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Disorder, Networks, and Cognition: Do Social Networks Buffer the Influence of Neighborhood and Household Disorder on Cognitive Functioning?

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Abstract

Objectives: To examine whether neighborhood and household disorder matter for cognitive functioning among middle-aged and older adults and whether the disorder-cognition link is moderated by social network resources.

Method: Data are drawn from National Social Life, Health, and Aging Project Wave 2 (N=3,198). Both neighborhood and household were considered as key residential contexts that shape one's social life and health. Exposure to neighborhood and household disorder was measured using interviewer assessments of signs of disorder and decay, including the presence of disrepair, trash, noise, and unpleasant smells such as air pollution, in the buildings and streets in which the respondent lives. Cognitive function was measured using the survey-adapted Montreal Cognitive Assessment (MoCA-SA). Network size, network range, and frequency of interaction among network members were assessed as moderators.

Results: Neighborhood and household disorder were independently associated with cognitive function. However, disorder in the household appeared to have more direct associations with cognitive function than did the neighborhood when both were present. The association between household disorder and cognitive function was mitigated by network size, such that poor housing conditions were associated with lower cognitive function only for those with small social networks.

Conclusion: The current study suggests a larger network may play a role in minimizing the negative influence of household disorder on cognitive function for middle-aged and older adults. Social policy and intervention aimed at promoting network ties may help reduce further disparities in cognitive function, especially for those vulnerable groups living in a poor-quality household.

Keywords

Environmental disorder; social networks; cognitive function; stress-buffering

Late-life living environments are important contexts for cognitive aging. Environmental stimulation can shape social opportunities and promote neural plasticity, but environmental stress can induce psychological distress and compromise cognitive function (Lupien et al.,

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2009). A growing body of work has examined whether disordered living environments matter for cognitive function in later life (see Wu et al., 2014 for a review). Studies have found that middle-aged and older adults tend to have poor cognitive function if they lived in a neighborhood with high levels of disorder, decay and pollution or in poor housing conditions (Ailshire et al., 2017; Besser et al., 2018; Boardman et al., 2012; Clarke et al., 2015; Glass et al., 2009; Lee & Waite, 2018).

While research increasingly suggests environmental disorder can adversely affect cognitive function, the underlying mechanisms by which environmental disorder influences cognitive function remain largely unclear. Some research has suggested that environmental disorder may contribute to poor cognitive function through their influence on social resources (Clarke et al., 2012; Lee & Waite, 2018). Social resources available through one's social networks can protect health by buffering stress (Cohen & Wills, 1985; Pearlin, 1989), but this notion of the stress-buffering perspective has not been explicitly tested for cognitive function among U.S. middle-aged and older adults.

The current study extends this line of work by exploring the links between environmental disorder, social networks, and cognitive function in later life. Data are drawn from the National Social Life, Health and Aging Project, one of the only population-based surveys of U.S. middle-aged and older adults that collects both social network characteristics and the evaluation of physical conditions of residential environments. Drawing on the recent theoretical developments in environmental health research (Lee & Waite, 2018; Schafer & Upenieks, 2015; Swope & Hernández, 2019), this study considers both household and neighborhood as important residential contexts that shape social life and health in mid and late adulthood.

Background

Environmental Disorder and Cognitive Function: Previous Empirical Evidence

Environmental disorder, often characterized by the pronounced levels of undesired, uncontrolled, and unruly conditions in one's neighborhood and housing unit, can be a source of psychological distress (Kim, 2010; Swope & Hernández, 2019), which may induce physiological dysregulation and compromise subsequent health (McEwen, 1998). A large number of studies have shown that features of the disordered neighborhood environment are important predictors of cognitive function in mid and late adulthood. According to social disorganization theory (McKay & Shaw, 1969), physical disorder in the neighborhood may affect the health and well-being of middle-aged and older adults through daily worries about danger in the neighborhood. With a regional sample of U.S. adults from the Multi-Ethnic Study of Atherosclerosis, Besser and colleagues (2018) found that presence of disordered conditions in the neighborhood may impede cognitive function because thinking about how to avoid traffic, crowds, and noise on the streets can tax cognitive capacity that worsens cognition. In a study of older adults in Chicago, Boardman and colleagues (2012) suggest that physical conditions of living environment, such as vandalism, poorly maintained streets and presence of trash, have adverse effects on older adults' cognitive function. Studies have also found that exposure to environmental hazards has an adverse impact on cognitive

function. Older adults who were exposed to fine particulate air pollution and tibia lead show lower levels of cognitive function (Ailshire et al., 2017; Glass et al., 2009).

In addition to neighborhood, others have argued that the role of household disorder should be considered because health may be more directly impacted by the home due to its proximity to daily lives (Iwarsson et al., 2007). Indeed, the majority of daily activities take place in the home as people age; on average, the oldest old spend about 80% of their waking hours at home (Krantz-Kent & Stewart, 2007). The literature on the relationship between household disorder and later-life health is, however, mostly limited to studies of disability and falls (Brenner & Clarke, 2016; Lord et al., 2006; Stevens et al., 2014). Only a few recent studies have linked household disorder to poor cognitive function (Ishiki et al., 2016; James III & Sweaney, 2010; Lee & Waite, 2018). For example, individuals are more likely to have lower cognitive function if they live in a messy household (Lee & Waite, 2018) or if they are unsatisfied with housing conditions (James III & Sweaney, 2010) in mid and late adulthood. Experiencing housing instability also significantly increases the risk of cognitive decline (Ishiki et al., 2016), indicating the important role of the immediate living conditions in determining cognitive function.

Despite the contribution of earlier work in expanding our knowledge about how environmental disorder affects cognitive function, previous studies have focused typically on one domain at a time—either neighborhood or home, capturing limited environmental boundaries of middle-aged and older adults. Very little research has explored associations between cognition and disorder across multiple contexts. Gaps also exist in our understanding of the underlying mechanisms by which environmental disorder influences cognitive function. Efforts to identify the underlying mechanisms have typically focused on social resources as mediating pathways through which environmental disorder is associated with cognitive function (Clarke et al., 2012; Lee & Waite, 2018). No prior work has considered the potential of social resources to act as moderators though the stress-buffering perspective suggests that social resources available through one’s networks may act to dampen or buffer the health consequences of stressful life circumstances (Cohen & Wills, 1985; Pearlin, 1989).

A Conceptual Model of Neighborhood and Household Disorder, Social Networks, and Cognitive Function

As shown in Figure 1, this paper tests a conceptual framework that considers social network resources as a buffer against psychological distress generated by pronounced levels of disordered conditions in the neighborhood and household. Key elements of social networks in the conceptualization include network size, network range, and frequency of interactions with network members.

Conceptually, there are three mechanisms why network conditions may mitigate the disorder-cognition relationship. First, networks can protect cognitive health by providing information support to cope with stress (Lin, 2002). For instance, a large network may bring new knowledge and resources into daily conversations, which can shape health-related behaviors and buffer responses to stress (Thoits, 2011). Individuals with larger social networks have been found to have greater brain connectivity and functioning (Joo et al.,

2017), while those with fewer social ties tend to have lower cognitive function and are at increased risk of cognitive decline in mid and late adulthood (Bassuk et al., 1999; Zunzunegui et al., 2003).

Second, networks can be protective because of the social and emotional support they provide. Emotional support from network members may enhance psychological resources including self-esteem and mastery, and individuals with high levels of mastery tend to better cope with stressful events, which may, in turn, benefit cognition (Soederberg Miller & Lachman, 2000). Lastly, network conditions can also be protective by providing mental attention and stimulation (Lupien et al., 2009). Evidence suggests that social interaction with the network may stimulate innovative thinking and activities, which may boost adaptive capacity in reappraising stressors (Pelling & High, 2005; Tsai & Ghoshal, 1998). Previous research also found that cognitively stimulating interaction with the diverse network may enhance cognitive capacity (Sharifian et al., 2019) and keep the brain alert and stimulated (Roberts & Dunbar, 2011).

Many on this topic examine the moderating role of social networks in the context of mental and sexual health (Schafer et al., 2018; Smith et al., 1993), and whether the buffering role of social networks holds true for cognitive function remains relatively understudied. Given the extensive line of literature on the disorder-cognition relationship and a large volume of work on the stress-buffering perspective, this paper expects to find the following:

Hypothesis 1: Exposure to household and neighborhood disorder will be significantly related to lower cognitive function.

Hypothesis 2: However, the adverse influences of the neighborhood and household disorder will be moderated by social resources available through one’s social networks.

This study overcomes the limitations of previous research in three ways: (a) the investigation of network resources as a potential moderating mechanism for the association between environmental disorder and cognitive function; (b) the assessment of disordered living environments at both household and neighborhood levels; and (c) the utilization of ego-centric network data using a nationally representative sample of U.S. middle-aged and older adults.

Data and Methods

This study uses data from the second wave of the National Social Life, Health, and Aging Project (NSHAP). The first wave of NSHAP was administered in 2005 and 2006 to a nationally representative sample of adults born between 1920 and 1947. In 2010 and 2011, NSHAP extended the Wave 2 sample to include those who were sampled in Wave 1 but declined to participate as well as cohabiting spouses and romantic partners of Wave 1 respondents, which resulted in 3,377 total respondents. The current study focuses on the second wave because it is the first time that fielded a comprehensive cognitive function testing in the NSHAP. Most participants in Wave 2 were White (77%) and cohabitated with romantic partners or spouses (75%). Over 55% were women. Detailed information on the study objectives and sampling design has been published elsewhere (O’Muircheartaigh

et al., 2014). The analytic sample was restricted to age-eligible respondents (ages 50 and older) who completed the network roster and cognitive function test (n=3,329), and was further reduced due to a small amount of missing data ranging from 0.30% (stroke) to 3.23% (neighborhood disorder), yielding a final analytic sample of 3,198. Because NSHAP is publicly available data that cannot be linked to identifiable individuals, this study did not require institutional review board approval.

Measures

Dependent Variable.—Cognitive function in the NSHAP was assessed using the survey-adapted Montreal Cognitive Assessment (MoCA-SA). The MoCA was developed as a cognitive screening tool for use in clinical settings (Nasreddine et al., 2005). After extensive pilot testing, the NSHAP team developed an 18-item MoCA-SA for use by field workers during in-home, face-to-face interviews. MoCA-SA scores correlate highly with the scores from the full MoCA and have been widely used and validated in previous work (Dale et al., 2018; McSorley et al., 2019; Shega et al., 2014). MoCA-SA ascertains cognitive performance across domains including orientation (date and month), executive function (abstraction and modified Trails-b), visuospatial skills (clock—contour, numbers, and hands), memory (5-word delayed recall), attention (forward digits, backward digits and subtract 7s), and language (naming rhinoceros, phonemic fluency and sentence repetition) (e.g., see Kotwal et al., 2015 and Shega et al., 2014 for more detailed information on this measure). MoCA-SA scores range from 0–20, with higher scores indicating better cognition.

Environmental Disorder.—Environmental disorder was assessed using interviewers' assessments on the poor physical conditions of the respondent's neighborhood and housing unit. At the end of each in-home interview, interviewers were asked to complete a Field Interviewer Questionnaire (FIQ) and provide five evaluations of the environmental context of the interview (see Cornwell & Cagney, 2014 for further information about the neighborhood measures in the NSHAP).

Following previous work (Schafer et al., 2018; Schafer & Upenieks, 2015), neighborhood disorder scale was constructed by standardizing and averaging five items from the NSHAP-FIQ. First, interviewers were asked to rate "How well kept are most of the buildings on the street (one block, both sides) where the respondent lives?" using a 4-point scale ranging from 1 (very poorly kept) to 4 (very well kept). The responses were reverse-coded so that higher scores indicate more disorder. Next, the interviewers were asked to describe the extent of problems or disorder on the street (one block, both sides) including presence of trash, noise, heavy traffic, and air pollution, using a 1–5 metric, with higher values indicating more disorder.

Household disorder scale was assessed using interviewer assessments of how well-kept the respondent's dwelling was (reverse-coded) and conditions of the room(s) in which the interview occurred including the presence of dirtiness, noise, messiness, and unpleasant smell (Cornwell, 2014; York Cornwell, 2016). These items also used four- or five-point scales used for the neighborhood-based evaluation (see above). To create continuity among items, the responses were standardized and averaged. These measures of environmental

disorder have been validated in previous work (Cornwell, 2014; Schafer et al., 2018; Schafer & Upenieks, 2015; York Cornwell, 2016).

Social Network Characteristics.—Network size, network range, and network interaction were measured using respondents' social network data. NSHAP assessed respondents' social networks using a name generator technique in the network roster. Respondents were asked to name up to five people with whom they discussed important matters. If a spouse or partner did not appear on this initial list, respondents were asked about their partnership status and their spouses or romantic partners were added to the network roaster if they were married or partnered. Following previous work (Cornwell & Waite, 2009), network size was assessed using the number of core network members that the respondent identified. The maximum network size is therefore six. Network range was measured using the respondent's report on his or her relationship to network members. Higher values indicate greater involvement in a diverse set of individuals (e.g., spouse, friend, co-worker). Frequency of interaction with network members was measured to assess an individual's exposure to his or her network members. Respondents were asked using a 8-point scale from 1 (every day) to 8 (less than once a year) to the question "How often do you talk to (network member's name)?" The responses to each network member were recoded and standardized.

Covariates.—All models included demographic covariates on age in years (range 50–99 in Wave 2), gender (1=female, 0=male), marital status (1=married, 0=non-married), race/ethnicity, and educational attainment. Race/ethnicity was categorized as non-Hispanic White (reference), non-Hispanic Black, Hispanic, and Other. Educational attainment was grouped into three categories: less than high school (reference), high school, and college or more. Neighborhood socioeconomic status was controlled as it is highly related to the disorderliness of home and neighborhood (Sampson & Winter, 2016). The 2010 Census was merged to the respondents' addresses to obtain neighborhood characteristics at the census-tract level. Following prior work (Caldwell et al., 2017; Sampson et al., 1997), neighborhood deprivation scale was created by averaging four items, including percent of individuals in poverty, percent of individuals without a high school diploma, percent of individuals who receive public assistance, and percent of households headed by a female (alpha=0.78).

Several health conditions and behaviors were controlled as correlates of poor cognitive function (Dale et al., 2018). These included, difficulty with activities of daily living (ADLs), depressive symptoms, diagnoses of stroke, smoking status, and drinking status. ADL scale was created by averaging seven items that asked difficulty with tasks of everyday life, including walking a block, walking across a room, dressing, bathing/showing, eating, getting in and out of bed, or using the toilet (alpha=0.83). Depressive symptoms were measured averaging an 11-item short form of the Center for Epidemiological Studies-Depression (CES-D) scale (for the detailed information about the CES-D measurement, see Payne et al., 2014). Respondents were considered as having stroke if being diagnosed by a doctor in the past five years (1=yes).

Three categories of smokers were assessed: never smoked (reference), former smoker, and current smoker. Similarly, three groups of drinkers—nondrinker (reference), light drinker, and heavy drinker—were measured based on guidelines from the National Institute on Alcohol Abuse and Alcoholism (https://www.niaaa.nih.gov/alcohol-health/overview-alcohol-consumption/moderate-binge-drinking). Heavy drinkers were measured if respondents reported consuming 4 or more drinks (women) or 5 or more drinks (men) per day, and those who reported consuming fewer drinks were coded as light drinkers.

Analytic Strategy

The current study conducted sequential linear regression models to examine the relationship between environmental disorder, social network characteristics, and cognitive function. First, in Models 1 and 2, neighborhood and household disorder were entered separately into the models. These unconditional models offer a preliminary assessment of the association between cognitive function and neighborhood and household disorder. In Model 3, neighborhood and household disorder were then added together in the same model, to assess the extent to which each stressor independently explains cognitive function. In Model 4, interaction terms between environmental disorder and network characteristics were included to test whether social networks buffer the disorder-cognition relationship. To account for between-interviewer differences in the evaluation of living conditions, all models added interviewer fixed effects. Survey weights were used to adjust for complex survey design in Stata 16.

Results

Descriptive Statistics

Table 1 shows descriptive statistics for our variables. The mean MoCA-SA score for cognitive function was 14.02 (standard deviation [SD]=3.84; range: 0–20) in the non-demented range of cognition, but below the cutoff for mild cognitive impairment, which is 17 (Dale et al., 2018). Neighborhood and household disorder scales were positively skewed, with the vast majority of respondents living in the well-organized living environments (mean=0.15 and 0.16, SD=0.15 and 0.19, range: 0–1). On average, NSHAP respondents reported 4.46 network members with whom they share important personal information. They reported that they frequently interacted with network members (Mean=0.82, range: 0–1). Almost 60% had at least college education. Nearly one in ten reported they had a stroke in the past five years. Nearly half of the respondents reported never smoking, and most of the rest reported being former (37.99%) rather than current smokers (13.40%). Similarly, nearly half the respondents reported being nondrinkers, with more than half reporting being only light drinkers (52.25%) and few reporting being heavy drinkers (4.04%).

Multivariable Regressions

Table 2 presents results from multivariable regression models predicting the relationship between environmental disorder, social networks, and cognitive function. Model 1 includes neighborhood disorder, model 2 includes household disorder. As expected, both forms of disorder predicted lower cognitive function. Model 1 suggests that, for every one unit increase in neighborhood disorder, MoCA-SA scores decrease by 1.39 points ($p<0.01$)

while Model 2 suggests that MoCA-SA scores decrease by 1.93 points with every one unit increase in household disorder ($p<0.001$). When both neighborhood and household disorder were considered simultaneously in Model 3, however, the influence of neighborhood disorder becomes statistically insignificant while household disorder continues to decrease MoCA-SA scores by 1.80 points ($p<0.001$).

Model 4 adds the interaction terms between household disorder and social network characteristics (network size, network range, and network interaction). Neighborhood interaction effects with social networks were not tested given the insignificant effect of neighborhood disorder in Model 3 when both environments are present. The significant interaction term crossing network size with household disorder indicates that the association between household disorder and cognitive function varies according to the size of one's network. Network range and interaction did not buffer the negative association between disorder and cognition. Adding interaction terms separately in the model did not change the overall findings.

Figure 2 displays the interaction between household disorder and network size. To ease the interpretation, it shows the relationship for small network sizes (= 3 people; one SD below the mean) and large network sizes (= 6 people; one SD above the mean). Results from Model 4 are used to generate predicted probabilities for cognitive function. The predicted probabilities illustrate that household disorder has a large, negative association with cognitive function for middle-aged and older adults with small networks. For those who have small network sizes, the level of cognitive function decreases as the household disorder scale increases. Those who have large networks appear to be less influenced by environmental stress. The differences between groups were tested using *margins* command. Results suggest that the slope for small network sizes is statistically significantly different from each of the other two slopes.

Several covariates are associated with cognitive function across the models. Consistent with previous work, both age and nonwhite minority status are significantly and negatively associated with cognitive function. Females and those who completed high school or more are more likely to have higher cognitive function. ADLs and depression are related to lower cognitive function, whereas light drinking is associated with higher cognitive function.

Discussion

The purpose of the current study was to examine the extent to which disordered neighborhood and household environments are associated with later-life cognitive function and whether network resources moderate the association between environmental disorder and cognition. This paper found three principal findings. First, disordered living environments, both neighborhood and household, influence cognitive functioning. Second, household disorder has more pronounced influences than neighborhood disorder when both are present. Third, network size buffered the influence of household disorder on cognitive function. Household disorder has an adverse association with cognitive function only for those with small social networks.

We found that cognitive function may be more sensitive to housing disorder than neighborhood disorder. This result is consistent with recent findings (Lee & Waite, 2018; Schafer et al., 2018; Schafer & Upenieks, 2015) that emphasize the unique effects of the home on health in later life. Though many studies have suggested that neighborhood environment plays a role in determining the health and well-being in later life, the household provides a key context for social life and interaction through which "individuals cultivate and maintain network ties" (York Cornwell, 2016). It can be a central place for exchanging resources, intimacy, and support, potentially affecting individual health more directly than does neighborhood.

This is the first study that observed the role of social networks in minimizing the negative influence of environmental disorder on cognitive function for middle-aged and older adults, especially for those who live in poor housing conditions. One possibility is that large networks may provide instrumental aid which helps individuals to engage in social activities that would otherwise decrease due to the presence of residential hazards at home in later life. Living with clutter and/or on uneven floors may make it difficult for them to move in and out of the house for socializing. However, if network members provide or arrange for rides to bring friends to their homes or to leave the house for community social gathering, people may continue to meet their social needs. According to the concept of "use it or lose it" (Salthouse, 2016), disuse of the brain as a result of social disengagement may result in atrophy of cognitive skills and put individuals at increased risk of poor cognitive performance. While previous studies have shown that network sizes can be resourceful for older adults in disease management (i.e., hypertension and cancer) (Cornwell & Waite, 2012; Schafer & Koltai, 2015), this finding adds to the literature by showing that large networks may also be beneficial for brain management with the potential provision of resources, support, and aid to maintain social life in later life.

One strength of this study is its assessment of both household and neighborhood disorder. Although there has been theoretical interest in exploring the impact of environmental disorder beyond neighborhood into household level (Swope & Hernández, 2019), empirical evidence has been limited especially for cognitive health. The majority of existing research on disorder and health has mostly focused on physical and mental health outcomes (Schafer & Upenieks, 2015; Upenieks et al., 2016). The finding that the relationship between neighborhood disorder and cognition disappeared after accounting for household conditions suggests the unique importance of the home that shapes older adult cognitive well-being.

Another strength of the current study is the use of interviewer assessments drawn from NSHAP-FIQ to measure environmental disorder. The FIQ was first developed in the Project on Human Development in Chicago Neighborhoods, and used the principles of systematic social observation (Sampson & Raudenbush, 1999). Despite the possibility of subjectivities in the interviewer's ratings, recent work has demonstrated that the field interviewer observations in the NSHAP are rarely influenced by interviewer characteristics (e.g., race and gender) and largely consistent across interviewers, which points to nontrivial measurement variability in the NSHAP-FIQ (Cornwell & Cagney, 2014; York Cornwell, 2016). Importantly, the present study applied interviewer fixed effects as well as survey

adjustments, which “should lessen the degree to which field interviewers’ ratings are clouded by subjectivities” (Cornwell & Cagney, 2014, pg. S55).

Despite these strengths, the current study has several limitations. First, although results show that network size protects cognitive function in the context of household disorder, it is worth noting that large networks can also have their costs. Especially in the context of household disorder, having many network members may adversely influence an individual’s psychological well-being if they criticize housing conditions and create social strain (e.g., York Cornwell, 2016). Network members may also foster dependence and lower sense of control of middle-aged and older adults which might negatively impact cognitive function (Agrigoroaei & Lachman, 2011). Furthermore, physical proximity from network members to the respondent may play a role in providing and receiving necessary instrumental aid, however, information on physical distance between the respondent and network members are not available in NSHAP.

Second, although the aim of this study is to determine whether one’s social network buffers the association between environmental disorder and cognition, there is evidence that community-level group interaction and social activities could confer cognitive benefits (Lee & Ang, 2019) by developing sense of belonging and identity. Future work investigating the role of community-level social participation such as volunteering, civic engagement, and socializing with neighbors in determining the effect of environmental disorder on cognition would be beneficial. Furthermore, exposure to new network members might bring new resources into daily conversations, which, coupled with navigation of social cues, may stimulate brain activities. Investigating network composition and strength, perhaps distinguishing proportion of kin vs. non-kin and strong vs. weak ties in the network, might help explore the multiplexity of social relationships among middle-aged and older adults and their effects on cognitive well-being.

Lastly, this study was cross-sectional and, therefore, unable to determine if network size buffers the effect of disorder on cognitive decline over time and if household disorder and social networks are the cause or the result of cognitive abilities. Social selection may also exist in the relationship between environmental disorder and cognition. People with poor cognition may be less likely to be economically successful, and, therefore, more likely to live in less pleasant and desirable environments. Future studies will benefit from employing longitudinal data to test reverse causality or bidirectionality.

Conclusion

People tend to remain in the same residential areas as they age (Joint Center for Housing Studies of Harvard University, 2014). Older adults may become more vulnerable to environmental stress than young adults as they have been exposed to unhealthy features of their environment for a longer period of time (Glass & Balfour, 2003). Poor cognitive function is a prevalent problem in later adulthood and may lead to neurodegenerative diseases such as Alzheimer’s disease and dementia (Larson et al., 2013; Rocca et al., 2011). Numerous interventions to maintain healthy cognition have been developed, implemented, and tested (Heyn et al., 2004; van Uffelen et al., 2008), but their effectiveness has been

questioned, suggesting there are other unexplored factors that contribute to cognitive function. Efforts to identify contributing factors have typically focused on individual-level socioeconomic or behavioral characteristics, with less attention to the role of environmental influences. This study highlights the importance of investigating housing conditions in examination of risk factors for cognitive health. Social policies and programs which provide financial support for household upkeep or repair for middle-aged and older adults may help reduce further disparities in cognitive function, especially for those vulnerable groups living with a poor-quality household (Upenieks et al., 2016). Furthermore, interventions aimed at promoting social resources through one's social network may help reduce or remediate the effect of living in the household with poor physical conditions.

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References

Agrigoroaei S, & Lachman ME (2011). Cognitive Functioning in Midlife and Old Age: Combined Effects of Psychosocial and Behavioral Factors. The Journals of Gerontology Series B: Psychological Sciences and Social Sciences, 66B(Suppl 1), i130–i140. 10.1093/geronb/gbr017

Ailshire J, Karraker A, & Clarke P. (2017). Neighborhood Psychosocial Stressors, Air Pollution, and Cognitive Function among Older U.S. Adults. Social Science & Medicine (1982), 172, 56–63. 10.1016/j.socscimed.2016.11.019 [PubMed: 27886528]

Bassuk SS, Glass TA, & Berkman LF (1999). Social disengagement and incident cognitive decline in community-dwelling elderly persons. Annals of Internal Medicine, 131(3), 165–173. [PubMed: 10428732]

Besser LM, Rodriguez DA, McDonald N, Kukull WA, Fitzpatrick AL, Rapp SR, & Seeman T. (2018). Neighborhood built environment and cognition in non-demented middle-aged and older adults: The Multi-Ethnic Study of Atherosclerosis. Social Science & Medicine, 200, 27–35. 10.1016/j.socscimed.2018.01.007 [PubMed: 29355828]

Boardman JD, Barnes LL, Wilson RS, Evans DA, & Mendes de Leon CF (2012). Social disorder, APOE-E4 genotype, and change in cognitive function among middle-aged and older adults living in Chicago. Social Science & Medicine (1982), 74(10), 1584–1590. 10.1016/j.socscimed.2012.02.012 [PubMed: 22465377]

Brenner AB, & Clarke PJ (2016). Understanding Socioenvironmental Contributors to Racial and Ethnic Disparities in Disability Among Older Americans. Research on Aging.

Caldwell JT, Lee H, & Cagney KA (2017). Disablement in Context: Neighborhood Characteristics and Their Association With Frailty Onset Among Middle-aged and older adults. The Journals of Gerontology: Series B. 10.1093/geronb/gbx123

Clarke PJ, Ailshire JA, House JS, Morenoff JD, King K, Melendez R, & Langa KM (2012). Cognitive Function in the Community Setting: The Neighborhood as a Source of "Cognitive Reserve"? Journal of Epidemiology and Community Health, 66(8), 730–736. 10.1136/jech.2010.128116 [PubMed: 21515547]

Clarke PJ, Weuve J, Barnes L, Evans DA, & Mendes de Leon CF (2015). Cognitive decline and the neighborhood environment. Annals of Epidemiology, 25(11), 849–854. 10.1016/j.annepidem.2015.07.001 [PubMed: 26253697]

Cohen S, & Wills TA (1985). Stress, social support, and the buffering hypothesis. Psychological Bulletin, 98(2), 310–357. 10.1037/0033-2909.98.2.310 [PubMed: 3901065]

Cornwell EY (2014). Social Resources and Disordered Living Conditions Evidence From a National Sample of Community-Residing Middle-aged and older adults. Research on Aging, 36(4), 399–430. [PubMed: 25651314]

Cornwell EY, & Cagney KA (2014). Assessment of neighborhood context in a nationally representative study. The Journals of Gerontology Series B: Psychological Sciences and Social Sciences, 69(Suppl 2), S51–S63.

Cornwell EY, & Waite LJ (2009). Social disconnectedness, perceived isolation, and health among middle-aged and older adults. Journal of Health and Social Behavior, 50(1), 31–48. [PubMed: 19413133]

Cornwell EY, & Waite LJ (2012). Social network resources and management of hypertension. Journal Of Health And Social Behavior, 53(2), 215–231. 10.1177/0022146512446832 [PubMed: 22660826]

Dale W, Kotwal AA, Shega JW, Schumm LP, Kern DW, Pinto JM, Pudelek KM, Waite LJ, & McClintock MK (2018). Cognitive Function and its Risk Factors Among Older US Adults Living at Home. Alzheimer Disease & Associated Disorders, 32(3), 207. 10.1097/WAD.0000000000000241 [PubMed: 29334499]

Glass TA, Bandeen-Roche K, McAtee M, Bolla K, Todd AC, & Schwartz BS (2009). Neighborhood Psychosocial Hazards and the Association of Cumulative Lead Dose With Cognitive Function in Middle-aged and older adults. American Journal of Epidemiology, 169(6), 683–692. 10.1093/aje/kwn390 [PubMed: 19155330]

Heyn P, Abreu BC, & Ottenbacher KJ (2004). The effects of exercise training on elderly persons with cognitive impairment and dementia: A meta-analysis11No commercial party having a direct financial interest in the results of the research supporting this article has or will confer a benefit upon the author(s) or upon any organization with which the author(s) is/are associated. Archives of Physical Medicine and Rehabilitation, 85(10), 1694–1704. 10.1016/j.apmr.2004.03.019 [PubMed: 15468033]

Ishiki A, Okinaga S, Tomita N, Kawahara R, Tsuji I, Nagatomi R, Taki Y, Takahashi T, Kuzuya M, Morimoto S, Iijima K, Koseki T, Arai H, & Furukawa K. (2016). Changes in Cognitive Functions in the Elderly Living in Temporary Housing after the Great East Japan Earthquake. PLoS ONE, 11(1). 10.1371/journal.pone.0147025

Iwarsson S, Wahl H-W, Nygren C, Oswald F, Sixsmith A, Sixsmith J, Szeman Z, & Tomsone S. (2007). Importance of the home environment for healthy aging: Conceptual and methodological background of the European ENABLE–AGE Project. The Gerontologist, 47(1), 78–84. [PubMed: 17327543]

James III RN, & Sweaney AL (2010). Housing Dissatisfaction and Cognitive Decline in Middle-aged and older adults. Journal of Housing For the Elderly, 24(1), 93–106. 10.1080/02763890903547104

Joint Center for Housing Studies of Harvard University. (2014). Housing America's middle-aged and older adults: Meeting the needs of an aging population. https://www.jchs.harvard.edu/research-areas/aging

Joo W, Kwak S, Youm Y, & Chey J. (2017). Brain functional connectivity difference in the complete network of an entire village: The role of social network size and embeddedness. Scientific Reports, 7(1), 1–12. 10.1038/s41598-017-04904-1 [PubMed: 28127051]

Kim J. (2010). Neighborhood disadvantage and mental health: The role of neighborhood disorder and social relationships. Social Science Research, 39(2), 260–271. 10.1016/j.ssresearch.2009.08.007

Kotwal AA, Schumm P, Kern DW, McClintock MK, Waite LJ, Shega JW, Huisingh-Scheetz MJ, & Dale W. (2015). Evaluation of a brief survey instrument for assessing subtle differences in cognitive function among middle-aged and older adults. Alzheimer Disease & Associated Disorders, 29(4), 317–324. [PubMed: 25390883]

Krantz-Kent R, & Stewart J. (2007). How do older Americans spend their time. Monthly Lab. Rev, 130, 8.

Larson EB, Yaffe K, & Langa KM (2013). New insights into the dementia epidemic. New England Journal of Medicine, 369(24), 2275–2277.

Lee H, & Ang S. (2019). Productive Activities and Risk of Cognitive Impairment and Depression: Does the Association Vary by Gender? Sociological Perspectives, 0731121419892622. 10.1177/0731121419892622

Lee H, & Waite LJ (2018). Cognition in Context: The Role of Objective and Subjective Measures of Neighborhood and Household in Cognitive Functioning in Later Life. The Gerontologist, 58(1), 159–169. 10.1093/geront/gnx050 [PubMed: 28666359]

Lin N. (2002). Social capital: A theory of social structure and action (Vol. 19). Cambridge university press. https://books.google.com/books?hl=en&lr=&id=fvBzIu5-yuMC&oi=fnd&pg=PR11&dq=%22nan+lin%22+social+capital+&ots=UV4wm0uGIT&sig=XWloBS_uvtBBXdb9B-wBPFY5cbo

Lord SR, Menz HB, & Sherrington C. (2006). Home environment risk factors for falls in older people and the efficacy of home modifications. Age and Ageing, 35(suppl_2), ii55–ii59. 10.1093/ageing/afl088 [PubMed: 16926207]

Lupien SJ, McEwen BS, Gunnar MR, & Heim C. (2009). Effects of stress throughout the lifespan on the brain, behaviour and cognition. Nature Reviews Neuroscience, 10(6), 434–445. [PubMed: 19401723]

McEwen BS (1998). Stress, adaptation, and disease: Allostasis and allostatic load. Annals of the New York Academy of Sciences, 840(1), 33–44. 10.1111/j.1749-6632.1998.tb09546.x [PubMed: 9629234]

McSorley VE, Bin YS, & Lauderdale DS (2019). Associations of Sleep Characteristics With Cognitive Function and Decline Among Middle-aged and older adults. American Journal of Epidemiology, 188(6), 1066–1075. 10.1093/aje/kwz037 [PubMed: 30759177]

Nasreddine ZS, Phillips NA, Bédirian V, Charbonneau S, Whitehead V, Collin I, Cummings JL, & Chertkow H. (2005). The Montreal Cognitive Assessment, MoCA: A brief screening tool for mild cognitive impairment. Journal of the American Geriatrics Society, 53(4), 695–699. [PubMed: 15817019]

O'Muircheartaigh C, English N, Pedlow S, & Kwok PK (2014). Sample design, sample augmentation, and estimation for Wave 2 of the NSHAP. The Journals of Gerontology Series B: Psychological Sciences and Social Sciences, 69(Suppl 2), S15–S26.

Payne C, Hedberg EC, Kozloski M, Dale W, & McClintock MK (2014). Using and Interpreting Mental Health Measures in the National Social Life, Health, and Aging Project. The Journals of Gerontology Series B: Psychological Sciences and Social Sciences, 69(Suppl 2), S99–S116. 10.1093/geronb/gbu100

Pearlin LI (1989). The Sociological Study of Stress. Journal of Health and Social Behavior, 30(3), 241–256. JSTOR. 10.2307/2136956 [PubMed: 2674272]

Pelling M, & High C. (2005). Understanding adaptation: What can social capital offer assessments of adaptive capacity? Global Environmental Change, 15(4), 308–319.

Roberts SGB, & Dunbar RIM (2011). Communication in social networks: Effects of kinship, network size, and emotional closeness. Personal Relationships, 18(3), 439–452. 10.1111/j.1475-6811.2010.01310.x

Rocca WA, Petersen RC, Knopman DS, Hebert LE, Evans DA, Hall KS, Gao S, Unverzagt FW, Langa KM, Larson EB, & others. (2011). Trends in the incidence and prevalence of Alzheimer's disease, dementia, and cognitive impairment in the United States. Alzheimer's & Dementia, 7(1), 80–93.

Salthouse TA (2016). Theoretical perspectives on cognitive aging. Psychology Press.

Sampson RJ, & Raudenbush SW (1999). Systematic social observation of public spaces: A new look at disorder in urban neighborhoods. American Journal of Sociology, 105(3), 603–651. Scopus. 10.1086/210356

Sampson RJ, Raudenbush SW, & Earls F. (1997). Neighborhoods and violent crime: A multilevel study of collective efficacy. Science, 277(5328), 918–924. [PubMed: 9252316]

Sampson RJ, & Winter AS (2016). THE RACIAL ECOLOGY OF LEAD POISONING: Toxic Inequality in Chicago Neighborhoods, 1995–2013. Du Bois Review: Social Science Research on Race, 13(2), 261–283. 10.1017/S1742058X16000151

Schafer MH, & Koltai J. (2015). Cancer Diagnosis and Mental Health among Older White Adults: Moderating Role for Social Networks? Society and Mental Health, 5(3), 182–202. 10.1177/2156869315577631

Schafer MH, & Upenieks L. (2015). Environmental disorder and functional decline among middle-aged and older adults: A layered context approach. Social Science & Medicine, 124, 152–161. 10.1016/j.socscimed.2014.11.037 [PubMed: 25461872]

Schafer MH, Upenieks L, & Iveniuk J. (2018). Putting Sex Into Context in Later Life: Environmental Disorder and Sexual Interest Among Partnered Seniors. The Gerontologist, 58(1), 181–190. 10.1093/geront/gnx043 [PubMed: 29361182]

Sharifian N, Kraal AZ, Zaheed AB, Sol K, & Zahodne LB (2019). The longitudinal association between social network composition and episodic memory in older adulthood: The importance of contact frequency with friends. Aging & Mental Health, 0(0), 1–7. 10.1080/13607863.2019.1660850

Shega JW, Sunkara PD, Kotwal A, Kern DW, Henning SL, McClintock MK, Schumm P, Waite LJ, & Dale W. (2014). Measuring Cognition: The Chicago Cognitive Function Measure in the National Social Life, Health and Aging Project, Wave 2. The Journals of Gerontology Series B: Psychological Sciences and Social Sciences, 69(Suppl 2), S166–S176. 10.1093/geronb/gbu106

Smith CA, Smith CJ, Kearns RA, & Abbott MW (1993). Housing stressors, social support and psychological distress. Social Science & Medicine, 37(5), 603–612. 10.1016/0277-9536(93)90099-P [PubMed: 8211274]

Stevens JA, Mahoney JE, & Ehrenreich H. (2014). Circumstances and outcomes of falls among high risk community-dwelling middle-aged and older adults. Injury Epidemiology, 1. 10.1186/2197-1714-1-5

Swope CB, & Hernández D. (2019). Housing as a determinant of health equity: A conceptual model. Social Science & Medicine, 243, 112571. 10.1016/j.socscimed.2019.112571

Thoits PA (2011). Mechanisms Linking Social Ties and Support to Physical and Mental Health. Journal of Health and Social Behavior, 52(2), 145–161. 10.1177/0022146510395592 [PubMed: 21673143]

Tsai W, & Ghoshal S. (1998). Social capital and value creation: The role of intrafirm networks. Academy of Management Journal, 41(4), 464–476.

Upenieks L, Schafer MH, & Iveniuk J. (2016). Does disorder get “into the head” and “under the skin”? Layered contexts and bi-directional associations. Health & Place, 39, 131–141. [PubMed: 27086267]

van Uffelen JG, Chinapaw MJ, van Mechelen W, & Hopman-Rock M. (2008). Walking or vitamin B for cognition in middle-aged and older adults with mild cognitive impairment? A randomised controlled trial. British Journal of Sports Medicine, 42(5), 344–351. [PubMed: 18308888]

Wu Y-T, Prina AM, & Brayne C. (2014). The association between community environment and cognitive function: A systematic review. Social Psychiatry and Psychiatric Epidemiology, 50(3), 351–362. [PubMed: 25087013]

York Cornwell E. (2016). Household Disorder, Network Ties, and Social Support in Later Life. Journal of Marriage and Family, 78(4), 871–889. 10.1111/jomf.12299 [PubMed: 27524834]

Zunzunegui M-V, Alvarado BE, Del Ser T, & Otero A. (2003). Social networks, social integration, and social engagement determine cognitive decline in community-dwelling Spanish middle-aged and older adults. The Journals of Gerontology Series B: Psychological Sciences and Social Sciences, 58(2), S93–S100.

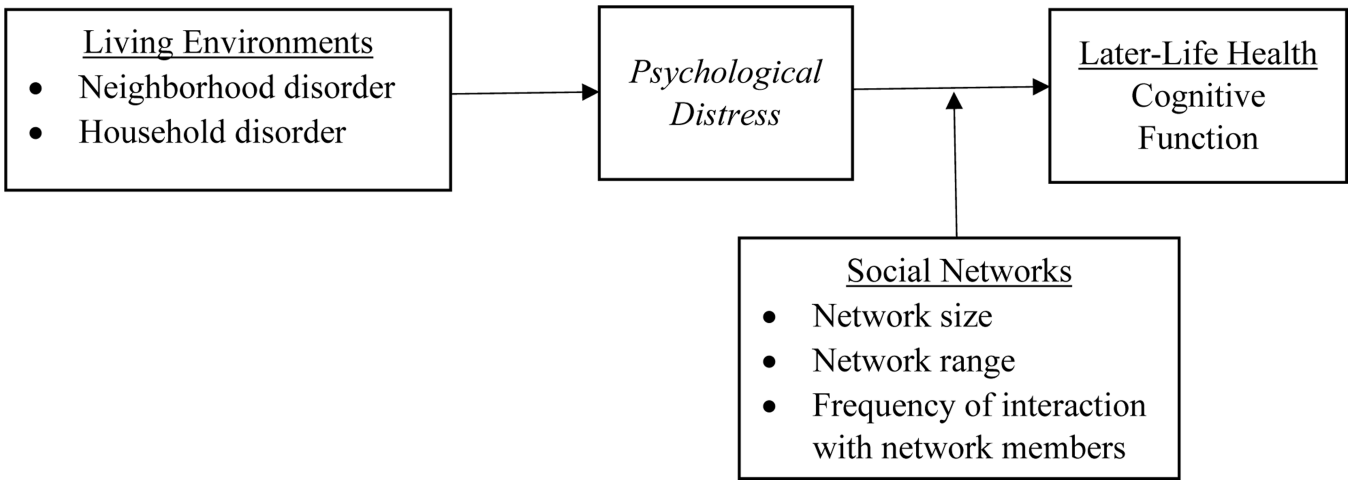

Figure 1.
Conceptual Framework of a Process by Which Environmental Disorder Shapes Cognitive Function.
Note: The highlighted font "Psychological Distress" is not explicitly tested in the model but presented here as a key mechanism through which neighborhood and household disorder are associated with later-life cognitive function.

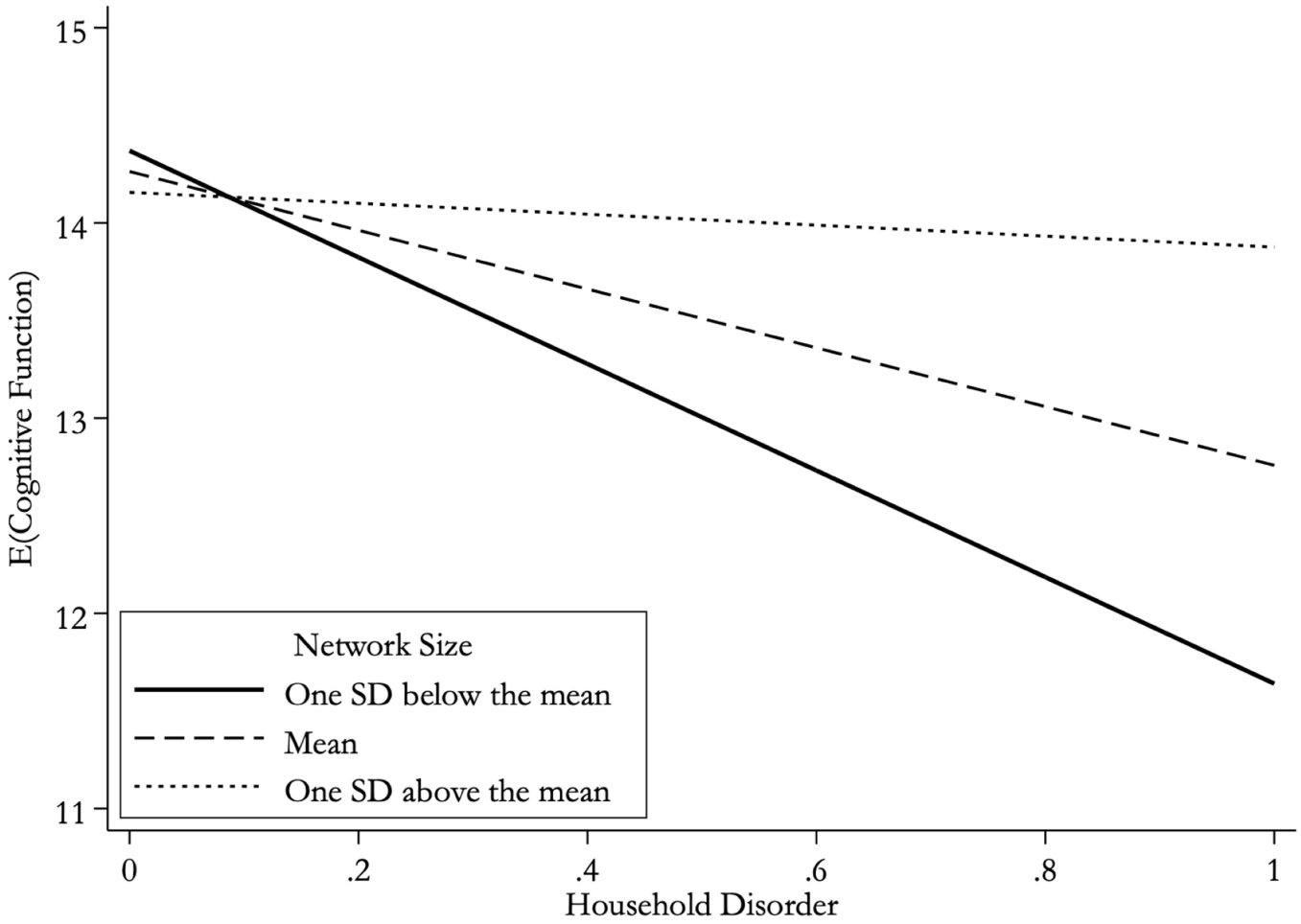

Figure 2.
Predicted probabilities of cognitive function in network size (± standard deviation above and below the mean) and household disorder. Figure 2 is based on Model 4 in Table 2.

Table 1.

Weighted Sample Characteristics of Key Variables, National Social Life, Health, and Aging Project, 2010/2011 (N=3,194)

Variable	Mean (SD) / Percentage (N)
MoCA-SA	14.02 (3.84)
Neighborhood disorder	0.15 (0.15)
Household disorder	0.16 (0.19)
Network size	4.46 (1.47)
Network range	3.02 (1.09)
Network interaction	0.82 (0.11)
Age (50–99)	71.54 (7.95)
Female	53.01%
Race/ethnicity	17.44%
White, non-Hispanic	81.59%
Black, non-Hispanic	9.25%
Hispanic	6.78%
Other	2.37%
Married	56.25%
Education	
Less than high school	14.29%
High school	26.15%
College or more	59.56%
ADLs	0.11 (0.29)
Depression	14.77 (2.75)
Stroke	9.78%
Smoking	
Never smoked	48.61%
Former smoker	37.99%
Current smoker	13.40%
Drinking	
Nondrinker	43.71%
Light drinker	52.25%
Heavy drinker	4.04%
Neighborhood deprivation	0.19 (0.08)

Note: All estimates are adjusted for survey design.

Table 2.

Linear Regression of Cognitive Function, National Social Life, Health, and Aging Project, 2010/2011 (N=3,198; age ≥ 50)

	Model 1	Model 2	Model 3	Model 4
Environmental Disorder				
Neighborhood disorder	−1.39 **		−0.44	−0.54
	(0.45)		0.49)	(0.48)
Household disorder		−1.93 ***	−1.80 ***	−8.78 *
		(0.37)	(0.41)	(3.49)
Social Network Resources				
Network size				−0.07
				(0.08)
Network range				0.20
				(0.10)
Network interaction				−2.81 **
				(0.84)
Household disorder X Size				0.84 *
				(0.36)
Household disorder X Range				−0.42
				(0.40)
Household disorder X Interaction				5.92
				(3.33)
Covariates				
Age	−0.13 ***	−0.13 ***	−0.13 ***	−0.13 ***
	(0.01)	(0.01)	(0.01)	(0.01)
Female	0.56 ***	0.51 **	0.51 **	0.47 **
	(0.15)	(0.16)	(0.16)	(0.15)
Married	0.16	0.10	0.09	0.02
	(0.13)	(0.13)	(0.12)	(0.12)
Race/Ethnicity (NH-White=ref.)				
NH-Black	−2.19 ***	−2.20 ***	−2.18 ***	−2.16 ***
	(0.19)	(0.20)	(0.19)	(0.20)
Hispanic	−2.11 ***	−2.18 ***	−2.16 ***	−2.11 ***
	(0.32)	(0.31)	(0.32)	(0.34)
Other	−1.60 **	−1.54 **	−1.53 **	−1.54 **
	(0.54)	(0.54)	(0.54)	(0.54)
Education (less than HS = ref.)				
HS	2.02 ***	2.01 ***	2.00 ***	1.88 ***
	(0.21)	(0.20)	(0.20)	(0.21)
College or more	3.31 ***	3.30 ***	3.28 ***	3.13 ***

	Model 1	Model 2	Model 3	Model 4
	(0.18)	(0.17)	(0.18)	(0.18)
ADLs	−1.84***	−1.75***	−1.75***	−1.77***
	(0.24)	(0.24)	(0.24)	(0.23)
Depression	−0.07**	−0.07**	−0.07**	−0.07**
	(0.02)	(0.02)	(0.02)	(0.02)
Stroke	−0.46	−0.45	−0.45	−0.46
	(0.26)	(0.26)	(0.26)	(0.26)
Smoking (Never smoked = ref.)				
Former smoker	−0.18	−0.17	−0.17	−0.17
	(0.14)	(0.14)	(0.14)	(0.14)
Current smoker	−0.41	−0.29	−0.29	−0.28
	(0.30)	(0.29)	(0.29)	(0.29)
Drinking (Nondrinker = ref.)				
Light drinker	0.74***	0.69***	0.69***	0.66***
	(0.18)	(0.18)	(0.18)	(0.19)
Heavy drinker	−0.05	−0.02	−0.03	−0.08
	(0.54)	(0.52)	(0.52)	(0.51)
Neighborhood deprivation	−1.32	−1.14	−0.96	−0.84
	(1.02)	(0.94)	(0.99)	(0.99)
Constant	23.42***	23.72***	23.76***	25.91***
	(0.90)	(0.90)	(0.91)	(1.36)

Note: Standard errors in parentheses. Ref. = reference. NH = non-Hispanic. HS = high school. ADLs = Activities of daily living.

* $p < 0.05$;

** $p < 0.01$;

*** $p < 0.001$