Selection Bias and Psychosocial Mediators Do Not Fully Explain Caregivers' Decreased Mortality Risk

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Submitted for PAA 2015

Middle and older-age adults commonly provide informal care for an ill-spouse. This care frequently entails substantial physical, emotional, and financial burdens. Prior research has shown that, on average, caregiving demands threaten caregivers' health: caregiving strain has been associated with elevated risk of mortality[1,2]. Caregiving has also been associated with increased morbidity due to onset of coronary heart disease, cardiovascular disease, and hypertension.[3-5] The primary mechanisms by which caregiving is thought to influence health are by exacerbating stress[6-12] and reducing time for health-promoting behaviors, like physical activity.[7,13] A number of meta-analyses in the last decade have summarized this literature about family caregiving and health, generally finding that caregiving is associated with more psychological stress and burden and worse physical health outcomes.[14-18]

In contrast, a few recent studies found the inverse relationship between caregiving and risk of mortality.[19,20] These studies posit two hypotheses to explain their findings. First, caregivers may be subject to a "healthy worker" selection bias, whereby caregivers are a selected group who are healthy enough to provide care.[21,22] Although this is not a type of selection bias unique to caregivers, it is especially difficult to address in cross-sectional caregiving studies or longitudinal studies with only one time point of measures caregiving exposure, which are common throughout caregiving research.[14] Secondly, some have speculated the psychological benefit of caregiving may mediate the relationship and explain the lower mortality risk associated with caregiving. In this case, caregiving results in a psychological benefit for the caregiver either rewarded directly from the process and reward of being helpful to someone[20,23] or because caregiving helps strengthen the emotional bond between the caregiver and care recipient.[24-26]. However, few studies have robustly tested the explanations for these competing results, including selection bias and the psychosocial mediating pathways, between caregiving and mortality.

In this paper, I used 12 years of data from the US Health and Retirement Study (HRS), a nationally representative prospective cohort of adults aged 50+, to test these methodological and theoretical mechanisms empirically. I hypothesized that there would be a significant, inverse controlled direct effect of caregiving on mortality after accounting for psychological mediators and selection into caregiving. To test these hypotheses, I estimated inverse probability weighted marginal structural models with weights that accounted for the probability of being a caregiver and the controlled direct effect of caregiving after controlling for psychological benefit mediators.

Methods

Study Sample

HRS is a longitudinal survey of a national sample of US adults aged 50+ years and their spouses. Details of the study are provided elsewhere.[27] Enrollments occurred in 1992, 1993, 1998; younger birth cohorts enrolled in 2004 and 2010 were not included in this analysis. Biennial follow-up interviews were conducted through 2012. The most up to date follow-up information shows retention above 80% through 2008. HRS was approved by the University of Michigan Health Sciences Human Subjects Committee and these analyses were determined exempt by University of Minnesota Institutional Review Board.

This study was restricted to married HRS participants born 1900 to 1947 and interviewed in 2000, which was the earliest year when caregiving assessments were consistently worded and asked with respect to spouses. The HRS sample included 11,476 age-eligible, married respondents interviewed in 2000.

Measures of caregiving exposure

Spousal caregiving demand was calculated in each biennial interview wave (2000–2010), based on the care recipient's report regarding assistance with activities of daily living (ADLs; including help with getting across a room, dressing, bathing, eating, getting in and out of bed, and using the toilet) and instrumental activities of daily living (IADLs; prepare meals, shop for groceries, make telephone calls, take medications). HRS respondents listed the people who provided them assistance in the last month and the number of days and hours of care they provided. An indicator variable was generated for whether a spouse was a listed caregiver and calculated amount of care provided per week for these analyses. Prior studies used varied cut points to define the hours associated with caregiving strain,[3,20] and these reports suggest that there may be an important threshold at 14 hours per week. This exposure of 14 hours per week is consistent with other caregiving studies from the HRS,[4,5,20,28] as well as other studies of caregiving and mortality from different cohorts.[19] Thus, the hours of care were dichotomized to <14 and ≥14 hours of care per week as the primary exposure. Moreover, we consider those who provided ≥14 hours of care per week at two consecutive waves as "long term" care givers; the reference is those who did not provide 14+ hours of care per week at both waves.

Mortality outcome

For the purposes of this paper, I defined mortality as all-cause mortality from 2002-2012. HRS collects information on deceased participants through exit interviews with next of kin. The publicly available HRS data reports death information in a variable that indicates the respondent's sample status (e.g., in the sample, died in a previous wave). Specifically, I created an indicator of whether a respondent had died by that survey wave by reverse coding whether the respondent was reported as alive in the 2012 HRS Tracker data file.

Covariates

Three sets of covariates—demographic, socioeconomic position (SEP), and health risk factors—that likely confound the association between caregiving and risk of mortality were considered. The demographic characteristics comprised baseline age and age-squared, race (white [reference]/black/other), Hispanic ethnicity (Hispanic/not-Hispanic [reference]), and gender (male/female [reference]). SEP included current, adult SEP (continuous years of education; income at baseline (household income divided by square root of household members)) and childhood SEP (continuous height (meters) and maternal education (<8 [reference] / ≥8 years)). Health risk factors consisted of smoking status (current/ever/never [reference]); body mass index in kg/m^2(categorical: <18 , 18-24.9 [reference] , 25 – 29.9, 30-34.9, 35+); vigorous physical activity (<3 times per week [reference] / 3+ times per week); and alcohol use in the last 2 weeks (any/none[reference]); self-reported diagnoses of hypertension and diabetes, respectively (any/none[reference]); elevated depressive symptoms (measured with a modified 8-item Center for Epidemiological Studies Depression (CES-D) Scale, dichotomized at <3 [reference], ≥3); self-rated health (fair/poor vs. good/very good[reference]); respondent's need for help with ≥1 ADL or ≥1 IADL (no I/ADL needs [reference]), respectively. For observations with missing values, continuous variables were set to the mean and categorical variables to the referent group and included a missing indicator variable in the weighting models. Several of the covariates are potentially affected by caregiving (e.g., health risk factors) and may thus mediate the effects of past caregiving on mortality. To avoid adjusting for variables downstream of the primary exposure, the values of these covariates as assessed in the wave *prior* to the caregiving assessment (e.g. 1998 covariates to control for caregiving demands in 2000) were controlled for. All other covariates time-constant and use the covariates reported in 2000 were considered as baseline.

Mediating mechanisms

Psychosocial modules were included in HRS beginning in 2006. Detailed information on these modules have been previously reported elsewhere.[29] Briefly, a psychosocial module was included in the HRS survey administration for a random 50% the HRS sample at each wave; measures were repeated for that half of the sample two survey waves later. For instance, approximately half of the sample completed the psychosocial module first in 2006 and again in 2010; the other half of the sample had the module first in 2008 and again in 2012.

Of the available data in HRS, positive social support was the best reflection of the psychological benefit of caregiving. Respondents were asked about perceived social support questions from four relationship categories: spouses, children, family and friends, respectively. The social support had high Chronbach's alpha for both positive and negative social support sub-scales (positive social support: alpha=0.82). For this analysis, I calculated a summary score of this index for the responses specific to positive social support from spouses as a measure of caregiving rewards. The positive social support subscale included three questions, each answered on a Likert scale (a lot, some, a little, not at all): How much [does your spouse] really understand the way you feel about things? How much can you rely on [your spouse] if you have a serious problem? How much can you open up to [your spouse] if you need to talk about your worries? The index of positive social support was calculated as an average of the reverse coded responses to the positive social support questions; if two of the three items were missing, the index score was set to missing.[29] I combined the earliest report of these data (half of the sample from 2006 and half from 2008) so that all respondents had one, time-constant measure of psychological benefit.

Analytic method

I used an inverse probability weighted (IPW) marginal structural model to account for time-varying confounding, mediation, and attrition.[30-32] The inverse probability weighted marginal structural model approach for dealing with time-varying confounders is appealing over standard statistical adjustment for time varying confounders in regression models because the latter would result in biased estimates of the main association of interest (caregiving on mortality). Instead, the weighting scheme accounts for these covariates but with less bias in the estimate of caregiving on mortality risk.

For attrition, weights based on the inverse probability of each surviving subject continued to participate in the study were calculated. Thus, the IPW approach is similar to a sampling weight in that the inverse of a lower probability of remaining in the study, conditional on covariates, means that someone who was likely to be lost to follow-up or leave the sample would be "upweighted" in the analytic sample.

To test the caregiver "healthy worker" selection bias, I also calculated a weight based on the probability of being a caregiver (i.e., an inverse probability of treatment). This approach allowed adjusting for variables likely to be both mediators and confounders, such as health behaviors that may be affected by high caregiving and may also impair a spouse's ability to provide care. Thus, the probability of being a caregiver was estimated as a function of time-varying health covariates this method is useful for testing the healthy worker explanation.

Lastly, to test caregiving reward as a mediating mechanism, I calculated a weight based on the probability of reporting positive high social support from one's spouse or low strain from chronic stressors. Specifically, I estimated the controlled direct effect of caregiving on mortality, whereby an individual's report of either high support or low stress was held constant; in other words, the intermediary role of the caregiving reward is controlled for in the estimation of the mortality risk associated with caregiving.

Thus, each observation was weighted by the inverse of the probability that individual was alive at the exposure wave, times the inverse of the probability that individual (conditional on having survived) was in the sample at both exposure and outcome waves, times the inverse of the probability that the individual received the caregiving treatment he or she actually received. This approach was used to test the healthy worker hypothesis. I added the product of an additional weight – the mediation by caregiving reward – for models to test the psychological benefit of caregiving pathway. Weights were stabilized and truncated at the 99th percentile using previously described protocols.[33,34]

In the analyses above, the reference group is all those married HRS respondents who provide carr 0-13 hours per week, which includes those who provide 0 hours of care because their spouses are healthy and do not need care. To test the sensitivity of this reference group, we restricted the analytic sample to those with a spouse with an ADL/IADL such that the reference group of those providing 0-13 hours of care consists of people more likely to be caregivers.

HRS used a multistage, clustered sample design. The HRS sampling weights were applied to make the population representative of the 1998 US population aged 50+ years. Models that do not account for clustering are presented, as I found no difference between models that account for clustering at the household level and those that did not.

Preliminary Results

In adjusted models, odds of mortality significantly lower for spousal caregivers compared to non-CG (OR: 0.62, results not shown). In IPW models that accounting for Healthy Worker Selection Bias, the estimate was very similar (OR=0.62, 95% CI: 0.48, 0.80; Table 1). These results were robust to a sensitivity analysis of non-CG "counterfactual" where we changed the reference group (OR=0.63, 95% CI: 0.47, 0.85). Moreover, after accounting for the altruism mediation mechanism, the controlled direct effect of caregiving on mortality remained similar in magnitude and statistical significance (OR=0.64, 95% CI: 0.48, 0.84). The estimated conteolled direct effect of long term caregiving on mortality were significantly decreased, but more modest (OR: 0.79; 95% CI: 0.69, 0.91; p<0.001).

Preliminary conclusions and future directions before PAA 2015

In a prospective nationally representative cohort of US adults aged 50+, we found spousal caregiving was associated with a significantly decreased risk of mortality. This decreased estimated mortality risk was true after accounting for: 1. the possibility that only healthier spouses select into (and selectively maintain) caregiving roles and 2. the possibility of social support from one's spouse offsetting (i.e., mediating) the mortality risk between caregiving and mortality. We see results similar in magnitude to recent studies on caregiving and mortality that did not account for these selection and mediation factors explicitly.[19,20]

Before PAA, I have specific plans for addition work to complete this analysis and paper, including:

- Including other psychosocial measures beyond social support
- To include additional dimensions of the care network and family structure (e.g., number of kids, frequency of contact with family) as covariates
- Testing for differences by cohort
- Testing for hetereogeneity by sex, race/ethnicity, and care recipient dementia status

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Table 1. Estimates of Association of Caregiving 14+ Hours per week on Mortality

	Odds Ratio	**95% CI**			**P-val**
Unadjusted	1.18	0.94	-	1.49	0.13
Demographics Adjusted	0.70	0.55	-	0.89	0.0032
SES Adjusted	0.66	0.52	-	0.83	<0.001
Caregiver Health Status Weighted	0.64	0.51	-	0.81	<0.001
Recipient Health Status Weighted	0.62	0.48	-	0.80	<.0001