.23) ***	<0.001 ***	
Psychological Distress					
Depression	1.00	0.87 (0.76, 1.00) *	0.78 (0.67, 0.90) **	0.001 **	
Depressive symptoms	0.00	-0.09 (-0.14, -0.04) **	-0.10 (-0.16, -0.04) **	0.001 **	
Hopelessness	0.00	-0.12 (-0.16, -0.08) ***	-0.16 (-0.21, -0.10) ***	<0.001 ***	
Negative Affect	0.00	-0.09 (-0.15, -0.02) *	-0.17 (-0.25, -0.09) **	0.001 **	
Perceived constraints	0.00	-0.08 (-0.14, -0.03) **	-0.12 (-0.19, -0.06) **	0.002 **	
Social Factors					
Loneliness	0.00	-0.14 (-0.20, -0.08) ***	-0.21 (-0.28, -0.13) ***	<0.001 ***	
Living with spouse/partner	1.00	1.02 (0.95, 1.09)	1.01 (0.94, 1.09)	0.71	
Contact children <1x/week	1.00	1.03 (0.94, 1.12)	1.01 (0.91, 1.12)	0.75	
Contact other family <1x/week	1.00	0.96 (0.89, 1.04)	0.96 (0.88, 1.04)	0.28	
Contact friends <1x/week	1.00	0.97 (0.88, 1.07)	0.91 (0.82, 0.99) *	0.08	

Abbreviations: CI, confidence interval; OR, odds ratio; RR, risk ratio.

^aIf the reference value is "1," the effect estimate is OR or RR; if the reference value is "0," the effect estimate is β.

^bThe analytic sample was restricted to those who had participated in the baseline wave (t1; 2010 or 2012). Multiple imputation was performed to impute missing data on the exposure, covariates, and outcomes. All models controlled for sociodemographic characteristics (age, sex, race/ethnicity, marital status, annual household income, total wealth, level of education, employment status, health insurance, geographic region), pre-baseline childhood abuse, pre-baseline religious service attendance, pre-baseline values of the outcome variables (diabetes, hypertension, stroke, cancer, heart disease, lung disease, arthritis, overweight/obesity, physical functioning limitations, cognitive impairment, chronic pain, self-rated health, binge drinking, current smoking status, physical activity, sleep problems, positive affect, life satisfaction, optimism, purpose in life, mastery, health mastery, financial mastery, depressive symptoms, hopelessness, negative affect, perceived constraints, loneliness, living with spouse/partner, contact children <1x/week, contact other family <1x/week, contact friends <1x/week), personality factors (openness, conscientiousness, extraversion, agreeableness, neuroticism) and the pre-baseline value of the exposure. These variables were controlled for in the pre-baseline was (in t0; 2006 or 2008).

^cWe used an outcome-wide analytic approach and ran a separate model for each outcome. We ran a different type of model depending on the nature of the outcome: 1) for each binary outcome with a prevalence of <10%, we used a generalized linear model (with a log link and Poisson distribution) to estimate a RR; 2) for each binary outcome with a prevalence of <10%, we used a logistic regression model to estimate an OR; and 3) for each continuous outcome, we used a linear regression model to estimate a β.

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All continuous outcomes were standardized (mean=0; standard deviation=1), and β was the standardized effect size.
 p
*
**

p<0.05 before Bonferroni correction;
p<0.01 before Bonferroni correction;
p<0.05 after Bonferroni correction (the p-value cutoff for Bonferroni correction is $p=0.05/35$ outcomes= $p<0.001$).

Table 3.

Robustness to Unmeasured Confounding (E-Values) for the Associations Between Perceived Neighborhood Social Cohesion (3rd Tertile vs. 1st Tertile) and Subsequent Health and Well-Being (N=12,998)^a

	Effect Estimate ^b	Confidence Interval Limit ^c
Physical Health		
All-cause mortality	1.41	1.00
Number of chronic conditions	1.17	1.00
Diabetes	1.18	1.00
Hypertension	1.11	1.00
Stroke	1.52	1.00
Cancer	1.23	1.00
Heart disease	1.18	1.00
Lung disease	1.22	1.00
Arthritis	1.12	1.00
Overweight/obesity	1.12	1.00
Physical functioning limitations	1.40	1.00
Cognitive impairment	1.15	1.00
Chronic pain	1.36	1.00
Self-rated health	1.32	1.17
Health Behaviors		
Binge drinking	2.21	1.40
Smoking	1.59	1.00
Frequent physical activity	1.12	1.00
Sleep problems	1.39	1.00
Psychological Well-being		
Positive affect	1.60	1.48
Life satisfaction	1.57	1.44
Optimism	1.47	1.28
Purpose in life	1.48	1.35
Mastery	1.50	1.33
Health mastery	1.44	1.27
Financial mastery	1.62	1.49
Psychological Distress		
Depression	1.90	1.45
Depressive symptoms	1.42	1.26
Hopelessness	1.57	1.44
Negative affect	1.62	1.43
Perceived constraints	1.48	1.31
Social Factors		
Loneliness	1.71	1.53
Living with spouse/partner	1.12	1.00
Contact children <1x/week	1.11	1.00

	Effect Estimate ^b	Confidence Interval Limit ^c
Contact other family <1x/week	1.25	1.00
Contact friends <1x/week	1.44	1.00

^aSee VanderWeele and Ding (2017) for the formula for calculating E-values.

^bThe E-values for effect estimates are the minimum strength of association on the risk ratio scale that an unmeasured confounder would need to have with both the exposure and the outcome to fully explain away the observed association between the exposure and outcome, conditional on the measured covariates.

^cThe E-values for the limit of the 95% confidence interval (CI) closest to the null denote the minimum strength of association on the risk ratio scale that an unmeasured confounder would need to have with both the exposure and the outcome to shift the confidence interval to include the null value, conditional on the measured covariates.