THE GERONTOLOGICAL SOCIETY OF AMERICA®

Journals of Gerontology: Social Sciences
cite as: *J Gerontol B Psychol Sci Soc Sci*, 2020, Vol. XX, No. XX, 1–12
doi:10.1093/geronb/gbaa047
Advance Access publication April 18, 2020

OXFORD

Research Article

The Foreclosure Crisis, Community Change, and the Cognitive Health of Older Adults

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Received: July 5, 2019; Editorial Decision Date: March 10, 2020

Decision Editor: Deborah Carr, PhD

Abstract

Objectives: While home foreclosures are often thought of as a household-level event, the consequences may be far-reaching, and spill over to the broader community. Older adults, in particular, could be affected by the spiral of community changes that result from foreclosures, but we know very little about how the foreclosure crisis is related to older adult health, in particular cognition.

Method: This article uses growth curve models and data from the Health and Retirement Study matched to Census and county-level foreclosure data to examine whether community foreclosures are related to older adults' cognitive health and the mechanisms responsible.

Results: We find that higher rates of county-level foreclosures are associated with a faster decline in individual cognition at older ages. Although we examined an extensive number of individual and community mechanisms, including individual housing wealth and depressive symptoms, community structural factors, social factors, and perceptions of physical disorder and cohesion, none of the mechanisms examined here explained this relationship.

Discussion: This study shows that the adverse consequences of home foreclosures spill over to the local community, with implications for the cognitive health of older adults.

Keywords: Cognitive decline, Community physical disorder, Community social cohesion, Foreclosures, Health and Retirement Study

Changes in the U.S. housing market resulted in unprecedented numbers of foreclosures during the "Great Recession," with its peak in 2010 (RealtyTrac, 2011). The timing of the recession intersected with an aging baby boomer population, raising questions about the potential impact of the housing crisis on the health and well-being of older adults. Drawing on theories of community physical disorder and social capital (Kawachi & Berkman, 2000; Krause, 1993; Ross & Mirowsky, 2001; Sampson, 2012; Sampson & Raudenbush, 2004; Skogan, 1992), we argue that the contextual consequences of foreclosures could lead to worsened cognitive health not only for the individuals who themselves experience foreclosures but for others in the community, through increased community physical disorder or community social change. This is the first article to look at the relationship between community foreclosures and individual cognition. We also expand on current work by examining a variety of individual and community factors that could be potential pathways through which community exposure to foreclosures leads to adverse health.

Foreclosures and Community Physical and Social Change

We hypothesize that community foreclosures could influence health by serving as a catalyst for other

community-level changes linked to health, such as increased physical decline and crime and changes in the social cohesion, ties, and the social composition of communities. One consequence of foreclosures is declines to the physical environment that come from the neglected or vacant housing that often follows foreclosures. Physical disorder theory (Ross & Mirowsky, 2001; Sampson, 2012; Sampson & Raudenbush, 2004; Skogan, 1992) suggests that the physical consequences of foreclosures for the local environment, including boarded-up buildings or property deterioration may lead to other aspects of decline including crime or loitering. Prior work shows that these factors lead to fear and psychological distress (Kim, 2010; Latkin & Curry, 2003; Ross & Jang, 2000; Ross & Mirowsky, 2001) and also worse overall health (Cohen et al., 2003; Kim, 2010; Krause, 1996; Lawton, Nahemow, & Tsong-Min-Yeh, 1980; Wu et al., 2015).

Foreclosures have also been linked to declines in social cohesion and overall opportunities for social contact in the local environment. Vacant housing leading to crime or loitering may make a neighborhood less conducive for socializing with local residents (Krause, 1993; Thompson & Krause, 1998). Fear for safety could also reduce the likelihood of walking in neighborhoods (Mendes de Leon et al., 2009), potentially leading to reduced contact with neighbors and lower levels of neighborhood social cohesion. More directly, when homes are foreclosed, individuals are forced out of their homes and this may sever long-standing ties, with those left behind losing daily access to neighbors and geographically proximate friends. Rising foreclosures may thereby result in fewer social ties and less local social capital in the surrounding community, which in turn may lead to worse health (Kawachi & Berkman, 2000; Seeman, Lusignolo, Albert, & Berkman, 2001; Seeman et al., 2011; Stafford, Mcmunn, & De Vogli, 2011). This may be particularly salient for older adults who might have long histories of ties to neighbors and be more connected to their communities.

Prior Research on Foreclosures and Health

There is already evidence that the consequences of the housing crisis go beyond the individuals who themselves experienced foreclosures. Two recent systematic reviews summarize studies of the relationship between home foreclosures and health-related outcomes and show that the majority of studies find adverse effects of foreclosures on health and mental health (Downing, 2016; Tsai, 2015), as well as for a variety of outcomes including home values, civic engagement, and crime (Downing (2016). Among the studies reviewed in Tsai (2015) that use multilevel data (e.g., county-level foreclosure rate) as a predictor of individual-level health outcomes, most showed significant associations, suggesting that foreclosure at the community level may be linked to individual-level outcomes. When it comes to mental health, rates of foreclosures at the state-level and MSA-level are related to increased suicide rates, especially among the middle-aged (Houle & Light, 2014) and white males (Houle & Light, 2017). Zip code and county-level foreclosure rates are also associated with individual mental health in two national studies (Cagney, Browning, Iveniuk, & English, 2014; Houle, 2014).

The relationship between community foreclosures and physical health has some support but is more mixed. Currie and Tekin (2015) show that foreclosure rates at the zip code level are related to an increased rate of emergency room and hospital visits. Living within 100 meters of a foreclosed property is associated with an increase in body mass index (BMI) and odds of being overweight (Arcaya et al., 2013) and having higher systolic blood pressure (Arcaya et al., 2014). Living in a census tract with a high estimated foreclosure risk score is associated with lower self-rated health among breast cancer survivors in Missouri (Schootman, Deshpande, Pruitt, & Jeffe, 2012). Two papers report null effects for weight gain and glycemic index for a diabetic sample (Downing et al., 2016; Downing et al., 2017a).

The precise mechanisms underlying these findings are not clear. Currie and Tekin (2015) rule out potential causes of these effects that relate to economics and health care and hypothesize that some of these effects may be directly driven by the stress of foreclosures. Schootman and colleagues (2012) explain some of the association between foreclosures and self-rated health through income, physical activity, and perceived neighborhood characteristics. Cagney and colleagues (2014) show that local poverty rates and physical decline do not explain the relationship between community foreclosures and mental health.

This relationship may also work in the opposite direction. Poor health, particularly chronic health conditions, may influence foreclosure risk (Houle & Keene, 2015; Pollack & Lynch, 2009), especially if the illness comes with medical debt or individuals lack health insurance or are of lower income (Cutshaw, Woolhandler, Himmelstein, & Robertson, 2016; Himmelstein, Thorne, Warren, & Woolhandler, 2009; Houle & Keene, 2015).While reverse causation may be an issue when considering individual-level foreclosure risk, this is less of a concern for examining how neighborhood or community-level foreclosures influence health and mental health over time.

Current Study

No study has examined the relationship between community foreclosures and cognitive health, even though many of the health outcomes described above—BMI, hypertension, and mental health—are associated with cognition. In Figure 1, we outline the proposed theoretical mechanisms that could link community foreclosures to cognitive health. Foreclosures can set many factors into motion, including changes to the community, declines in wealth, and loss of community social ties. We hypothesize that these factors could either directly or indirectly influence cognition. For

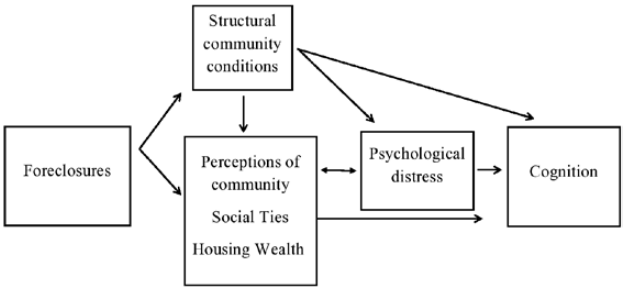

Figure 1. Theoretical model of a process by which community foreclosures increase cognitive decline in older adults.

instance, neighborhood factors, such as institutional and physical resources, neighborhood deprivation, neighborhood physical disorder, and neighborhood social cohesion have been directly associated with cognition in other work (Clarke, Weuve, Barnes, Evans, & Mendes de Leon, 2015; Lang et al., 2008; Zaheed et al., 2019). Loss of social ties, social isolation, and social vulnerability are also directly linked with cognitive decline (Armstrong et al., 2015; Andrew & Rockwood, 2010; Rafnsson, Orrell, d'Orsi, Hogervorst, & Steptoe, 2020; Shankar, Hamer, McMunn, & Steptoe, 2013). Alternatively, these factors may influence cognitive health indirectly through increased psychological distress, a known precursor to cognitive decline (Chodosh, Kado, Seeman, & Karlamangla, 2007; Goveas et al., 2014) or by increasing stress, which has also been associated with cognitive decline and dementia in other work (for a review see Gulpers et al., 2016).

We use 5 years of national data from the Health and Retirement Study (HRS) during the height of the foreclosure crisis (2006–2010) merged to lagged data on county-level foreclosures (2005–2009) to examine the relationship between foreclosures and cognition and potential underlying mechanisms. We focus on this time period because this is at the height of the housing crisis in the United States, and a time when we can capture variation in community foreclosures by county.

Although our theoretical framework suggests that the cognitive effects of foreclosures could be further downstream, and it may take some time to see the effects of foreclosures on cognitive health than on mental health, other work already shows an immediate effect of foreclosures on health during a similar time period (Currie & Tekin, 2015). There is also evidence that the impact of stress on cognition can occur in a relatively short timeframe. Perceived stress in a community sample was associated with cognitive decline among older adults in a 6- to 7-year period (Aggarwal et al., 2014). Another study using an experimental design showed an association between level of global perceived stress and cognitive slowing over a 2-year period (Munoz, Sliwinski, Scott, & Hofer, 2015). Loss of social ties, social isolation and social vulnerability, some of our proposed mechanisms, have also been linked with cognitive decline over relatively short follow-up periods ranging from 3 to 6 years (Armstrong et al., 2015; Andrew & Rockwood, 2010; Rafnsson et al., 2020; Shankar et al., 2013). Finally, older adults living in economically disadvantaged neighborhoods, where psychosocial stressors are more common, experienced significantly faster rates of cognitive decline than those in more advantaged neighborhoods over a 5-year period (Sheffield & Peek, 2009). This article similarly looks at the near-term effects of foreclosures on cognition during the peak years of the housing crisis.

Specifically, we examine the following research questions:

(1) Is the percentage of foreclosures in a county associated with cognition and cognitive decline in middle-aged and older adult residents within that county?
(2) Which community and individual factors, if any, explain the relationship between foreclosures and individual-level cognition?

Method

Data

Data came from three sources: individual data on respondents from the 2006–2010 waves of the HRS, county-level data on foreclosure from the 2005–2009 RealtyTrac data, and county-level data on the community context from the American Community Survey (ACS). The HRS is a multi-cohort longitudinal biennial survey of a nationally representative sample of older community-dwelling adults ages 51 and over and their spouses. The HRS study was first launched in 1992 and data have been collected biennially since 1998. New cohorts are added periodically to keep the population representative of adults ages 51 and over. The HRS is one of the few datasets available with longitudinal cognitive histories that allow us to track cognitive change over time and includes extensive information on psychosocial factors. This combination of information allows us to examine the association between foreclosures on cognitive status and decline as well as the potential social, economic, and contextual factors that might explain this relationship. Addresses were geocoded to 2000 census tract boundary definitions and made available in the restricted use HRS Cross-wave file. In addition to the aforementioned reasons, another reason why we focused only on the 2006–2010 HRS is because the ACS community measures used in this analysis (see below) have only been constructed and validated through 2010 (Weden, Peterson, Miles, & Shih, 2015). This captures the height of the foreclosures crisis and a time when we would expect to have the largest population of people exposed to high foreclosure rates. While there might be lasting or even delayed effects of the foreclosures crisis on cognition, the first step is to examine whether there are any immediate impacts during this period of high foreclosure rates.

We began with 24,502 eligible respondents for the 2006–2010 HRS. We dropped 97 respondents missing census

tract information who, therefore, could not be matched to the county data. An additional 1,223 respondents were dropped due to incomplete cognition data and another 2,479 respondents were missing other model covariates (this includes missing lagged covariates). We also dropped 496 respondents who were living in a nursing home because these individuals may not experience foreclosure rates in the same way as community-dwelling older adults. Finally, we censored observations after a respondent moved, and this resulted in 137 respondents being dropped because they moved in the first year of the study period. Thus, our final analytic sample included 20,070 HRS respondents aged 51 and older, for a total of 40,163 person-waves.

Measures

Cognitive function

Our key dependent variable is cognitive status and decline over time. The HRS assessed cognitive function at each wave with the modified Telephone Interview for Cognitive Status (TICS), a multidimensional measure of cognitive function (Brandt et al., 1988), modeled after the Mini-Mental State Exam (Folstein, Folstein, & McHugh, 1975) as described elsewhere (Herzog & Wallace, 1997; Welsh, Breitner, & Magruder-Habib, 1993). In sum, respondents were asked a series of questions that include assessments of word recall, working memory, episodic memory, mental processing, vocabulary, and general orientation. Cognitive function is the sum of the component scores and ranges from 0 to 27.

Foreclosures

The primary explanatory factor is county-level foreclosures. Annual data on foreclosures beginning in 2005 were obtained from RealtyTrac for another study. These data have been used elsewhere in a similar manner (Cagney et al., 2014; Houle, 2014; Houle & Light, 2014, 2017). The foreclosure process is a multistage process that varies across states but generally starts with a notice of default (NOD), where homeowners are notified that their payments are delinquent. If the lender is unable to sell the property for the remaining value of the loan at auction, the property is repossessed and becomes real estate-owned (REO). We construct county-level measures of the foreclosure rate for both NOD and REO stages, where the denominator is the number of households in a county and the numerator is the number of households with a NOD or REO designation, respectively. We lag county-level foreclosures by 1 year in order to capture foreclosures prior to the wave in which cognition was assessed. We hypothesize that REO would have a stronger relationship to cognition in the community than would NOD because the NOD stage may not be publicly known to others whereas at the REO stage homes are often left vacant and communities may be visibly changed leading to more physical disorder and there may even be physical postings announcing the home foreclosure. Other work has already found stronger associations for REO than an overall measure of foreclosures for mental health (Houle, 2014) and this distinction has been argued to explain why one study on this topic finds null findings (see commentary by Arcaya 2017), and response by Downey et al.(2017b).

Mechanisms

We examine several potential mediating factors that could explain the relationship between county-level foreclosures and cognitive health; all are measured at the time period immediately prior to the measure of cognition (either 1 year or 2 years prior, depending on what is available in the data). For these analyses, change scores are also included in the models for all structural community measures from the ACS and for HRS measures with sufficient sample sizes (exceptions are those drawn from the "leave-behind questionnaires" and discussed below). *Individual Factors*. Both housing wealth and mental health are measured at the individual level. To capture mental health status, we use a measure of depressive symptoms using the Center for Epidemiologic Studies Depression (CESD) scale. The CESD score is provided in the HRS data and is based on questions asking whether the respondent experienced the following sentiments all or most of the time: depression, everything is an effort, sleep is restless, felt alone, felt sad, and could not get going. Because it is not clear whether raw levels of wealth or depressive symptoms would be related to cognition or if this is a function of change in these measures over this stressful time period, we include both raw scores as well as change scores (capturing change from the prior wave). *Housing Wealth*. Housing wealth is the self-reported value of the respondents' primary residence in dollars (continuous). *Social Ties*. The social ties measures come from the Psychosocial and Lifestyle Questionnaire in the HRS. This questionnaire was introduced in 2006 and was restricted to a 50% random sample each year with the same sample of respondents re-interviewed in alternate waves. Respondents are asked how often they meet up with a variety of family and friends on a 6-point scale ranging from three times a week or more to every few months. We include the number of visits from social ties for each of three relationships: children, friends, and family. Our measures capture the absence of ties; scores of 1–4 (meeting three times a week to every few months) are coded 0 and 5–6 (meeting once or twice a year or fewer times) are coded 1. In sensitivity analyses, we broke this measure down a few different ways, but results were similar, so we report the results of dichotomized measures here. As this measure is only available every 4 years and for a more limited sample, we cannot include change scores in these models and models including these measures have smaller sample sizes. *Community Structural Factors*. Several community structural factors capturing the social and physical environment could be possible mediators as well. We examine three here: The percent of the total population that

is age 65 and older; the percent of housing occupied by the owner; and the percent of housing units that are vacant. All are constructed from the ACS at the county level and interpolated using methods described previously (Weden et al., 2015). Models include both raw scores as well as change scores (capturing change between the last 2 years). *Perceived Community-level Social Cohesion and Physical Disorder.* Perceptions of community social cohesion and physical disorder came from eight items that were part of the Psychosocial and Lifestyle Questionnaire in the HRS. Respondents rated their perceptions of the extent of perceived community physical disorder on four items, which includes safety (i.e., vandalism/graffiti, cleanliness/garbage, vacant/deserted houses, and perceived safety walking alone at night). Social cohesion is an index based on four items (i.e., feeling part of the area, trusting people, friendliness of people, and the availability of help if in trouble). Both social cohesion and physical disorder measures use a reference area of a 20-min walk or 1 mile from one's home. Scores range from 1 to 4, with higher scores indicating more physical disorder/more social cohesion. Similar to the social ties measure, these measures are only available for half the sample in each wave resulting in smaller sample sizes for these analyses.

Other covariates

Other covariates measured at the individual or household level are captured in the wave concurrent to cognition and include birth cohort, age, gender, race/ethnicity, marital status, and individual socioeconomic status (i.e., wealth and education). Birth cohort indicates which of the six HRS cohorts individuals fell into based on year of birth. Age is time-varying and includes both a continuous and a quadratic term. Race/ethnicity is a time-invariant indicator categorized as non-Hispanic white, non-Hispanic black, and Hispanic/Other. Marital status is time-varying and includes three categories to capture (a) married/partnered, (b) divorced/separated/never married, (c) or widowed. Wealth is time-varying and captures total net assets of the household, excluding housing wealth (we include housing wealth as a separate mediator in several models). It is parameterized as a categorical measure due to both the skewness of the wealth distribution and to account for negative wealth. The first category captures negative wealth and the other four approximate quartiles, specifically: (a) negative wealth, (b) $0 to $49,999, (c) $50,000 to $149,999, (d) $150,000 to $399,999; and (e) $400,000 or greater. Highest attained education is time-invariant, coded in years, and centered at a value of 12 indicating high school attainment. We also included controls for whether a respondent owns a home (which may make him or her more sensitive to the foreclosure crisis). Finally, to adjust for the economic structure of communities prior to the foreclosure assessment, we also control for the percent of households in a county with income <100% of the poverty line, and the percent of the working-age population within a county who are unemployed. Both are captured 2 years prior to cognition to adjust for the community economic situation prior to the period when foreclosures are measured.

Method

Multilevel linear regression growth models were used to examine the relationship between two stages of county-level foreclosures: NOD and REO and trajectories of cognitive function. We lag county-level foreclosures by 1 year in order to capture foreclosures in the year prior to the wave in which cognition was assessed. Because we have up to three observations per person and individuals are clustered within census tracts, we employed three-level growth curve models. This included person-level random intercepts and linear age slopes to account for repeated measures within individuals and county-level random intercepts to account for individuals within county. Models also included state-level fixed effects to account for within-state differences in the foreclosures process. We considered but did not include year fixed effects because our models already include birth cohort, age, and age-squared, and we did not feel we had the power to include both year and age-fixed effects in the models. In addition, we chose to focus on age-fixed effects because in our preliminary investigations of model fit, we compared models with different random and fixed effects and the model with age was a better fitting model than that with time. This approach is consistent with other work on the topic, which includes fixed effects for geographic areas but not time trends (e.g., Houle 2014). Models controlled for: age centered at 70; birth cohort; sex; race-ethnicity; marital status; education in years; wealth; home ownership, % households with income <100% of Poverty line; and % population 16+ unemployed. Models were weighted using time-invariant HRS sampling weights from the year respondents entered the analytic sample. Age was the time scale for the models and followed a quadratic structural form consistent with other work modeling this outcome (Friedman, Shih, Slaughter, Weden, & Cagney, 2017; Kovalchik, Slaughter, Miles, Friedman, & Shih, 2015). To account for change over time, models included interactions between foreclosure rates and age and age-squared.

To plot the trajectory over time, we calculated the average adjusted predictions (AAPs) (Williams, 2012). For a given level of community foreclosures and age, the AAP is the average of predicted cognitive scores based on the multivariate model using specified values of community foreclosure and age and observed covariate values for all other variables in the model. This prediction represents the expected cognitive status if all individuals in the sample are from the community with a particular level of foreclosures at a specified age while holding all other variables at their actual values. Growth curves, or trajectories of the AAPs, were obtained using the mean community foreclosure rate across all survey years, and also for +2 and −2 *SD*s from the mean community foreclosure rate.

Results

Descriptive Statistics

Table 1 shows descriptive statistics for the year of entry into the analytic sample, which is generally 2006, although some respondents enter the study for the first time in a later wave. The average age of the full sample is 63. Approximately 76% of the sample is non-Hispanic white; the mean years of education is 13 years (a little more than a high school degree), and 18% have negative wealth (i.e., debt). The average cognitive function score is 15.8 on a scale of 0–27. In terms of the county-level structural characteristics, on average, 13% of a county is 65 or older, though there is a broad range (range: 4.5–45.2). About 60% of housing is owner-occupied (range: 18.6–86.4), and about 11% of housing units are vacant in an average county (range: 3.5–64.4). Average perceived neighborhood social cohesion and physical disorder/safety were 5.6 (range: 1–7) and 2.3 (range: 1–7), respectively. Less than 9% of respondents reported only infrequent contact with friends (i.e., meeting twice a year or less), about 14% reported infrequent contact with children, and a third of respondents reported infrequent contact with other family members. The 1-year lagged mean REO and NOD foreclosures are 0.31% and 0.24%, respectively.

Table 1. Descriptive Characteristics in Year of Entry into Analytic Sample, Health and Retirement Study 2006–2010 (Number of Unique Individuals = 20,070; Biennial Person Years = 40,163)

	Mean (*SD*) or Percent
% REO (mean, *SD*)	0.31 (0.5)
% NOD (mean, *SD*)	0.24 (0.7)
Cognitive function score (mean, *SD*)	15.8 (4.4)
Age in years (mean, *SD*)	63.2 (10.2)
% Female	53.1
Education in years (mean, *SD*)	13.1 (3.0)
Race-ethnicity (%)	
Non-Hispanic white	76.3
Non-Hispanic black	11.7
Hispanic/other	12.0
Marital status (%)	
Married/partners	65.9
Divorced/separated/never married	20.6
Widowed	13.5
Total wealth in quintiles (%)	
Negative wealth	18.3
$0 to <$50,000	19.7
$50,000 to <$150,000	20.3
$150,000 to <$400,000	21.2
$400,000+	20.6
Home ownership (%)	79.0
% with income <100% of poverty line	13.0 (0.04)
% population 16+ unemployed	10.8 (0.02)
Community structural conditions	
% age 65 and older	13.1 (3.6)
% owner occupied housing	61.31 (8.01)
% of vacant housing	10.61 (5.51)
Individual mediators	
Housing wealth	$188,903 ($344,196)
Depressive symptoms	1.42 (1.95)
Social mediators	
Infrequent contact with children	13.8
Infrequent contact with friends	8.9
Infrequent contact with family	32.6
Perceptions of community	
Perceived cohesion	5.6 (1.2)
Perceived physical disorder	2.3 (1.2)

Note: *SD* = standard deviation; NOD = notice of default; REO = real estate-owned. Weighted using HRS survey weights.

Table 2 digs deeper into the percent of county-level foreclosures and how it changes over time for our analytic sample. In this table, we show survey-weighted means and standard deviations for REO and NOD county-level foreclosures measures in each year from 2005 to 2009, shown as a percentage of households for ease of interpretability. For both NOD and REO, there was an increase in percent county foreclosures over this period. But the patterns differed for the two types of foreclosures. For REO foreclosures, we see a gradual increase from 2005 to 2007, a jump between 2007 and 2008 (from 0.34% to 0.67%), and then another smaller increase in 2009 to 0.70%. For NOD foreclosures, we do not see the same jump between 2007 and 2008, and the increases from 2007 on are relatively small and gradual. Other measures of county-level context from the ACS show even less dramatic changes over time than do foreclosures. For instance, percent of counties with occupied housing is 60.3% in 2005 and declined slightly over this period to 58.7% by 2009, and the percent of vacant housing units in the county for this sample is 10.7% in 2005 and goes up to 11.5% in 2009 (not shown).

Is Community Rate of Foreclosures Related to Cognitive Status and Decline?

Table 3 shows the results of models for two stages of foreclosures, REO (Model 1) and NOD (Model 2). Both models are weighted using survey weights and include state fixed effects and all sociodemographic and community contextual control variables (i.e., poverty, unemployment). In the first model, we see that the rate of REO foreclosures at age 70 (age is centered 70) is associated with 7 fewer points on the TICS. However, this is not statistically significant. Where we do see significant results is in the rate of change at age 70—that is, the interaction between the REO stage of foreclosures with age. This suggests that as individuals age, the greater the rate of REO foreclosures in their county, the faster their decline in cognition. As hypothesized, we see a much smaller relationship between the NOD stage of foreclosures and cognition, as shown in Model 2. The coefficient for the association between NOD foreclosures and

Table 2. Mean County-level Foreclosures, Health and Retirement Study 2005–2009 (Number of Unique Individuals = 20,070; Biennial Person Years = 40,163)

	2005	2006	2007	2008	2009
REO (%)	0.17 (0.25)	0.23 (0.39)	0.34 (0.45)	0.67 (0.79)	0.70 (0.68)
NOD (%)	0.16 (0.23)	0.23 (0.42)	0.40 (0.93)	0.44 (1.1)	0.45 (1.3)

Note: NOD = notice of default; REO = real estate-owned. Standard deviations in parenthesis. Weighted using HRS survey weights.

Table 3. Coefficients and Standard Errors Associated With Cognitive Function, Growth Curve Models, Health and Retirement Study 2006–2010 (Number of Unique Individuals = 20,070; Biennial Person Years = 40,163)

		Model 1		Model 2	
		β	SE	β	SE
Foreclosure rate (proportion)					
	REO	−6.987	6.237		
	NOD			−3.187	3.718
Indicator for foreclosure rate = zero		NA	NA	0.0529	0.0527
Age		−0.174***	0.010	−0.180***	0.009
Age-squared		−0.003***	0.0004	−0.003***	0.0004
Foreclosures * Age70		−1.522***	0.378	−0.160	0.194
Foreclosures* Age70 Squared		−0.033	0.045	−0.002	0.021
Race/ethnicity (%)	Non-Hispanic white	Reference		Reference	
	Non-Hispanic black	−2.133***	(0.086)	−2.137***	(0.086)
	Hispanic/other	−1.032***	(0.116)	−1.033***	(0.115)
Gender (%)	Female	0.828***	(0.057)	0.828***	(0.057)
Education in years (mean, *SD*)		0.454***	(0.015)	0.453***	(0.015)
Marital Status	Married/partnered	Reference		Reference	
	Divorced/separated/never married	−0.199*	(0.080)	−0.203*	(0.079)
	Widowed	0.0967	(0.077)	0.0941	(0.077)
Total wealth in quintiles (%)	Negative wealth	Reference		Reference	
	$0 to <$50,000	−0.696***	(0.104)	−0.690***	(0.105)
	$50,000 to <$150,000	−0.221**	(0.077)	−0.219**	(0.077)
	$150,000 to < $400,000	0.239***	(0.063)	0.236***	(0.063)
	$400,000+	0.458***	(0.075)	0.455***	(0.076)
Home ownership	Owns home	0.364***	(0.091)	0.363***	(0.091)
Community controls	% with income <100% of poverty line	−0.029***	(0.008)	−0.027***	(0.008)
	% 16+ unemployed	−0.021	(0.016)	−0.025	(0.015)

Note: NOD = notice of default; REO = real estate-owned. Weighted using HRS Survey weights. Age and age-squared are centered at 70. Models also include birth cohort in categories and state fixed effects.
*$p < .05$, **$p < .01$, ***$p < .001$.

cognitive status is about half that of REO foreclosures and is not significant. We also do not see a significant relationship between NOD foreclosures and cognition over time.

Because the tables only show findings for growth curve models at one point in time, it is helpful to view a figure of the full growth curves over the entire age range of the study. We show these results in Figure 2 (for REO) and Figure 3 (for NOD). Figure 2 displays the predicted growth curves for the mean proportion of county-level foreclosures as well as for two standard deviations above and below the mean to capture communities that are worst and best off in terms of the rate of foreclosures. As Figure 2 shows, for the REO stage of foreclosures, there is very little difference between individuals living in communities at the average, high, and low end of foreclosures on cognition until around age 70 when a divergence begins in the rate of cognitive decline. This difference in slope results in a divergence in the level of cognition for individuals in communities with high when compared with low rate of foreclosures. We do not see this difference between the three groups in Figure 3, for the NOD stage of foreclosures.

What Explains This Relationship?

To better understand the relationship between the REO stage of foreclosures and cognition, we reran the model depicted in Table 3 Model 1 but with additional covariates capturing four sets of potential mediators: community structural

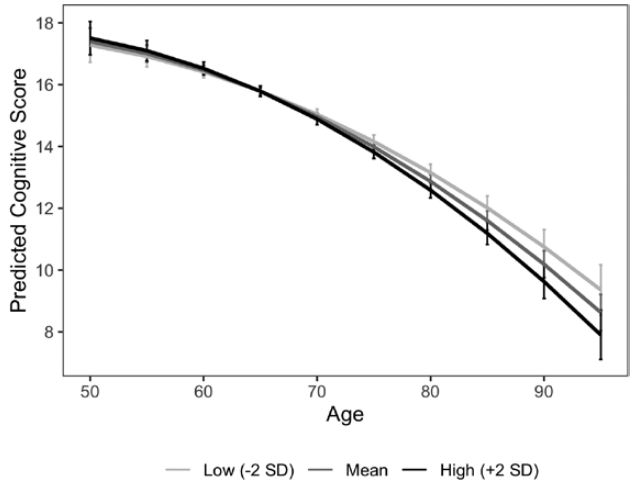

Figure 2. Predicted cognitive trajectories by age for communities with high, low, and mean percent real estate-owned (REO) foreclosures.

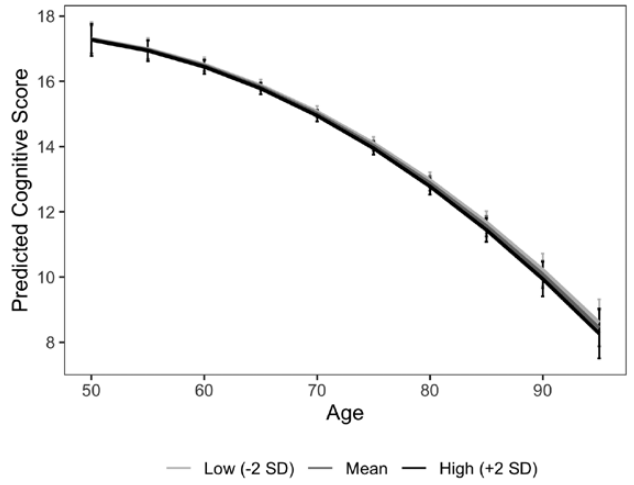

Figure 3. Predicted cognitive trajectories by age for communities with high, low, and mean percent notice of default (NOD) foreclosures.

characteristics; perceived community characteristics; social ties; and other individual characteristics (i.e., housing wealth and depressive symptoms). Figures depicting the results for each set of mechanisms are provided in the Supplementary Figures S1–S4. To sum, none of the mechanisms examined here do very much to reduce the association between REO and cognition. The inclusion of depressive symptoms (Supplementary Figure S4) shows a slightly stronger relationship to cognitive health, but it is still small. The coefficient for the interaction term between REO and AGE is reduced from 1.20 to 1.15 once depressive symptoms are added to the model (not shown). This is the strongest mediator we found, but the change is small, at approximately 4%.

Discussion

This is the first study to examine the relationship between the rate of county-level foreclosures and cognition of middle-aged and older adults during a period in U.S. history with an unprecedented number of foreclosures. We hypothesized that community foreclosures set off a spiral of events that lead to changes in the local physical disorder and social cohesion that ultimately resulted in poorer mental and cognitive health. Consistent with other work on the spillover of community foreclosures on individual physical health (Arcaya et al., 2013, 2014; Currie & Tekin, 2015; Schootman et al., 2012), we found that simply living in the same county as foreclosed homes have significant consequences for cognitive health, in particular cognitive decline. Higher rates of county-level REO foreclosures are associated with a faster decline in individual cognition over time. To put this in context, when we compare the magnitude of the relationship between foreclosure and TICS to that of the decline associated with age, we can interpret the association between foreclosures and cognition in terms of the implied additional years of cognitive aging. At age 70, a 4% increase in the foreclosure rate (i.e., going from 0% to 4% foreclosures), was associated with about a 0.35 decline in TICS cognition score. This is similar in magnitude to about 1 year of cognitive aging.

We do not see this same relationship for the NOD stage of the foreclosures process. This may be because the REO rate is a more overt measure of the housing crisis, is more likely to be associated with community decline, and is also the point at which local community members are able to perceive the change in their environment. While we attempt to adjust for many of the perceptions that could "kick in" at the REO stage and explain the difference between REO and NOD foreclosures, we are unable to explain the relationship with the measures examined here.

For instance, when we attempted to unpack the contextual factors through which foreclosures result in cognitive decline, we did not find evidence that the association between foreclosures and cognition were explained by either objective structural contextual characteristics or perceived characteristics. We looked at the main effects for these measures as well as change over time (when sample sizes allowed), but very little of the relationship between foreclosures and cognition was explained by any or a combination of these factors. We also examined individual-level factors including social ties, housing wealth, and depressive symptoms that could point to other mechanisms linking foreclosures to cognitive decline. Individual depressive symptoms were the strongest mediator of those examined here, but even this factor only reduced the relationship between REO foreclosures and cognition by a small margin.

The HRS data have many strengths for this analysis. They are ideal for capturing validated measures of cognition for a national sample of the U.S. population during the height of the housing crisis; however, the measures on perceived community characteristics and social ties were obtained from leave-behind questionnaires made available to only a half of the sample each wave, which meant that

information was only available for a smaller sample of respondents. We also did not find any significant findings for our more objective contextual measures from the ACS (i.e., age structure, % rent/own, and % vacant housing), which suggests that foreclosures are not acting through home vacancies or community decline. This is consistent with other work suggesting that the impact of foreclosure on communities is independent of disorder (Wallace, Hedberg, & Katz, 2012) and with other studies on the relationship between foreclosures and health that do not find a mediating effect of perceived or objective measures of disorder (Cagney et al., 2014; Schootman et al., 2012). We did find some (small) changes upon inclusion of depressive symptoms in these models, which may suggest that other aspects of mental health and well-being could be promising avenues for future research. The models examining these mechanisms make several assumptions. Because we did not include interactions between neighborhood factors and foreclosures, in essence, we assume that foreclosures do not interact with community contextual factors. This framework also assumes that self-reported perceptions of community factors are sufficient for capturing mediating effects, which they may not be if people have a poor sense of their community context. In addition, these models also assume that observed community characteristics are sufficient to adjust for potential confounding, but there could be unobserved factors or other mechanisms not available in the data that explain the relationship between foreclosures and cognition. Finally, although we examine change scores for the mechanisms to capture change over time in these factors, we do not interact these factors with age, which may limit the ability of these models to explain the change in the association between foreclosures and cognition that is occurring over time. One or more of these assumptions could explain the lack of significant findings for the mechanisms examined here.

Consistent with other work on this topic (Houle, 2014), we used county to capture the local community. Yet, there are many levels at which one could investigate the spillover of community foreclosures for health and the geographic boundary examined in this literature varies from foreclosures within 100 meters to those at the state-level (Downing, 2016). In preliminary analyses, we found consistent but weaker associations when examining foreclosures at the ZIP code level. The weaker results may be because we had ZIP code level data for foreclosures but matched this to census tract data in the ACS and the HRS, which may have produced a less than accurate match. Another explanation is that when it comes to the impact of foreclosures on cognitive health, people may perceive or experience their environment at the county level, which provides resources, dictates school district boundaries, and sets real estate values more so than the ZIP code level. More work is needed to better understand the geographic boundaries of communities for different aspects of life. For older adults, in particular, residential locations may not capture the full extent of the communities to which they are exposed (Cagney et al., 2013; Coulton, Korbin, Chan, & Su, 2001). Finally, in the tradition of neighborhood research, we treated county-level foreclosures as a macro factor separate from the individual foreclosure experience. The HRS has additional information on individual foreclosures experiences, but the small sample sizes—only 64 respondents reported experiencing a home foreclosure—made it impossible to analyze.

While we hypothesize that foreclosures are associated with changes in cognition, it is also possible that declines in cognition could lead to foreclosures. Other work already suggests that the effect of foreclosures on health works both ways, with high rates of foreclosure leading to poor health and poor health increasing risk of home foreclosure (Cutshaw et al., 2016; Himmelstein et al., 2009; Houle & Keene, 2015). To minimize this risk, we use lagged data to look at foreclosures the year before cognition is reported. In addition, this is of somewhat less concern for analyses of community-level foreclosures than those investigating individual-level foreclosures. Finally, by examining change over time (slopes) in addition to intercepts, we are also somewhat minimizing the risk of reverse causation.

The cognitive effects of foreclosures could be downstream effects stemming from other adverse effects on mental or physical health caused by exposure to foreclosures. If this is the case, our study is likely to provide conservative estimates of the effect of foreclosures on cognition. Relatedly, the implications of community foreclosures for cognition could be more severe and lasting than with other health outcomes because once decline begins, it is unlikely to recover and may require extra efforts to prevent further decline. Policies could consider the level of foreclosures in a community, serve to keep up property conditions, and provide supports for reducing physical disorder associated with vacant properties, although further work is needed to know which of these characteristics of communities is most closely linked to cognition. To the extent that local foreclosures result in worsened individual mental health, greater access to mental health services could be provided to those areas hardest hit by the housing crisis to potentially stave off steeper cognitive declines. Our study suggests that public policies targeting communities hardest hit by the housing crisis may be one possible avenue for improving population-level cognitive health in middle and late life and help older adults maintain the levels of cognition needed to age in place, but more work is still needed to identify the precise mechanisms linking community foreclosures to cognitive health.

Supplementary Material

Supplementary data are available at *The Journals of Gerontology, Series B: Psychological Sciences and Social Sciences* online.

Funding

This work was supported by the National Institute on Aging (NIA) at the National Institutes of Health (R01 AG043960 to R. Shih). The Health and Retirement Study is funded by the NIA (U01 AG009740) and housed at the Institute for Social Research, University of Michigan.

Author Contributions

E.M. Friedman planned the study, supervised the data analysis, and wrote the article. M. E. Slaughter performed all statistical analyses. K. Cagney, J. Houle, and R. Shih helped to plan the study, reviewed model output, and reviewed the manuscript.

Conflict of Interest

None reported.

References

Aggarwal, N. T., Wilson, R. S., Beck, T. L., Rajan, K. B., De Leon, C. F. M., Evans, D. A., & Everson-Rose, S. A. (2014). Perceived stress and change in cognitive function among adults aged 65 and older. *Psychosomatic Medicine*, **76**, 80. doi:10.1097/PSY.0000000000000016

Andrew, M. K., & Rockwood, K. (2010). Social vulnerability predicts cognitive decline in a prospective cohort of older Canadians. *Alzheimer's & Dementia*, **6**, 319–325. e311. doi:10.1016/j.jalz.2009.11.001

Arcaya, M. C. (2017). Invited commentary: Foreclosures and health in a neighborhood context. *American Journal of Epidemiology*, **1**, 436–439. doi:10.1093/aje/kww169

Arcaya, M., Glymour, M., Chakrabarti, P., Christakis, N. A., Kawachi, I., & Subramanian, S. V. (2013). Effects of proximate foreclosed properties on individuals' weight gain in Massachusetts, 1987–2008. *American Journal of Public Health*, **103**, e50–e56. doi:10.2105/AJPH.2013.301460

Arcaya, M., Glymour, M., Chakrabarti, P., Christakis, N. A., Kawachi, I., & Subramanian, S. V. (2014). Effects of proximate foreclosed properties on individuals' systolic blood pressure in Massachusetts, 1987 to 2008. *Circulation*, **129**, 2262–2268. doi:10.1161/CIRCULATIONAHA.113.006205

Armstrong, J. J., Mitnitski, A., Andrew, M. K., Launer, L. J., White, L. R., & Rockwood, K. (2015). Cumulative impact of health deficits, social vulnerabilities, and protective factors on cognitive dynamics in late life: A multistate modeling approach. *Alzheimer's Research & Therapy*, **7**, 38. doi:10.1186/s13195-015-0120-7

Brandt, J., Spencer, M., & Folstein, M. (1988). The telephone interview for cognitive status. *Cognitive and Behavioral Neurology*, **1**, 111–118.

Cagney, K. A., Browning, C. R., Iveniuk, J., & English, N. (2014). The onset of depression during the great recession: Foreclosure and older adult mental health. *American Journal of Public Health*, **104**(3), 498–505. doi:10.2105/AJPH.2013.301566

Cagney, K. A., Browning, C. R., Jackson, A. L., & Soller, B. (2013). Networks, neighborhoods, and institutions: An integrated "activity space" approach for research on aging. In *New directions in sociology of aging*. Washington, DC: National Academies Press.

Chodosh, J., Kado, D. M., Seeman, T. E., & Karlamangla, A. S. (2007). Depressive symptoms as a predictor of cognitive decline: MacArthur Studies of Successful Aging. *The American Journal of Geriatric Psychiatry*, **15**, 406–415. doi:10.1097/01.JGP.0b013e31802c0c63

Clarke, P. J., Weuve, J., Barnes, L., Evans, D. A., & Mendes de Leon, C. F. (2015). Cognitive decline and the neighborhood environment. *Annals of Epidemiology*, **25**, 849–854. doi:10.1016/j.annepidem.2015.07.001

Cohen, D. A., Mason, K., Bedimo, A., Scribner, R., Basolo, V., & Farley, T. A. (2003). Neighborhood physical conditions and health. *American Journal of Public Health*, **93**, 467–471. doi:10.2105/AJPH.93.3.467

Coulton, C. J., Korbin, J., Chan, T., & Su, M. (2001). Mapping residents' perceptions of neighborhood boundaries: A methodological note. *American Journal of Community Psychology*, **29**, 371–383.doi:10.1023/A:1010303419034

Currie, J., & Tekin, E. (2015). Is there a link between foreclosure and health? *American Economic Journal: Economic Policy*, **7**, 63–94. doi:10.1257/pol.20120325

Cutshaw, C. A., Woolhandler, S., Himmelstein, D. U., & Robertson, C. (2016). Medical causes and consequences of home foreclosures. *International Journal of Health Services*, **46**, 36–47. doi:10.1177/0020731415614249

Downing, J. (2016). The health effects of the foreclosure crisis and unaffordable housing: A systematic review and explanation of evidence. *Social Science & Medicine*, **162**, 88–96. doi:10.1016/j.socscimed.2016.06.014

Downing, J., Karter, A., Rodriguez, H., Dow, W. H., Adler, N., Schillinger, D.,…Laraia, B. (2016). No Spillover effect of the foreclosure crisis on weight change: The Diabetes Study of Northern California (DISTANCE). *PloS One*, **11**, e0151334. doi:10.1371/journal.pone.0151334

Downing, J., Laraia, B., Rodriguez, H., Dow, W. H., Adler, N., Schillinger, D.,…Karter, A. J. (2017a). Beyond the great recession: Was the foreclosure crisis harmful to the health of individuals with diabetes? *American Journal of Epidemiology*, **1**, 429–435. doi:10.1093/aje/kww171

Downing, J., Laraia, B., Rodriguez, H., Dow, W. H., Adler, N., Schillinger, D.,…Karter, A. J. (2017b). Downing *et al.* respond to "Foreclosures and Health in a Neighborhood Context." *American Journal of Epidemiology*, **185**, 440–441. doi:10.1093/aje/kww170

Folstein, M. F., Folstein, S. E., & McHugh, P. R. (1975). "Mini-mental state": A practical method for grading the cognitive state of patients for the clinician. *Journal of Psychiatric Research*, **12**, 189–198. doi:10.1016/0022-3956(75)90026-6

Friedman, E. M., Shih, R. A., Slaughter, M. E., Weden, M. M., & Cagney, K. A. (2017). Neighborhood age structure and cognitive function in a nationally-representative sample of older adults in the US. *Social Science & Medicine*, **174**, 149–158. doi:10.1016/j.socscimed.2016.12.005

Goveas, J. S., Espeland, M. A., Hogan, P. E., Tindle, H. A., Shih, R. A., Kotchen, J. M.,…Resnick, S. M. (2014). Depressive symptoms and longitudinal changes in cognition: Women's health initiative study of cognitive aging. *Journal of Geriatric Psychiatry and Neurology*, **27**, 94–102. doi:10.1177/0891988714522697

Gulpers, B., Ramakers, I., Hamel, R., Köhler, S., Voshaar, R. O., & Verhey, F. (2016). Anxiety as a predictor for cognitive decline and dementia: A systematic review and meta-analysis. *The American Journal of Geriatric Psychiatry*, **24**, 823–842. doi:10.1016/j.jagp.2016.05.015

Herzog, A. R., & Wallace, R. B. (1997). Measures of cognitive functioning in the AHEAD Study. *The Journals of Gerontology. Series B, Psychological Sciences and Social Sciences*, **52**(Spec No), 37–48. doi:10.1093/geronb/52b.special_issue.37

Himmelstein, D. U., Thorne, D., Warren, E., & Woolhandler, S. (2009). Medical bankruptcy in the United States, 2007: Results of a national study. *The American Journal of Medicine*, **122**, 741–746. doi:10.1016/j.amjmed.2009.04.012

Houle, J. N. (2014). Mental health in the foreclosure crisis. *Social Science & Medicine*, **118**, 1–8. doi:10.1016/j.socscimed.2014.07.054

Houle, J. N., & Keene, D. E. (2015). Getting sick and falling behind: Health and the risk of mortgage default and home foreclosure. *J Epidemiol Community Health*, **69**, 382–387. doi:10.1136/jech-2014–204637

Houle, J. N., & Light, M. T. (2014). The home foreclosure crisis and rising suicide rates, 2005 to 2010. *American Journal of Public Health*, **104**, 1073–1079. doi:10.2105/AJPH.2013.301774

Houle, J. N., & Light, M. T. (2017). The harder they fall? Sex and race/ethnic specific suicide rates in the US foreclosure crisis. *Social Science & Medicine*, **180**, 114–124. doi:10.1016/j.socscimed.2017.03.033

Kawachi, I., & Berkman, L. (2000). Social cohesion, social capital, and health. In L. Berkman and I. Kawachi (Eds.), *Social Epidemiology* (pp. 174–190). Oxford, NY: Oxford University Press.

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

Kovalchik, S. A., Slaughter, M. E., Miles, J., Friedman, E. M., & Shih, R. A. (2015). Neighbourhood racial/ethnic composition and segregation and trajectories of cognitive decline among US older adults. *Journal of Epidemiology and Community Health*, **69**, 978–984. doi:10.1136/jech-2015-205600

Krause, N. (1993). Neighborhood deterioration and social isolation in later life. *The International Journal of Aging and Human Development*, **36**, 9–38. doi:10.2190/UBR2-JW3W-LJEL-J1Y5

Krause, N. (1996). Neighborhood deterioration and self-rated health in later life. *Psychology and Aging*, **11**, 342. doi:10.1037/0882-7974.11.2.342

Lang, I. A., Llewellyn, D. J., Langa, K. M., Wallace, R. B., Huppert, F. A., & Melzer, D. (2008). Neighborhood deprivation, individual socioeconomic status, and cognitive function in older people: Analyses from the English Longitudinal Study of Ageing. *Journal of the American Geriatrics Society*, **56**, 191–198. doi:10.1111/j.1532-5415.2007.01557.

Latkin, C. A., & Curry, A. D. (2003). Stressful neighborhoods and depression: A prospective study of the impact of neighborhood disorder. *Journal of Health and Social Behavior*, **44**, 34–44. doi:10.2307/1519814

Lawton, M. P., Nahemow, L., & Tsong-Min-Yeh. (1980). Neighborhood environment and the wellbeing of older tenants in planned housing. *International Journal of Aging & Human Development*, **11**, 211–227. doi:10.2190/2BQ7-71JT-V7NN-J9V6

Mendes de Leon, C. F., Cagney, K. A., Bienias, J. L., Barnes, L. L., Skarupski, K. A., Scherr, P. A., & Evans, D. A. (2009). Neighborhood social cohesion and disorder in relation to walking in community-dwelling older adults: A multilevel analysis. *Journal of Aging and Health*, **21**, 155–171. doi:10.1177/0898264308328650

Munoz, E., Sliwinski, M. J., Scott, S. B., & Hofer, S. (2015). Global perceived stress predicts cognitive change among older adults. *Psychology and Aging*, **30**, 487. doi:10.1037/pag0000036

Pollack, C. E., & Lynch, J. (2009). Health status of people undergoing foreclosure in the Philadelphia region. *American Journal of Public Health*, **99**, 1833–1839. doi:10.2105/AJPH.2009.161380

Rafnsson, S. B., Orrell, M., d'Orsi, E., Hogervorst, E., & Steptoe, A. (2020). Loneliness, social integration, and incident dementia over 6 years: Prospective findings from the English Longitudinal Study of Ageing. *The Journals of Gerontology: Series B*, **75**, 114–124.doi:10.1093/geronb/gbx087

RealtyTrac. (2011). Record 2.9 million U.S. properties receive foreclosure filings in 2010 despite 30-month low in December (www.realtytrac.com/content/press-releases/record-29-million-us-properties-receive-foreclosure-filings-in-2010-despite-30-month-low-in-december-6309). Accessed September 6, 2017.

Ross, C. E., & Jang, S. J. (2000). Neighborhood disorder, fear, and mistrust: The buffering role of social ties with neighbors. *American Journal of Community Psychology*, **28**, 401–420.doi:10.1023/A:1005137713332

Ross, C. E., & Mirowsky, J. (2001). Neighborhood disadvantage, disorder, and health. *Journal of Health and Social Behavior*, **42**, 258–276. doi:10.2307/3090214

Sampson, R. J. (2012). *Great American city: Chicago and the enduring neighborhood effect*. University of Chicago Press. Retrieved from https://doi.org/10.7208/chicago/9780226733883.001.0001

Sampson, R. J., & Raudenbush, S. W. (2004). Seeing disorder: Neighborhood stigma and the social construction of "broken windows." *Social Psychology Quarterly*, **67**, 319–342. doi:10.1177/019027250406700401

Schootman, M., Deshpande, A. D., Pruitt, S. L., & Jeffe, D. B. (2012). Neighborhood foreclosures and self-rated health among breast cancer survivors. *Quality of Life Research*, **21**, 133–141. doi:10.1007/s11136-011-9929-0

Seeman, T. E., Lusignolo, T. M., Albert, M., & Berkman, L. (2001). Social relationships, social support, and patterns of cognitive aging in healthy, high-functioning older adults: MacArthur studies of successful aging. *Health Psychology*, **20**, 243. doi:10.1037/0278-6133.20.4.243

Seeman, T. E., Miller-Martinez, D. M., Merkin, S. S., Lachman, M. E., Tun, P. A., & Karlamangla, A. S. (2011). Histories of social engagement and adult cognition: Midlife in the US study. *The Journals of Gerontology Series B: Psychological Sciences and*

Social Sciences, **66**(suppl 1), i141–i152. doi:10.1093/geronb/gbq091

Shankar, A., Hamer, M., McMunn, A., & Steptoe, A. (2013). Social isolation and loneliness: Relationships with cognitive function during 4 years of follow-up in the English Longitudinal Study of Ageing. *Psychosomatic Medicine*, **75**, 161–170. doi:10.1097/PSY.0b013e31827f09cd

Sheffield, K. M., & Peek, M. K. (2009). Neighborhood context and cognitive decline in older Mexican Americans: Results from the Hispanic Established Populations for Epidemiologic Studies of the Elderly. *American Journal of Epidemiology*, **169**, 1092–1101. doi:10.1093/aje/kwp005

Skogan, W. G. (1992). *Disorder and decline: Crime and the spiral of decay in American neighborhoods*. Berkeley, CA: University of California Press.

Stafford, M. A. I., Mcmunn, A., & De Vogli, R. (2011). Neighbourhood social environment and depressive symptoms in mid-life and beyond. *Ageing and Society*, **31**, 893–910. doi:10.1017/S0144686X10001236

Thompson, E. E., & Krause, N. (1998). Living alone and neighborhood characteristics as predictors of social support in late life. *The Journals of Gerontology Series B: Psychological Sciences and Social Sciences*, **53**, S354–S364. doi:10.1093/geronb/53B.6.S354

Tsai, A. C. (2015). Home foreclosure, health, and mental health: A systematic review of individual, aggregate, and contextual associations. *PloS One*, **10**, e0123182. doi:10.1371/journal.pone.0123182

Wallace, D., Hedberg, E. C., & Katz, C. M. (2012). The impact of foreclosures on neighborhood disorder before and during the housing crisis: Testing the spiral of decay. *Social Science Quarterly*, **93**, 625–647. doi:10.1111/j.1540-6237.2012.00886.x

Weden, M. M., Peterson, C. E., Miles, J. N., & Shih, R. A. (2015). Evaluating linearly interpolated intercensal estimates of demographic and socioeconomic characteristics of US counties and census tracts 2001–2009. *Population Research and Policy Review*, **34**, 541–559. doi:10.1007/s11113-015-9359-8

Welsh, K. A., Breitner, J. C. S., & Magruder-Habib, K. M. (1993). Detection of dementia in the elderly using telephone screening of cognitive status. *Cognitive and Behavioral Neurology*, **6**, 103–110.

Williams, R. (2012). Using the margins command to estimate and interpret adjusted predictions and marginal effects. *Stata Journal*, **12**, 308. doi:10.1177/1536867X1201200209

Wu, Y.-T., Prina, A. M., Jones, A. P., Barnes, L. E., Matthews, F. E., & Brayne, C. (2015). Community environment, cognitive impairment and dementia in later life: Results from the Cognitive Function and Ageing Study. *Age and Ageing*, 46, **44**, 1005–1011. doi:10.1093/ageing/afv137.

Zaheed, A. B., Sharifian, N., Kraal, A. Z., Sol, K., Hence, A., & Zahodne, L. B. (2019). Unique effects of perceived neighborhood physical disorder and social cohesion on episodic memory and semantic fluency. *Archives of Clinical Neuropsychology*, **34**, 1346–1355. doi:10.1093/arclin/acy098