Housing dissatisfaction and cognitive decline in older adults

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Abstract

This paper investigates the relationship between housing dissatisfaction and subsequent cognitive decline in community-dwelling older adults. Longitudinal data from a longitudinal survey of over 15,000 Americans above age 50 indicated that a poor rating of the physical condition of one's dwelling unit at baseline predicted significantly more rapid cognitive decline in the following years. The relationship was true even after controlling for a variety of other baseline factors such as wealth, income, education, health, family status, neighborhood safety, depression, and initial cognitive ability. Physically inadequate housing may have a direct effect on the rate of cognitive decline in older adults. Addressing housing inadequacy for older adults may thus produce a wider range of societal benefits than previously realized.

Housing dissatisfaction and cognitive decline in older adults

The physical quality of housing for the elderly has been implicated in a number of important social and medical issues. Using longitudinal data from over 15,000 individuals above age 50 in the 1998, 2002, and 2006 Health and Retirement Study, this paper examines the possibility that poor quality housing may lead to more rapid cognitive decline in older adults. Given the high social costs of cognitive decline, understanding the relationship between housing and cognitive decline may provide critical insights into the social benefits of quality senior housing.

Literature Review

Housing quality has been linked to a variety of important health outcomes. Accessibility and safety of housing has commonly been linked with subsequent injuries, hospitalization, and institutionalization. For example, home modifications and assistive technology can have a positive impact on residents' abilities to age in place and avoid institutionalization across a variety of cognitive spectrums (Hutchings, Olsen, & Moulton, 2008; Trickey, Maltais, Gosselin, & Robitaille, 1993). This concept of supporting independence in activities of daily living (ADL) and reducing the risk for physical injuries through home modifications has been generally supported as an appropriate policy approach (Fange & Iwarsson, 2005; Rogers, Rogers, Takeshima, & Islam, 2004).

Although such studies have demonstrated the significance of the home environment as a physical space in which older adults perform tasks, others have shown that the home environment is also place of significant personal and social meaning (Tanner, Tilse, & Jong,

2008). This suggests that housing is not merely a place of task-oriented functionality, but is also intimately related to one's mental and emotional well-being (Rowles & Chaundhury, 2005).

A variety of previous research has suggested a relationship between the built environment and cognitive function. For example, studies of institutionalized adults have suggested that specific environmental features, such as contact with nature, can contribute to positive outcomes for those with cognitive impairment or dementia (Hernandez, 2007; Zeisel, 2007). Both poor housing quality (Obasanjo, 1998) and a lack of contact with nature (Wells, 2000) were found to be predictive of poor cognitive outcomes for minor children. Caplan, et al., (2006) found that among a population with serious mental illness, socially isolating housing was associated with weakened executive functioning. This link between near environments and cognition is a common finding in animal studies as well. Researchers found that in strains of mice designed to replicate Alzheimer's disease symptoms, long-term housing in an enriched physical environment (with, e.g., platforms, passageways, and lofts) resulted in improvement of cognitive function (Arendash, et al., 2004; Jankowsky, et al., 2005; Costa, 2007).

For community-dwelling older adults, several studies have presented evidence for a link between neighborhood deprivation and cognitive decline. Lang, et al. (2008) found evidence of such a neighborhood effect using a nationally-representative cross-sectional study of England. In this study, living in neighborhoods of relatively high deprivation was independently associated with lower cognitive ability, even after controlling for individual socioeconomic circumstances. Neighborhood deprivation was measured using the Index of Multiple Deprivation which includes components representing area income, employment, health and disability, education, living environments, and crime. Wight, et al. (2006), in a cross-sectional study of American's over 70, found evidence of a neighborhood effect on cognitive scores based

upon the average educational attainment within the census tract. Again, this effect persisted even after controlling for various individual respondent characteristics. Espino, Lichtenstein, Palmer, and Hazuda (2001), in a regional cross-sectional study, found that neighborhood type, measured by income and ethnic composition, was a predictor of cognitive impairment even after controlling for individual respondent characteristics.

Such neighborhood-level effects between deprivation and cognition could come from a person's interaction with his or her neighborhood. However, such effects could also come from a person's interaction with his or her individual dwelling. Because poor quality dwellings are more likely to be found in deprived neighborhoods and because these previous studies do not control for the respondent's individual dwelling quality, the possibility exists that some part of this neighborhood effect is driven by respondents' individual dwelling quality. The policy implications from such a distinction are substantial. If an entire community must be reformed in order to produce environmentally-driven improvements in cognitive decline for older residents, such a prescription may be realistically unattainable. However, if rates of cognitive decline are influenced by respondents' opinions of the physical quality of their own individual structures, rather than only neighborhood-level characteristics, then more targeted interventions may be an available option.

The following analysis considers the possibility of such a link between a perceived deficit in the physical quality of one's residence and subsequent cognitive decline. Morris and Winter's (1978) causal model of housing-deficit induced stress suggests that a gap between housing quality and housing norms or expectations can lead to psychological stress resulting in negative mental health outcomes. Under this model, such subjective housing deficits can also lead to social stress and biological stress, each of which can result in additional psychological stress

resulting in negative mental health outcomes. While not specifically focused on the issue of cognitive decline, Morris and Winter's (1978) model linking subjective housing deficits to psychological pathology is in line with the current hypothesis of a pathway from subjective housing deficit to cognitive decline.

Methods

This paper examined data from the 1998, 2002, and 2006 Health and Retirement Study (HRS). The HRS is a longitudinal study that can be weighted to be nationally representative of the U.S. population over age 50. This paper examines respondents over age 50 who completed cognitive tests in the 1998 survey and also in the 2002 survey and/or the 2006 survey.

Following Morris and Winter's (1978) causal model of housing-deficit induced stress, this paper's hypothesis is that subjective housing deficits in community-dwelling older adults will have a negative impact on subsequent cognitive decline. A subjective housing deficit was measured by the respondents answer to the question, "How about the physical condition of your (house or apartment/house/apartment), would you say it is in excellent, very good, good, fair, or poor condition?" The responses were coded as "1" for "poor," "2" for "fair," "3" for "good," "4" for "very good," and "5" for "excellent."

Cognition was measured by the combined score on the delayed and immediate word recall test. For the immediate word recall task, the interviewer read one of four possible lists of 10 nouns to the respondent. The word list was randomly assigned at the initial interview. No two respondents in the same household were assigned the same set of words in the same wave or in immediately adjacent waves. Rather, the word lists were rotated in each of four successive interview waves. After the word list was read, respondents were asked to recall as many words

as possible from the list. The total number of words correctly recalled, up to 10, was the respondent's score for this test. Words could be recalled in any order and there was no penalty for naming incorrect words. After approximately 5 minutes of asking other survey questions, interviewers would again ask the respondents to name as many words from the original list as possible. The number of words correctly named, up to 10, was the respondent's score for the delayed word recall test. The outcome variable for all following analyses was the change in the 20 point total recall score between the baseline year (in 1998) and the subsequent year.

In some models, a variety of controls were introduced in an attempt to isolate the connection between housing dissatisfaction and cognitive decline. For example, homes of poor physical quality may be more common in undesirable neighborhoods where residents feel less safe. The stress caused by this lack of perceived safety may itself be a contributor to cognitive decline. To control for this factor, the "neighborhood safety" variable reflects respondents' answers to the question "Would you say the safety of your neighborhood is excellent, very good, good, fair or poor?" The responses were coded as "1" for "poor," "2" for "fair," "3" for "good," "4" for "very good," and "5" for "excellent." In this, and all other control variables, the data for the variable come from the baseline (1998) survey wave.

People with depression may be more likely to perceive a deficit in the physical condition of the home. To the extent that depression is associated with subsequent cognitive decline, an association between a perceived housing deficit and subsequent cognitive decline may merely be reflecting depressive characteristics of the respondent. In order to control for this, the CES-D (depression) variable reflects the respondent's cumulative score on a 9-question version of the Center for Epidemiologic Studies Depression Scale (CES-D). These questions asked, "Now

think about the past week and the feelings you have experienced. Please tell me if each of the following was true for you much of the time during the past week."

(1) "Much of the time during the past week, you felt depressed."

(2) "Much of the time during the past week you felt that everything you did was an effort."

(3) "Much of the time during the past week your sleep was restless

(4) "Much of the time during the past week you were happy

(5) "Much of the time during the past week you felt lonely

(6) "Much of the time during the past week you enjoyed life

(7) "Much of the time during the past week you felt sad

(8) "Much of the time during the past week you could not get going

(9) "Much of the time during the past week you had a lot of energy

The CES-D (depression) variable increased by one point for positive answers to questions 1-3, 5, 7-9, and for negative answers to questions 4 and 6.

Other control variables included total household assets and total household income. Income and assets reflected total household amounts as imputed by RAND estimations (RAND, 2007). Income included all forms of income such as government transfers, wages, interest, and capital gains. In order to improve coefficient readability, these variables were scaled to $10,000 units in the regression analysis. (E.g., $9,410 of income would generate an income variable of .941 in the regression analysis).

The education variable reflected the number of years of formal education completed, up to 16 for a bachelor's graduate. All graduate degrees were recorded as 17. The variable "married" was one for those currently married or partnered and zero for those not currently with a spouse or partner.

Self-reported health resulted from responses to the question, "Would you say your health is excellent, very good, good, fair, or poor?" The responses were coded as “1” for “poor,” “2” for “fair,” “3” for “good,” “4” for “very good,” and “5” for “excellent.” The cancer variable indicates the person's response to the question, "Has a doctor ever told you that you have cancer or a malignant tumor, excluding minor skin cancer?" The stroke variable reflects the response to the question, "Has a doctor ever told you that you had a stroke?" Finally, the "heart problems" variable comes from the survey question, "Has a doctor ever told you that you had a heart attack, coronary heart disease, angina, congestive heart failure, or other heart problems?"

If the respondent indicated that he or she was currently employed, the “working” variable was “1” and otherwise was “0.” Volunteer status reflected the respondents answer to the question, “Have you spent any time in the past 12 months doing volunteer work for religious, educational, health-related or other charitable organizations?” Charitable donor status indicated whether or not the respondent or respondent’s spouse had donated “money, property, or possessions totaling $500 or more to religious or other charitable organizations?”

Results

[Insert Table 1]

Table 1 reports the sample means and standard deviations for the sample used in the analysis. This sample was limited to respondents over age 50 who completed the word recall cognition tests in the baseline year of 1998 as well as in the 2002 survey wave and/or the 2006 survey wave. Very few respondents, about 1.7%, rated the physical condition of their home as “poor” in the baseline survey. The average age of the sample was slightly more than 64.

Over time, the average recall score of this group fell. In 1998, the average score was 10.78, out of a possible 20. By 2006, the average score had fallen to 9.50. The sample in 2006

was smaller, as some panel members who had completed the word recall test in 1998 and 2002 did not complete the test in 2006. This may be due to intentional non-participation or intervening factors such as death or mental incapacity. Only 158 respondents completed the test in 2006, but not in 2002.

[Insert Table 2]

Table 2 reports results where the outcome variable was the change in cognitive score between 1998 and 2002 and between 1998 and 2006. In Table 2 the independent variables include only housing satisfaction and the baseline cognitive score. This simple examination suggests a positive association between housing dissatisfaction and subsequent cognitive decline. A one level greater baseline housing satisfaction corresponded with an improvement in the subsequent change in total recall score of roughly .21 points in both the four-year and eight-year follow up tests.

Employing a single housing satisfaction variable where each outcome level is treated as a number is convenient for a quick approximation. However, such an approach contains problematic assumptions. For example, the subjective difference between each level is unlikely to be precisely equivalent. Thus, the subjectively perceived difference between "poor" and "fair" is probably somewhat different than that between "very good" and "excellent." In order to address this deficiency, columns three and four report results including each separate level of housing satisfaction. Here, each level of satisfaction is compared against the baseline of a "poor" rating of the physical quality of housing. In this unadjusted analysis, each higher level of housing satisfaction is associated with a greater improvement to subsequent changes in recall scores in both the four and eight year time frames. In both time periods, having a baseline

housing satisfaction of "excellent" as compared with "poor" corresponds to a greater than one-point difference in the subsequent change in recall scores.

[Insert Table 3]

These associations, however, may simply reflect a variety of factors associated with high housing quality. One might expect that those with greater education, income, wealth, and better health might be more likely to afford high quality housing. In order to control for these type of intervening mechanisms, Table 3 reports the same analyses with a full set of control variables. Once control variables are introduced, column 1 shows that the single housing satisfaction variable remains significant and positive for the four-year time period, but column 2 shows that is becomes insignificant for the eight-year time period.

Breaking this variable into its separate component parts helps to illuminate the reasons behind this difference. Column 4 shows that, in every case, the higher housing satisfaction categories are significantly associated with better subsequent cognitive changes *when compared with "poor" housing quality.* However, when comparing among the higher categories, there is little difference. Column 2 reports an insignificant linear trend in large part because the only notable difference is between the lowest level and any higher levels, but there is no notable linear trend within the higher levels. Similarly, Column 3 shows that in the four-year time frame, a "good" rating is associated with a .5 question improvement in subsequent recall test scores as compared with a "poor" rating. However, a "very good" rating produces no greater level of improvement than did the "good" rating, and an "excellent" rating shows only modestly different gains of about .57.

Thus, it appears that there is little difference in subsequent cognitive scores associated with "good," "very good," or "excellent" housing, but rather dramatic differences in subsequent

cognitive scores associated with being in housing in "poor" physical condition. This suggests that potential gains to be made in subsequent cognitive decline may come, almost exclusively, from targeting the small percentage of housing with the lowest physical quality. Given that only 1.7% of housing was rated as "poor," this segment generating the most notable differences was relatively small. Nevertheless, the magnitude of the impact on subsequent cognitive decline associated with "poor" quality housing is difficult to ignore. In both the four-year and eight-year time frames, the difference in subsequent cognitive decline associated with being in "poor" quality housing instead of "good" quality housing is roughly equivalent to six years of age.

Discussion

In 1978, Morris and Winter proposed a model suggesting that housing-deficit induced stress could lead to negative mental health outcomes. The present analysis provides evidence that supports this assertion particularly where cognitive decline is the mental health outcome of interest. Specifically, the use of the term "deficit" seems particularly appropriate. The current results suggest that the effect of housing satisfaction was seen primarily at the very lowest end of the rating spectrum, i.e., only where a clear deficit is being indicated.

This "deficit" based concept suggests that there may not be substantial gains in cognitive trajectory by improving housing from "good" to "very good." It is not simply the case that improving housing quality, in general, was associated with improved cognitive trajectory. Rather, it appears that improvements came mostly from avoiding clearly perceived deficits, defined here as housing with "poor" physical condition.

Cognitive decline in older adults is a primary driver of institutionalization. Such institutionalization constitutes a large source of government expenditure. Policies targeted towards improving the physical condition of poorest existing housing for senior adults may pay

substantial dividends in postponing cognitive decline and consequently postponing institutionalization. The effect is by no means insignificant. Even after controlling for a variety of health, financial, and emotional characteristics, residing in housing rated as having poor physical quality was associated with subsequent cognitive declines trajectories normally seen in individuals six years older.

Housing researchers have long understood the potential cost savings and health benefits from improving the accessibility and safety of housing for older adults. These cost savings arguments, advanced to support housing improvements based upon reducing the likelihood of physical injuries (and subsequent institutionalization), now appear to have a parallel argument related to cognitive decline. Thus, policies targeted to improve the physical condition of the poorest housing for older adults may provide benefits in both physical functioning and cognitive functioning, both of which may, ultimately, reduce expenditures from government-funded institutionalization.

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Table 1

Descriptive statistics of respondents over age 50 who completed recall test at baseline (1998) and also in 2002 and/or 2006

Variable	Mean (St. Dev.)	N
House condition rating	3.8 (1.00)	15898
House condition = “poor”	1.7%	15898
House condition = “fair”	8.7%	15898
House condition = “good”	25.7%	15898
House condition = “very good”	35.7%	15898
House condition = “excellent”	28.3%	15898
Neighborhood safety	3.9 (1.01)	15876
CES-D	2.1 (1.78)	15473
Volunteer	34.4%	16042
Working	41.8%	16042
Charitable donor	46.5%	16042
Education (years)	12.29 (3.18)	16000
Age	64.35 (10.01)	16040
Assets	31.67 (68.02)	16042
Income	5.32 (8.49)	16042
Married	71.1%	16042
Number of children	3.27 (2.2)	16038
Health (self-rated)	2.76 (1.12)	16038

Cancer	9.6%	16042
Stroke	4.6%	16042
Heart problems	17.1%	16042
Baseline (1998) recall score	10.78 (3.56)	15331
2002 recall score	9.86 (3.71)	15173
2006 recall score	9.5 (3.55)	13100

Table 2:

Rating of housing physical condition and subsequent change in cognition scores

Ordinary least squares analysis of the Health and Retirement Study (1998, 2002, 2006)

Baseline variables	Recall score Δ (4 years)	Recall score Δ (8 years)	Recall score Δ (4 years)	Recall score Δ (8 years)
House condition score	0.2174	0.2075		
	(0.0261)***	(0.0283)***		
House condition “fair”			0.3597	0.6778
			(0.2255)	(0.2457)**
House condition “good”			0.7269	0.9783
			(0.2139)***	(0.2329)***
House condition “very good”			0.9145	1.2168
			(0.2124)***	(0.2312)***
House condition “excellent”			1.0630	1.2761
			(0.2137)***	(0.2324)***
Baseline (1998) recall score	-0.4222	-0.4844	-0.4226	-0.4851
	(0.0073)***	(0.0081)***	(0.0072)***	(0.0081)***
Intercept	2.8093	2.9883	2.7951	2.6785
	(0.1203)***	(0.1336)***	(0.2181)***	(0.2392)***
R-square	0.1951	0.2325	0.1954	0.2332
n	13887	11736	13887	11736

Table 3:

Rating of housing physical condition and subsequent change in cognition scores with controls

Ordinary least squares analysis of the Health and Retirement Study (1998, 2002, 2006)

Baseline variables	Recall score Δ (4 years)	Recall score Δ (8 years)	Recall score Δ (4 years)	Recall score Δ (8 years)
House condition score	0.0779	0.0175		
	(0.0287)**	(0.0301)		
House condition “fair”			0.3088	0.6227
			(0.2169)	(0.2280)**
House condition “good”			0.5000	0.6757
			(0.2070)*	(0.2175)**
House condition “very good”			0.4953	0.6690
			(0.2079)*	(0.2184)**
House condition “excellent”			0.5742	0.6164
			(0.2112)**	(0.2219)**
Neighborhood safety	0.0514	0.1186	0.0549	0.1240
	(0.0281)	(0.0296)***	(0.0282)	(0.0297)***
CES-D (depression)	-0.0375	-0.0459	-0.0361	-0.0430
	(0.0151)*	(0.0159)**	(0.0151)*	(0.0159)**
Volunteer	0.3013	0.2127	0.3015	0.2135
	(0.0549)***	(0.0573)***	(0.0549)***	(0.0572)***
Working	-0.0611	0.1734	-0.0634	0.1699

	(0.0593)	(0.0606)**	(0.0593)	(0.0606)**
Charitable donor	0.0653	-0.0021	0.0645	-0.0052
	(0.0557)	(0.0583)	(0.0557)	(0.0583)
Education (years)	0.1196	0.1614	0.1198	0.1614
	(0.0094)***	(0.0100)***	(0.0094)***	(0.0100)***
Age	-0.0862	-0.1155	-0.0863	-0.1157
	(0.0033)***	(0.0037)***	(0.0033)***	(0.0037)***
Household assets ($10k)	0.0004	0.0006	0.0004	0.0007
	(0.0004)	(0.0004)	(0.0004)	(0.0004)
Household income ($10k)	0.0072	0.0054	0.0072	0.0055
	(0.0034)*	(0.0037)	(0.0034)*	(0.0037)
Married	-0.1481	0.0227	-0.1509	0.0177
	(0.0577)*	(0.0614)	(0.0578)**	(0.0614)
Number of children	0.0023	0.0188	0.0028	0.0189
	(0.0117)	(0.0123)	(0.0117)	(0.0123)
Health (self-rated)	0.1478	0.1763	0.1475	0.1763
	(0.0261)***	(0.0275)***	(0.0261)***	(0.0275)***
Cancer	0.0862	0.1980	0.0889	0.2028
	(0.0832)	(0.0890)*	(0.0832)	(0.0890)*
Stroke	-0.4636	-0.3258	-0.4658	-0.3304
	(0.1173)***	(0.1346)*	(0.1174)***	(0.1346)*
Heart problems	-0.0437	-0.0500	-0.0411	-0.0469
	(0.0675)	(0.0735)	(0.0675)	(0.0735)

Baseline (1998) recall score	-0.5535	-0.636	-0.5536	-0.6362
	(0.0078)***	(0.0083)***	(0.0078)***	(0.0083)***
Intercept	8.2561	9.5540	8.0486	8.9684
	(0.3067)***	(0.3264)***	(0.3586)***	(0.3813)***
R-square	0.269	0.3525	0.2693	0.353
n	13829	11687	13829	11687