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Original Article

Older Adults' Residential Proximity to Their Children: Changes After Cardiovascular Events

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Abstract

Objectives. To assess changes in family residential proximity after a first cardiovascular (CV) event among older adults and to identify families most likely to experience such moves.

Method. Using a nationally representative longitudinal study of older adults in the United States, we identified respondents with no prior diagnosis of CV disease (CVD). We examined subsequent development of stroke, heart attack, and/or heart failure among these older adults and examined changes in their residential proximity to their closest child before and after the CV event. We then compared the likelihood of changes in proximity between families with and without CV events. Finally, we determined which types of families are most likely to relocate following a CV event.

Results. Having a first CV event increases the 2-year predicted probability of children and adult parents moving in with and closer to each other (relative risk ratio = 1.61 and 1.55, respectively). Families are especially likely to move after a first CV event if the older person experiencing the event is spouseless or has a daughter.

Discussion. CVD is a leading cause of disability, which in turn creates a significant need for personal care among older adults. Assessment of changes in family residential proximity responding to CV events is important to fully understand the consequences of older adults' CV events including the cost of caregiving.

Key Words: Cardiovascular events—Intergenerational proximity—Residential mobility

Cardiovascular disease (CVD) causes significant disability in the United States (Cutler, Landrum, & Steward, 2008; Guccione et al., 1994; Martin, Freedman, Schoeni, & Andreski, 2010). Among the population 65 and older who have limitations in activities of daily living (ADLs) and in instrumental ADL (IADLs), heart and circulatory conditions are the leading self-reported cause of disability (Freedman, Schoeni, Martin, & Cornman, 2007). Having a disability often leads to a need for help with personal care, and informal caregiving is one of the most important sources of personal care assistance. Substantial economic resources are spent on informal caregiving in the United States, with the monetary value of such care estimated at $375 billion annually. This amounts to roughly 87% of Medicare spending in a given year (Houser & Gibson, 2008).

The majority of caregiving in the United States is provided by adult children to parents. Among people providing care, 36% provide care to a parent and 8% to a parent-in-law (NAC & AARP, 2009). And among individuals 65 and older who have a limitation with an IADL, about 36% report that a child is a source of informal support; this is the most common source of support, even more common than a spouse (Lin & Wu, 2010).

Providing care for people with disabilities is typically facilitated by geographic proximity. Compared with older adults who have no children nearby, older adults who have at least one child living with or near them prior to the onset of the ADL limitation are less likely to go to a nursing home and depend on formal care (Choi, Schoeni, Langa, & Heisler, 2014). However, when older parents and their adult children do not live near each other, the monetary and time costs of commuting can be exorbitant, preventing informal assistance from being provided. Alternatively, adult children or parents may decide to relocate in response to changes in health status, which may create economic and social burdens on family members. For example, family members may have to quit their jobs, find employment in the new location, change schools, develop new social networks, or sell a house when the housing market is depressed.

When older parents' health declines, they tend to select a target child with greater potential to provide support, and the effect of poor health on the expectation of moving closer to a child is especially large for older persons who live alone (Silverstein & Angelelli, 1998). However, little evidence exists about family residential migration patterns in response to older persons' unexpected health declines, for example, at the onset of a stroke or heart attack.

Accordingly, the goal of this study is to examine the association between the development of a specific health condition—CV events—and the spatial proximity of adult children and parents. The primary objective is to empirically determine the extent to which a CV event is associated with parents and adult children moving closer to each other. Furthermore, we examine whether the location decisions of particular types of families (e.g., spouseless or having a daughter) are more responsive to older adults' CV events.

We first place our disease-specific focus within the context of existing research that has examined the impact of health on migration. The subsequent section describes the empirical methods used, including the sample, key variables, and analytic approach. After discussing the results, the evidence is summarized and discussed in a concluding section.

A Disease-Specific Approach

Changes in health status have been identified as an important determinant of migration patterns among the older population (Bradsher, Longino, Jackson, & Zimmerman, 1992; Litwak & Longino, 1987; Longino, Jackson, Zimmerman, & Bradsher, 1991; Miller, Longino, Anderson, James, & Worley, 1999; Speare, Avery, & Lawton, 1991; Zhang, Engelman, & Agree, 2013; Zimmerman, Jackson, Longino, & Bradsher, 1993). This prior work has focused on the impact of changes in overall disability, typically measured by limitations in ADL or physical functioning.

We believe a focus on specific health conditions is important for many reasons. First, specific diseases may have differential effects on functioning and disability. These differential effects may translate into specific caregiving needs that then shape the response of adult children and parents in addressing that need. To illustrate this point, consider two distinct conditions: a broken hip caused by a fall, and a stroke. The typical treatment of a broken hip for an otherwise healthy older person is surgery. Following surgery, the patient will typically have new limitations in a number of ADLs, especially the ability to walk, but most individuals will recover their ability to walk independently within 6 months (Ortiz-Alfonso et al., 2012). There is thus likely less need for adult children or the older parent to relocate permanently. By contrast, a stroke is much more likely to lead to long-term or permanent limitations in ADLs and IADLs that require ongoing daily help for physical and cognitive deficits up to 5 years or more after the stroke (Hankey, Jamrozik, Broadhurst, Forbes, & Anderson, 2002; Hickenbottom et al., 2002). In such a case, permanent relocation of an older adult or adult children may be required in order to meet the ongoing poststroke caregiving needs.

Prior longitudinal studies of the impact of health on residential mobility have examined the impact of changes in functioning and disability (Silverstein, 1995; Zhang et al., 2013). This research has typically examined changes in proximity of parents relative to adult children in response to changes in functioning or disability, where both residential proximity and health status would be measured at time *t* and *t-1*. This approach is a significant step forward relative to cross-sectional analyses. A potential threat to the internal validity of the estimates derived from this approach, however, is that changes in proximity may also influence changes in health and functioning (Speare et al., 1991). Extensive research has demonstrated that social support can have large beneficial effects on health status (Gallant, 2003; Krumholz et al., 1998; Sayers, Riegel, Pawlowski, Coyne, & Samaha, 2008; Uchino, 2004). Given these findings, it seems possible that point-in-time measures of health status such as ADLs or IADLs may be influenced by whether the older person has adult children or others living nearby who can help them. For this reason, a second motivation for examining specific conditions—and particularly the conditions that we examine here like stroke, congestive heart failure (CHF), and myocardial infarction

(MI)—is that they are less susceptible to this criticism. CV events are most often unexpected, particularly the timing of specific events. As described below, we examine changes in residential proximity in response to a discrete CV event that occurs sometime between the two time periods in which residential proximity is measured. Furthermore, these analyses control for extensive measures of health status at baseline, prior to the CV event, and exclude individuals who have a history of CVD.

A final reason for focusing on CVD in particular is that it is one of the leading causes of disability (Cutler et al., 2008). Extensive analyses have examined the consequences—including costs of—CVD. A disease-specific approach allows one to incorporate the relocation effects of CVD into analyses that attempt to assess the cost of the disease. We will examine three CV events—stroke, MI, and CHF—that can provide more nuanced context to potential health effects on family residential migration. Stroke survivors likely must contend with more severe long-term disability, both from physical and cognitive deficits related to their stroke (Brault, Hootman, Helmick, Theis, & Armour, 2009; Go et al., 2013; Roger et al., 2012). Therefore, we hypothesized that family residential changes would be more common for stroke survivors than for others. MI may lead to sudden death, either from extensive heart muscle damage or a fatal heart arrhythmia. However, MI survivors may have less extensive long-term disability than stroke survivors and may be more likely to return to full function after a rehabilitation program. Therefore, we expected to find a less significant effect of MI on permanent relocation of family members. Untreated CHF may also lead to death, but lifestyle changes and appropriate medications can improve heart function. Therefore, it is less clear how families of those with CHF would respond in terms of family residential changes.

Method

Sample

We used the Health and Retirement Study (HRS), a biennial longitudinal survey of a nationally representative sample of U.S. adults 51 and older designed to explore changes in labor force participation and health transitions. Specifically, we used the 2004, 2006, and 2008 waves of the HRS because in these waves respondents reported geographic information on their children, enabling us to determine residential proximity between respondents and their children.

For the multivariate analyses of change in residential proximity to children in response to the onset of a new CV event, we restricted the baseline sample to respondents who were: 55 and older in 2004; living in the community in 2004; interviewed in 2004 and in 2006 and/or 2008; did not have a history of CVD as of 2004 (i.e., they had never had a heart attack, coronary heart disease, angina, CHF, or stroke/transient ischemic attack); and had no coresident child but at least one non-coresident child in the prior interview (i.e., in 2004 [2006] for observations pertaining to change between 2004 and 2006 [2006 and 2008]). These restrictions resulted in a sample of 7,502 respondents. Among these individuals, in the 2006 interview 453 reported a diagnosis of CVD, and 142 had missing values for CVD questions. To include only respondents who did not have CVD history and to identify first CV events, these 595 respondents are excluded for the analyses of change between 2006 and 2008 and are included for the analyses of change between 2004 and 2006.

The main outcome measure is the change in the residential proximity over a 2-year period, in particular moving-in and moving closer between 2004 and 2006, and between 2006 and 2008. Therefore, if a respondent and a child moved in with each other between 2004 and 2006, the respondent was excluded for the observation of moving closer between 2006 and 2008. Because we examine only previously community-dwelling older adults, we excluded 24 respondents who moved to a nursing home between 2004 and 2006 for the analyses of change between 2006 and 2008. Respondents who did not have a CV event and who did not become coresident with a child between 2004 and 2006 could contribute two observations to the multivariate analyses, that is, residential proximity change between 2004 and 2006, and residential proximity change between 2006 and 2008.

We have 13,257 observations after applying the above sample restrictions. About 15% were missing in the outcome or covariate measures. Therefore, the complete analytic sample consists of 11,202 observations from 6,368 respondents.

Key Variables

The primary outcome of interest is change in the residential proximity of respondents to their children. The geographic data were obtained through confidential contract with the HRS. For children's geographic information, three different sources were utilized. First, coresident children were identified based on the household roster. Second, the HRS asked respondents whether each of their non-coresident children lives within 10 miles. Third, for children living farther than 10 miles from the respondent, the zip code of each child was obtained.

Based on these geographic data, we determined the residential proximity between a respondent and each of their children. Because we focused on the spatial availability of any child as a potential primary caregiver and the unit of observation in the analysis is older adults, we measured respondents' proximity to the closest child. Our proximity variable contains six exclusive categories: (a) coresident; (b) 1–10 miles (or same zip code area); (c) 10–30 miles; (d) 30–100 miles; (e) 100–500 miles; and (f) greater than 500 miles. Based on this categorical variable, we created our outcome variables of proximity change between two consecutive interview waves, which includes three mutually exclusive categories: "moved in with each other"; "moved closer to each other"; and "no change in proximity or further from each other." More specifically, "moved in with each other" means that the respondent changed status from not living with a child at time *T-2* (i.e., 2004 or 2006) to living with a child at time *T* (i.e., 2006 or 2008). "Moved closer to each other" means that the distance from a parent to their closest child at time *T* (i.e., 2006 or 2008) was smaller than the distance from the parent to their closest child at the time *T-2* (i.e., 2004 or 2006). The remaining status of migration/proximity change is the third category of "no change in proximity or further from each other" between *T-2* and *T*.

CV events include stroke, MI, and CHF. The HRS asked respondents whether they had a stroke, MI, or CHF since the prior interview. An indicator variable was constructed that takes the value of 1 if such an event occurred since the prior interview, 2 years earlier, or 0 otherwise.

To control for disability status prior to the CV event, we used limitations with six ADLs: bathing, eating, dressing, walking across a room, getting in or out of bed, and using toilet. The ADL index ranges from 0 to 6 by summing six indicator variables, one for each activity. Because we have few respondents with three or more ADL limitations in our analysis sample, we categorized the measure to be: 0, 1, 2 and 3, or more.

The multivariate analyses control for the presence of a variety of specific health conditions through the use of a comorbidity index. The index is the sum of indicators for whether a doctor had ever told the respondent that he or she had ever had any of the following eight diseases: high blood pressure, diabetes, cancer, lung disease, heart disease, stroke, psychiatric problems, and arthritis. Note that we excluded respondents who had a history of CVD in our analysis sample. The measurement of comorbidity in our analysis sample, therefore, ranges from 0 to 6.

Also included in the multivariate analyses are the respondents' age, sex, race (white/nonwhite), and education level (some college or more/no college) to control for baseline sociodemographic characteristics. A spouse is oftentimes the primary caregiver, thereby reducing the need for care by adult children. Having more children is likely to increase the chance of a respondent having a child living nearby. Children's characteristics are also likely to be important in the relationship. If an adult child is employed, the opportunity cost of them relocating to care for a disabled parent on daily basis is likely to be greater than for a child who is unemployed. It is well known that daughters are more likely to provide care for the parents with disabilities. We, therefore, included in the multivariate analyses variables representing spousal status, the number of children, children's working status (indicative of at least one child not working), and the status of having a daughter. Home ownership might affect the opportunity cost of residential mobility and hence spatial proximity; therefore, we included home ownership status in the analysis as a control variable. We also controlled for respondents' economic status, specifically total wealth holdings. Finally, we included proximity of respondents and their children during the last interview as a control variable.

Analytic Approach

The focus of our analysis is estimating the change in older adults' residential proximity to the closest child in response to the older adults' CV event. To do so, we utilized the longitudinal structure of the HRS for the three available waves: 2004, 2006, and 2008. The main outcome variable of change in proximity is measured as the within-respondent change since the last interview.

We first describe the prevalence and proximity of adult children among older adults who are about to have a CV event, providing evidence on the extent to which older adults who are likely to soon need assistance already have adult children living nearby. We then perform multivariate, multinomial logistic regressions for the categorical outcome of proximity change: moved in with each other; moved closer to each other; others (no change in proximity or moved further from each other). We used the "others" category as the base outcome to obtain relative risk ratios in terms of moved in and moved closer. We applied the sample weight for the interview year 2004 to all analyses except for the analysis with the propensity score matching sample (described below). Robust standard errors were obtained by allowing clustering at the household level. All analyses were conducted using Stata version 13. Descriptive statistics for all variables used in the multivariate analyses are provided in the Supplementary Table 1.

As with most observational studies, endogeneity is a primary concern in attempting to estimate unbiased effects. To minimize endogeneity, we pursued four strategies. First, we used a health event occurrence—a CV event—as the main explanatory variable instead of a global measure of health status. Unlike many changes in chronic health conditions, a CV event is likely to be unexpected. And as described in the introduction, CV events are a leading cause of disability and hence the need for informal care. Second, we restricted the sample to those who did not have a history of CVD prior to the CV event. This sample selection further reduces the potential for endogeneity arising from respondents expecting a CV event. Third, by utilizing rich information on respondents, we adjusted for the respondents' prior comorbidity and disability status and prior proximity to the closest child as well as demographic and socioeconomic characteristics. Fourth, as a sensitivity analysis, we repeated the main analysis but used propensity score matching, specifically, one-to-one nearest neighbor matching (Leuven & Sianesi, 2003). Among respondents who were examined in the multinomial logistic analysis, we selected a subsample from each of two groups: one group that did not experience a CV event between 2004–2008 and the other group that experienced a CV event between 2004–2008 but who were deemed to have similar CV risk at baseline.

Many studies have examined the prevalence and profiles of informal care providers. Older adults' spousal availability, gender, race and children's gender and economic condition were found as important factors associated with informal care provision for older adults (Allen, Lima, Goldscheider, & Roy, 2012; Bianchi, Hotz, McGarry, & Seltzer, 2008; Burton et al., 1995; Katz, Kabeto, & Langa, 2000; Silverstein & Angelelli, 1998; Wolff & Kasper, 2006).

Given these findings, we examined whether certain types of individuals and families were more likely to relocate following a CVD event. Specifically, we tested for interactions between CV event and respondents' gender, race, spousal status, education level, economic condition, child's working status, and home ownership.

In addition to the propensity score matching method, we provided a series of sensitivity analyses. First, to examine whether moving to a nursing home changes the influence of CV events on residential proximity change, we repeated our analyses after excluding 105 observations who moved to a nursing home between *T*-2 and *T* (*N* = 11,097). Second, there were about 4% of missing values in covariates of ADLs, spousal status, education, home ownership, and wealth. We imputed missing values in those covariates by employing multiple imputation (with 10 replicates) using chained equation, a sequence of univariate imputation methods with fully conditional specification of prediction equation (Raghunathan, Lepkowski, Van Hoewyk, & Solenberger, 2001; Royston, 2004, 2005a, 2005b, 2009; van Buuren, Boshuizen, & Knook, 1999; White, Royston, & Wood, 2011). We used ordinary least squares to impute linear measures (e.g., log-transformed wealth), logistic regression for dichotomized measures (e.g., spousal status, education), and multinomial logistic regression for categorical measures (e.g., home ownership, ADLs). Finally, to assess the sensitivity to mortality and to missing data on geographic location (i.e., the dependent variable), we employed a competing risk model by including death and missing in outcomes in the multinomial logit model (i.e., base outcome = no change in proximity or moved further, 1 = moved in, 2 = moved closer, 3 = missing in the measure of proximity change or death).

Results

Prevalence and Proximity of Adult Children for Older Adults About to Have a CV Event

Before estimating the extent to which geographic proximity changes in response to CV events, it is important to assess the need to move. That is, perhaps many older adults about to experience a CV event already have a child living nearby. Among older adults who had their first CV event between 2004 and 2008, the vast majority have at least one living child: only 10% had no living children, 10% had one living child, 28% had two, and 53% had three or more. In Table 1 we report the distance to the nearest child among those older adults who have children (Note that the number of respondents who had a CV event as reported in Table 1 is larger than the number reported in the Supplementary Table 1 because Table 1 does not exclude respondents whose children are coresident or who have missing values on covariates.). Roughly one out of four—26%—of respondents are living with a child prior to the CV event. An additional 47% have a child living less than 10 miles away or in the same zip code area. Relatively few respondents—3%—do not have a child within 100 miles, and only 6% have their nearest child more than 500 miles away.

Caregiving burden can be shared more easily if the respondent has more than one child living nearby. Six percent of respondents about to have a CV event have more than one child living with them, and 34% have two or more children within 10 miles or were living in the same zip code, including living together (estimate not shown in tables). Over half of the respondents—56%—have two or more children living within 100 miles.

Among older adults about to have a CV event, those who are nonwhite, have less than a college education, and have wealth below the median in our analysis sample are more likely to have children living nearby (Table 1). Coresident rates are 38% for nonwhites and 24% for

Table 1. Distance to Closest Child in 2004 Among Older Adults Who Have First CV Event Between 2004 and 2008

	Coresident	<10 miles or same zip code	10–30 miles	30–100 miles	100–500 miles	>500 miles	*p* Value
All older adults (*N* = 609)	26%	47%	7%	7%	7%	6%	
Nonwhite (*N* = 118)	38%	50%	1%	6%	2%	3%	.007
White (*N* = 491)	24%	46%	8%	7%	8%	6%	
No college (*N* = 401)	28%	52%	6%	5%	6%	5%	.004
At least some college (*N* = 208)	24%	38%	9%	12%	9%	8%	
Wealth < median (*N* = 305)	34%	50%	4%	5%	5%	3%	<.001
Wealth > median (*N* = 304)	19%	44%	10%	10%	9%	8%	

Notes. Weighted percentages are reported. *p* Value is from Pearson's chi-square test. The number of respondents who had a CV event as reported in Table 1 is larger than the number reported in the Supplementary Table 1 and other tables because Table 1 does not exclude respondents whose children are coresident or who have missing values on covariates. Median wealth is 155K in this table. CV = cardiovascular.

whites, and while among nonwhites only 5% have their nearest child living more than 100 miles away, 14% of whites have their nearest child at this distance. The gaps are largest by wealth: older adults in the bottom half of the wealth distribution are nearly twice as likely to have a coresident child: 34% versus 19%. Seventeen percentage of the higher wealth group has their nearest child more than 100 miles away, while the comparable rate is only 8% for the lower wealth category.

A First CV Event and Residential Proximity of Parent–Child

A first CV event significantly increases the probability that older adults and their children move in with or move closer to each other. Over a 2-year period, the predicted probability of older adults becoming geographically closer to an adult child is 9.5% if they do not experience a CV event (3.8% by moving-in and 5.7% by moving closer, Table 2, model 1). Having a CV event increases this rate by 4.7%

Table 2. Relative Risk Ratios and Predicted Probabilities of Older Adults and Their Children Moving in With and Moving Closer to Each Other

	Multinomial logistic regression (*N* = 11,202)									
	Model 1		Model 2		Model 3		Model 4		Model 5	
	Moved in	Moved closer	Moved in	Moved closer	Moved in	Moved closer	Moved in	Moved closer	Moved in	Moved closer
First CV event between *T-2* and *T*	1.61*	1.55*								
First stroke between *T-2* and *T*			1.97*	1.97*					1.95*	1.89*
First MI between *T-2* and *T*					0.85	1.08			0.73	0.95
First CHF between *T-2* and *T*							1.84	1.72	1.87	1.57
Number of ADLs, *T-2*										
0 (reference)										
1	0.93	1.68**	0.92	1.66**	0.93	1.68**	0.94	1.68**	0.92	1.66**
2	1.10	0.75	1.11	0.75	1.12	0.75	1.11	0.74	1.11	0.75
3 or more	1.52	1.14	1.54	1.15	1.59	1.18	1.55	1.15	1.51	1.13
Comorbidity index, *T-2*										
0 (reference)										
1	1.01	0.98	1.01	0.98	1.00	0.98	1.00	0.98	1.01	0.98
2	0.88	1.02	0.88	1.02	0.88	1.02	0.88	1.02	0.88	1.02
3 or more	0.93	0.91	0.94	0.92	0.94	0.92	0.93	0.91	0.94	0.92
Age in 2004	0.99	0.99+	0.99	0.99+	0.99	0.99+	0.99	0.99+	0.99	0.99+
Female	1.23+	1.00	1.23+	1.00	1.23+	1.00	1.23+	1.00	1.23+	1.00
Race (white)	0.65**	1.07	0.65**	1.07	0.65**	1.07	0.65**	1.07	0.65**	1.07
At least some college, T0	1.06	0.85	1.06	0.85	1.06	0.85	1.06	0.85	1.06	0.85
ln(Total wealth, *T-2*)	0.82***	0.99	0.82***	0.99	0.82***	0.99	0.82***	0.99	0.82***	0.99
Ownership type, T-2										
Own (reference)										
Rent	0.36***	1.25	0.36***	1.25	0.36***	1.25	0.36***	1.25	0.35***	1.25
Other	1.09	1.42+	1.1	1.42+	1.09	1.42+	1.09	1.42+	1.09	1.42+
Have a spouse, *T-2*	0.69**	1.04	0.68**	1.04	0.68**	1.04	0.69**	1.04	0.68**	1.04
Number of children, T0										
1 (reference)										
2	1.12	1.13	1.12	1.13	1.12	1.13	1.12	1.13	1.12	1.13
3 or more	1.95**	1.21	1.96**	1.21	1.95**	1.21	1.95**	1.22	1.96**	1.21
Have at least one child not working, *T-2*	1.20	1.03	1.20	1.03	1.19	1.03	1.19	1.03	1.20	1.03
Have at least one daughter, *T-2*	0.84	0.93	0.83	0.93	0.84	0.93	0.84	0.93	0.84	0.93
Close proximity to a child, *T-2*	1.91***	0.17***	1.90***	0.17**	1.91***	0.17***	1.91***	0.17***	1.90***	0.17***
Predicted probability										
Without first (CV; stroke; MI; CHF) between *T-2* and *T*	3.8%	5.7%	3.8%	5.8%	3.8%	5.8%	3.8%	5.8%		
With first (CV; stroke; MI; CHF) event between *T-2* and *T*	5.7%	8.3%	6.8%	10.1%	3.3%	6.2%	6.5%	9.1%		

Notes. Unit of observation is respondent-year. 2004 population weight was applied for all analyses. Significance levels are $+p < .1$; $*p < .05$; $**p < .01$; $***p < .001$. Robust standard errors were obtained and used to assess significant levels. Base outcome is the category of "no change in proximity or further proximity." ADL = activities of daily living; CHF = congestive heart failure; CV = cardiovascular; MI = myocardial infarction.

points, to 14.0% (5.7% by moving in and 8.3% by moving closer, Table 2, model 1).

The influence of a first CV event differs by type of event, and the pattern is largely consistent with the differential impact of these types of events on disability (results are not shown). Individuals having a first stroke have a predicted probability of 16.9% of becoming spatially closer to their children (6.8% by moving in and 10.1% by moving closer, Table 2 model 2), whereas those not experiencing a stroke have a predicted probability of 9.6% (3.8% by moving in and 5.8% by moving closer, Table 2, model 2). There is no statistically significant effect of having a first MI. Although there are sizable estimates of CHF, these are not statistically significant at conventional levels.

Among respondents experiencing a first CV event, families of respondents without a spouse are particularly more likely to move in with and move closer to each other than families with respondents who have a spouse (relative risk ratio [RRR] = 2.1 and 3.1 for spouseless; RRR = 1.3 and 1.0 for those with spouse; p = .02 and .01 for equality test between group RRRs respectively; effects are not reported in tables). This finding is consistent with the prior literature examining the effects of disability and with the hypothesis that spouses often provide care to each other, reducing the need to be spatially closer to their children. Furthermore, families are more likely to move closer after a first CV event if the older person has a daughter (RRR = 0.4 for daughterless; RRR = 1.9 for those who have a daughter; p = .04 for equality test between group RRRs; effects are not reported in tables) while we did not find any significant variation by having a daughter in terms of moving-in. Interactions between CV event and respondent's gender, race, education, home ownership, and their children's working status were not statistically significant.

Sensitivity Analyses

Change in residential proximity may be motivated by a move to a nursing home. To determine whether such events influence our findings, we reestimated model 1 in Table 2 excluding such individuals (Table 3, row I). We find that the greater likelihood of moving in after a first CV event is robust to this modification in the sample (RRR = 1.66), but the effect on moving closer becomes statistically insignificant.

We examined the robustness of the results to the use of propensity score matching (Table 3, row II). We find that the estimated RRR of moving in remains significant (RRR = 2.02) using propensity score matching. The estimated effect on moving closer becomes statistically insignificant but the magnitude is comparable between the RRR from main analysis and that from propensity score matching: 1.55 versus 1.49, respectively.

We reestimated the baseline model after imputing missing values in covariates. With the imputed data, the RRRs of moving in and moving closer by CV event are 1.57 and 1.53, respectively (Table 3, row III) and remains significant at the 5% level.

Table 3. Sensitivity Analysis

	Effect of first CV event between *T*-2 and *T* (relative risk ratios)		
	N	Moved in	Moved closer
I. Exclude subjects moved to nursing home between *T*-2 and *T*	11,097	1.66*	1.22
II. Propensity score matching method	1,158	2.02*	1.49
III. Multiple imputations for missing values in covariates	11,696	1.57*	1.53*
IV. Including another outcome of death or missing	11,471	1.62*	1.58*

Notes. Unit of observation is respondent-year. 2004 population weight was applied for all analyses. Significance levels are *$p < .05$. Robust standard errors were obtained and used to asses significant levels. Base outcome is the category of "no change in proximity or further proximity." CV = cardiovascular.

Missing responses in proximity change and death may be associated with a CV event and hence may affect the estimation. By specifying a fourth outcome which is indicative of missing in proximity change or death, we reestimated the CV event effect. The RRRs of moving in and moving closer are 1.62 and 1.58, respectively (Table 3, row IV), similar to that from the main model.

Summary and Discussion

CVD is one of the leading causes of disability among older adults. Having limitations in physical and/or cognitive functioning creates a need for daily personal care assistance, and adult children are a major source of this support. Given the intensity of care often required by many disabled adults, parents and their children need to be located close to each other if children are going to provide such care. The goal of this study was to empirically estimate family migration patterns related to CV events in older parents.

Among older adults who have no history of CVD, a CV event, especially a stroke, causes family members to relocate, reducing the distance between their homes and their children's residences. Within a 2-year period, the predicted probability of older adults becoming geographically closer to their children is 9.5% if they did not experience an adverse CV event. Having a CV event increases the predicted probability of geographic mobility to achieve closer proximity to 14.0%. As hypothesized, families are especially likely to move after a first CV event if the older person experiencing the event does not have a spouse or has at least one daughter.

While family proximity increases in response to CV events, a significant majority of older persons who experience such events already have children living nearby well before the event takes place. In fact, of such individuals, 72% had at least one child living with them, living within 10 miles of them, or living within the same zip code 1–2 years prior to the event. At the same time, 20% of these older adults do not have a child within 30 miles, making it very difficult and costly to rely on extensive care from their children unless someone in the family relocates.

In general, when migration occurs, it is typically a child who moves (Zhang et al., 2013). In our analysis sample, among all families for whom the distance between the parent and children declined—not just those experiencing a CV event—the child—and only the child—was the one who relocated 67% of the time. However, such general migration patterns might not characterize the movement of children and parents in response to the onset of health conditions (e.g., CV events). According to our preliminary analysis, the spatial distance between parents and their children declines because the parents, not the adult children, relocate.

A number of emerging issues regarding family care for older adults who suffer acute or chronic health declines are important topics for future research. For instance, given the rapidly evolving technologies for monitoring the health and function of older adults within their homes and communicating that information to both health care providers and family members who live at a distance (Aikens, Zivin, Trivedi, & Piette, 2014), it is possible that these technologies will reduce the need for children to relocate geographically to provide or oversee care for the growing number of older adults. A second key issue that in the future may affect children's ability to care for older adults and, therefore, whether they will relocate to become caregivers for aging parents, is whether rising levels of obesity and diabetes will lead to earlier onset of disability in potential caregivers. A number of studies have suggested recent increases in mobility difficulties among those aged 50–64 in the United States (Martin et al., 2010; Martin, Schoeni, & Andreski, 2010), suggesting that future "caregivers" may be less able to actually provide care to their aging parents. Both of these trends may have important implications for if and how families relocate after health shocks to older adults.

Because (adult) children's characteristics and circumstances are likely to be important factors in determining family residential changes, future research should also examine children's characteristics (e.g., age, gender, employment status, etc.) by using respondents and each of their children as the unit of analysis. It is also important to know, when parents move after a health shock, how decisions about relocating into a nursing facility is related to the proximity to an adult child. A larger sample size is necessary to examine further detailed patterns of intergenerational proximity change that incorporate individual migration and formal residential care utilization.

Despite these limitations, this paper has clear contributions to the literature on family residential proximity in the context of older adults' health declines. First, previous literature on the association between older adults' health and family residential proximity change used indicators of general health or functional limitations. By focusing on CV events, this paper provides a more nuanced examination of responses to a specific condition. CVDis a leading cause of disability that creates a significant need for personal care among older adults. In particular, families of older adults who experienced CV events may need to change their residences, often unexpectedly, to provide necessary care. Among CV events (stroke, MI, and CHF), we found that stroke is the most significant predictor of disability (result was not shown) and of the family moving geographically closer. A sizable increase in family residential proximity (i.e., closer proximity) was found with CHF, but not with MI. This pattern is consistent with our a priori hypothesis that MI is a significant risk factor of death, but is a less significant cause for long-term disability compared with stroke. Although CHF survivors are likely less disabled than stroke survivors, the often progressive nature of CHF-related disability compared with that from MI alone may lead to more need and opportunities for family to assist with self-care and medical care for patients with CHF.

Second, we believe our approach reduces the likelihood of endogeneity creating biases in the estimates of the effects of the health event on spatial proximity. By the nature of CV events, we tend to observe more exogenous variation in outcomes. Moreover, we attempted to reduce potential bias further by identifying comparison samples carefully. We compared residential proximity changes within older adults who never previously had been diagnosed with CVD. We also employed sensitivity analyses such as one-to-one propensity score matching to reduce potential bias attributable to different sample composition prior to CV events. Like most all observational studies, we cannot completely rule out the possibility of endogeneity bias. For example, children and parents may decide to live near each other in anticipation of future health challenges such as CV events even if the parents have no history of CVD. Although we reduced such endogeneity sources by controlling for respondents' health conditions prior to any CV event, there might still be remaining risk factors that were not captured by the control variables but were observed by the family members.

Evidence of significant residential changes among family members in response to an older adult's health deterioration is of importance for public policy regarding care for the aging population. In particular, adult children are among the most prevalent care providers for disabled older persons who need help with daily activities, and close proximity to an adult child significantly reduces subsequent risk of a newly disabled older adult's transitioning to a nursing home. Accordingly, facilitating residential adjustments among family members to provide care for an older person may be an important focus of policies to create a sustainable, cost-effective community-based care system for the aging population.

Supplementary Material

Supplementary material can be found at: http://psychsocgerontology.oxfordjournals.org/

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