Living Longer but Unhealthier?
Spouse Caregivers' Health and Mortality in the US[1]

Nader Mehri[2]

Department of Sociology and Gerontology, Miami University, Oxford, Ohio, USA.

Paper for the 2019 Meeting of the Population Association of America

Abstract

Using two waves of the Health and Retirement Study (2012-2014), this study aims to resolve the paradox of spouse caregivers' poorer health and lower mortality in the US. The Bayesian multistate life table technique was utilized to estimate Healthy Life Expectancy (HLE), Unhealthy Life Expectancy (ULE), Total Life Expectancy (TLE), and the proportion of remaining life to be spent healthy (PLE) among spouse caregivers and non-caregiver peers. Results show that married non-caregivers at age 64-65, on average, can expect to live an additional 22.7 years of which 71% (16 years) should be healthy years. These figures are 11 years and 57% (6.2 years) among spouse caregivers, respectively. The gap in HLE, ULE, TLE, and PLE between married non-caregivers and spouse caregivers are evident after controlling for sex, race, and education. These findings are consistent with stress theory which speculates that informal caregiving is deleterious to caregivers' physical and mental health.

Keywords: Informal Caregiving, Health, Mortality, Paradox, Healthy Life Expectancy.

[1] Work in progress, please do not cite.

[2] I would like to express my deepest appreciation to Dr. S. Brown and Dr. J. Kinney for their feedback and valuable comments on the earlier draft of this manuscript.

Introduction and Background

Informal caregiving has been described as the backbone of the US healthcare system. Its economic value has been estimated to be around $470 billion which is more than total Medicaid expenditures in 2013 (Reinhard et al. 2015). Spouses provide most informal care for married older adults with impairments, women more so than men (Lin, Fee & Wu 2012). Spouse caregivers' psychological and physical health were found to be lower than non-caregivers (Pinquart and Sorensen 2003; Lee et al. 2003; Burton et al. 2003; Capistrant et al. 2012, Capistrant, Moon & Glymour 2012; Capistrant, Berkman & Glymour 2014) as well as other caregivers such as children and children-in-law (Pinquart and Sorensen 2003, 2011). Besides, spouse caregivers benefit less from the caregiving intervention as compared to adult children (Sorensen, Pinquart & Duberstein 2002). While adverse health-related caregiver outcomes have been found to be worse among spouse caregivers, Brown et al. (2009) found that their mortality risk is lower than non-caregiver peers. This paradox (i.e., poorer health and lower mortality risk) reflects two competing perspectives on the consequences of being an informal caregiver: stress theory and the healthy caregiver hypothesis.

Stress theory suggests that informal caregiving is a burdensome and stressful career that can cause persistent psychiatric and physical morbidity (Pearlin et al., 1990, Schulz and Beach 1999). Schulz and Beach (1999) affirmed this by referring to studies which suggested that "caregivers are less likely to engage in preventive health behaviors, decrements in immunity measures compared with controls, exhibit greater cardiovascular reactivity, and experience slow wound healing" (p. 2215). Likewise, Bennett, Fagundes, and Kiecolt-Glaser (2013) pointed out that caregiving as a chronic stressor can accelerate the natural shrinkage of the immune system, which can predict an increased risk of disease and potentially premature death. Specifically, spousal caregiving has been found to be associated with self-reported poorer health, higher levels of psychological distress as well as cardiovascular disease incidence. For example, Lee et al. (2003) over a 4-year follow-up study found a significant relationship between caregiving and the risk of coronary heart disease among U.S. women with 9 or more hours of the provision of care for a disabled or ill spouse. In a 5-year follow-up study, Burton et al. (2003) found that transition into spousal caregiving role (i.e., provision of ADL/IADL assistances) predicts self-reported poorer health, higher levels of depressive symptoms, lower levels of self-mastery as well as higher counts of health risk behaviors as compared to non-caregiver counterparts.

A growing body of longitudinal population-based studies have challenged stress theory by revealing that caregivers are at a decreased risk of dying (Brown et al., 2009; O'Reilly et al., 2008, 2015; Ramsay, Grundy, O'Reilly 2013; Fredman et al., 2009, 2010, 2015; Roth et al., 2013). Roth, Fredman, and Haley (2015) reviewed six population-based studies that differ concerning key characteristics: the sample, definition of informal caregivers, care recipients' severity of disability, and the length of the follow-up period (4-8 years). Their review revealed that generally, mortality rates are not higher among caregivers, but rather are lower than non-caregivers. Specifically, regarding spouse caregivers, Brown et al. (2009) found that spouses who provided 14 or more hours of ADL or IADL assistance per week had a 36 percent lower mortality risk than married non-caregivers. These findings have supported the healthy caregiver hypothesis, which in contrast to stress theory, underscores the positive aspects of family caregiving to justify caregivers' lower mortality rates and better physical functioning (Fredman et al., 2009, 2010, 2015). The healthy caregiver hypothesis has two main aspects. First, healthier people are more likely to take care of individuals with care needs and to remain in that role. Thus, they are more likely to remain physically and cognitively active by providing care, which in turn can help them to maintain their health advantage. Remaining physically and cognitively active is assumed to be positively correlated with better health. Second, family caregivers may enjoy emotional and psychological supports such as gratitude and recognition from their care recipients as some of the health benefits of caregiving (Fredman et al., 2009, 2010, 2015; Roth et al., 2015).

It should be noted that although a recent growing body of studies has supported the healthy caregiver hypothesis, it seems that the hypothesis is still unable to justify the results of studies revealing that caregiving is deleterious for health. Likewise, stress theory is unable to explain why mortality rates are lower among caregivers compared to non-caregivers. In fact, the question is why stress theory does not explain caregivers' lower mortality rates as compared to non-caregivers though it explains the negative health-related consequences of caregiving? A short answer to this question could be that caregivers' longer life does not necessarily eliminate the possibility of living a greater proportion of life in the unhealthy state. A combination of stress theory and the healthy caregiver hypothesis is quite possible and might be able to enlighten new aspects of the relationship among informal caregiving, health, and mortality. The present study seeks to resolve the paradox of poorer health and lower mortality risk among spouse caregivers by examining the "living- longer- but- unhealthier" hypothesis. This hypothesis speculates that the survival advantages of caregiving, as the healthy caregiver hypothesis argues, can be accompanied by a higher prevalence of chronic physical and mental diseases, as stress theory speculates. On the one hand, studies have suggested that caregivers are physically healthier and more likely to maintain their role as caregivers (McCann et al., 2004) and therefore they might be less likely to suffer from fatal diseases. On the other hand, since being a caregiver is a burdensome and stressful role, caregivers can be more likely to suffer from chronic diseases that disable them. In addition, the combination of a longer lifespan and medical advances can contribute to an increased risk for chronic ailments (Pearlin et al., 1990), which supports the "living- longer- but-unhealthier" hypothesis. Crimmins, Hayward, and Saito (1996) used similar speculation to justify the paradox of longer life but the poorer health of women compared with men. They stated that "if men suffer from diseases that are more likely to kill them and women from diseases that are more likely to disable them, this could result in a longer life with more disability for women" (Crimmins et al., 1996, p. S112).

Statement of Purpose

This study aims to explore whether the survival advantage of spouse caregivers is accompanied by self-rated poorer health as compared to non-caregiver counterparts. Using the Bayesian multistate life table technique (Lynch & Brown 2005, 2010), this study seeks to examine the "living- longer- but- unhealthier" hypothesis by estimating Healthy Life Expectancy (HLE), Unhealthy Life Expectancy (ULE), Total Life Expectancy (TLE=HLE+ULE), and the proportion of remaining life to be spent healthy (PLE=HLE/TLE) among spouse caregivers and married non-caregivers in the US between 2012 and 2014. This study should contribute to efforts to clarify the relationships among informal caregiving and health as well as mortality.

Hypotheses

General Hypothesis: It is expected that spouse caregivers live longer but unhealthier than married non-caregivers.

Hypothesis 1.a. Spouse caregivers' life expectancy is expected to be significantly longer than married non-caregivers.

Hypothesis 1.b. Spouse caregivers are expected to be living a greater proportion of life expectancy in the unhealthy state as compared to married non-caregivers.

Innovations

1) **Proposing a New Hypothesis in the Caregiving Literature**

At present, it seems that the existing literature on the relationship among informal caregiving, health, and mortality have reached an impasse. On the one hand, stress theory does not explain caregivers' lower mortality as compared to non-caregivers though it explains the negative health-related consequences of caregiving. On the other hand, the healthy caregiver hypothesis does not explain the adverse health-related caregiving outcomes though it explains the caregivers' lower mortality as compared to non-caregivers. Stress theory and the healthy caregiver hypothesis appear to be incapable of resolving the paradox of poorer health and lower mortality risk among informal caregivers including spouse caregivers. The present study is an improvement over the previous studies by combining stress theory and the healthy caregiver hypothesis and proposing a new hypothesis in the caregiving studies: the "living- longer- but-unhealthier" hypothesis. This hypothesis speculates that the survival advantages of caregiving, as the healthy caregiver hypothesis argues, can be accompanied by a higher prevalence of chronic physical and mental diseases, as stress theory speculates.

2) Estimating Spouse Caregivers' Healthy Life Expectancy (HLE), Unhealthy Life Expectancy (ULE) and Total Life Expectancy (TLE)

A partial explanation for the paradox of spouse caregivers' poorer health and lower mortality is that previous studies have investigated health or mortality as outcome variables separately. Yet, in the caregiving studies, these two highly correlated outcomes are rarely studied in conjunction. A partial explanation for this limitation could be that psychological epidemiology has dominated caregiving studies while it appears to be unequipped to strong tools to investigate health and mortality in conjunction as outcome variables. In contrast, demography is equipped to strong tools such as multistate life table technique that has significant capabilities in extending our knowledge about spouse caregivers' health and mortality by linking and investigating health and mortality in conjunction as outcome variables. To date contribution of demography to the caregiving studies has been absent or small while using important tools such as multistate life table technique it could produce easily understandable and important information about spouse caregivers' health and mortality. In contrast to the previous studies, using the Bayesian multistate life table technique, this study investigates the impact of spousal caregiving on health and mortality simultaneously by estimating spouse caregivers' healthy life expectancy (HLE), unhealthy life expectancy (ULE) and total life expectancy (TLE) in the US from 2004 to 2014. HLE/ULE is a single measure that reflects the mortality and morbidity status of individuals simultaneously. This measure is the major output of the multistate life table technique that can be easily understood by the policymakers and social researchers with no strong statistical background (Zang and Lynch, 2018).

Method

Data and Target Population

This study uses two waves of the HRS or Health and Retirement Study (2012 and 2014), a nationally representative longitudinal survey of Americans aged 50 and over which is produced and distributed by the University of Michigan. The present study focuses on spouse caregivers and married non-caregivers aged 64-65 in the US from 2012 to 2014.

Identifying Spouse Caregivers in the HRS

In the HRS, for individuals who report ADL or IADL difficulties, they are asked to report if they receive any help with the ADL(s)/IADL(s), and who provides the help. If the individual responds that his/her spouse provides the help, their spouse is assigned spouse caregiver status. It is of note that the HRS does not currently collect health measures from other individuals associated with the household such as children, siblings or parents, so one would only have these data for spouse caregivers. Generally, family caregivers can be identified by the HRS helper data file items such as 2014's OG033_1-7 (ADLs helper relationship to the respondent) and OG055_1-6 (IADLs helper relationship to the respondent). These variables specify the relationship of any helpers with a respondent's own ADL(s) and IADL(s), including spouses. As such, multiple variables are needed to code the caregiver variable. All the necessary variables can be found in the section G of the HRS Core data. After identifying the family caregivers, they are merged to the RAND version of HRS which contains self-reported health status and many other health measures for the core household respondents and spouses. Regarding mortality, the HRS collects information about deceased respondents from living respondents. This information can be found in the HRS Exit data files.

Analytic Strategy

The present study utilizes the Bayesian multistate life table technique (Lynch & Brown 2005, 2010) to estimate HLE, ULE, TLE, and PLE by the covariates of interest. The technique involves multiple steps to achieve its goal. The steps include (1) estimating a multivariate hazard model using a Gibbs sampler, (2) generating the distribution of transition probabilities based on the sample of model parameters yielded in step 1 and (3) constructing the life table quantities using the probability of transitions generated in step 2. The first step uses the Bayesian Markov Chain Monte Carlo (MCMS) methods to produce a sample from the joint posterior distribution of the hazard model parameters. At this step, a linear combination of independent variables as well as the covariates of interest is involved in a multivariate probit model to predict the outcome variables including health and mortality. Step 2 involves using bivariate normal integration performed by the "pmvnorm" function to convert the parameters obtained at step 1 to age-specific predicted probabilities. At step 3, the age-specific transition probabilities are used to construct multistate life table quantities. According to Lynch and Brown (2005), the following equation expresses the general equation for the transfers in and out of state m:

$$l_{a+1}^{m} = l_{a}^{m} - \sum_{n \neq m} p_{a}^{mn} \times l_{a}^{m} + \sum_{n \neq m} p_{a}^{nm} \times l_{a}^{n},$$

Where l_{a+1}^{m}refers to the survivors in state m at age a+1, l_{a}^{m} refers to the survivors in state m at age a, p_{a}^{mn} is the probability of transition from state m to state n at age a, p_{a}^{nm} is the probability of transition from state n to state m at age a, and l_{a}^{n} is the survivors in state n at age a (Lynch and Brown 2005, 2010).

Figure 1 shows a three-state space multistate system reflecting all possible transitions among states of interest including healthy, unhealthy, and dead. In this three-state space multistate system six transitions are allowed: healthy to healthy, healthy to unhealthy,

healthy to dead, unhealthy to unhealthy, unhealthy to healthy and unhealthy to dead. Obviously, dead state is irreversible. The "p" character on each arrow reflects the transition probabilities which are crucial to constructing life table quantities as well as hypotheses testing. As shown in Figure 1, in total, six transition probabilities can be calculated at each age for each iteration of the Gibbs sampler as follows:

$p^{g}_{hd}(a, a + n) = \Phi\ ([-\infty, +\infty], [-\infty, X\ (2, s = 0)\ \beta^{g}], \Sigma^{g})$

$p^{g}_{ud}(a, a + n) = \Phi\ ([-\infty, +\infty], [-\infty, X\ (2, s = 1)\ \beta^{g}), \Sigma^{g})$

$p^{g}_{hu}(a, a + n) = \Phi\ ([-\infty, X\ (1, s = 0)\ \beta^{g}], [X\ (2, s = 0)\ \beta^{g}, +\infty], \Sigma^{g})$

$p^{g}_{uu}(a, a + n) = \Phi\ ([-\infty, X\ (1, s = 1)\ \beta^{g}], [X\ (2, s = 1)\ \beta^{g}, +\infty], \Sigma^{g})$

$p^{g}_{hh}(a, a + n) = 1 - (p^{g}_{hu}(x, x + n) + p^{g}_{hd}(x, x + n))$

$p^{g}_{uh}(a, a + n) = 1 - (p^{g}_{uu}(x, x + n) + p^{g}_{ud}(x, x + n))$

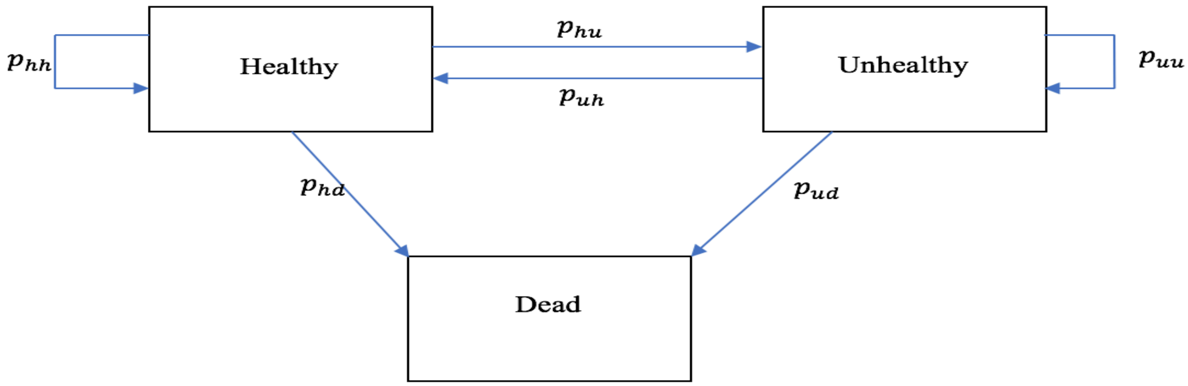
$p_{dh} = 0$

$p_{du} = 0$

$p_{dd} = 1$

Where u is unhealthy, h is healthy, and d is dead. The superscript of g stands for the g^{th} iteration of the Gibbs sampler and (a, a+n) refers to age interval from age a to age a+n. "On the right-hand side of the equation, Φ ([a, b], [c, d], e] is the integral of the bivariate normal distribution with limits a, b in the first dimension (the health equation) and c, d in the second dimension (the mortality equation), and e is the covariance matrix" (Lynch and Brown 2008, p. 4). In sum, $p_{hd}(a, a + n)$ refers to the transition probability (p) from the healthy state (h) to dead state (d) in the age interval of a to a+n. Obviously, the transition probability from dead state to healthy or unhealthy states are 0 (pdh = 0, pdu = 0).

Figure 1. A three-state space multistate system involving six possible transitions



Software and Functions

This study uses STATA and R to analyze the HRS data. Stata 15 (StataCorp 2015) is utilized for cleaning and data management, and R is utilized to run the multivariate probit model, and converting the parameters to transition probabilities as well as constructing life table quantities. Lynch and Brown (2008) developed R codes entitled "Gibbs sampler for multistate life table software (GSMLT v.91)" which includes two programs: GMSLThazard.R and GMSLTtables.R. The first program runs the multivariate probit model, and the second one uses the output of the first program as input to convert the hazard parameters to transition probabilities as well as constructing the life table quantities.

Measures

Dependent Variables

Any outcome variable in a multistate framework has to be binary or at least a set of indicator variables. The dependent variables for the multivariate probit model consist of two measures: 1) health and 2) mortality.

Health measure: A review of 27 community-based longitudinal studies (Idler and Benyamini 1997) revealed that self-rated health (SRH) is an independent predictor of mortality in almost all the studies after controlling for health status indicators and other related confounding factors. Likewise, Lynch (2003) stated that subjective measures of health such as SRH not only are valid measures of health but also are good predictors of mortality as compared to objective measures such as physicians' assessment. Moreover, in the context of family caregiving, SRH also may be preferred to other widely used health measures such as ADL, as ADL disability could cause a transition out of the caregiver role, whereas poor health might not induce such a transition. Thus, the present study uses dichotomized SRH (healthy vs. unhealthy) as a measure of health. SRH is usually dichotomized in the multistate framework as excellent/very good/good as "healthy" vs. fair/poor as "unhealthy."

Mortality Measure: The mortality measure consists of two categories: alive coded as 1 or dead coded as 0.

Independent Variables and Covariates of Interest

The main independent variable of interest in the multivariate probit model includes the spousal caregiving status consisting of two categories: (1) spouse caregiver and (2) married non-caregiver. Covariates of interest include key characteristics of spouse caregivers such as gender (male vs. female), race (white vs. African-American), and education (years of schooling).

Why the Multistate Life Table Technique?

Sullivan (1971) developed a single index that combines mortality and morbidity rates to compute the approximate expectation of life free of disability or other health-related subjects of interest. Sullivan's index has been widely used to measure the health status of the nation's population. It combines current abridged life table (i.e., mortality data) and a set of age-specific disability rates (i.e., morbidity data) applicable to the population of interest. The person-year column of life table or nLx is modified using age-specific disability rates and then the disability-free of life expectancy is computed using the new (modified) nLx. Thus, Sullivan's method requires two independently cross-sectional data that are widely available in the developed countries and most of developing countries. In addition, computation of the index is simple and requires basic demographic knowledge. However, according to Lynch and Brown (2010) "the subpopulation for which estimates can be produced is limited by two factors: 1) the level of disaggregation possible in mortality data, and 2) the subsample size for aggregated subpopulations in survey-based prevalence data" (p. 1055). In fact, in order to compute the disability-free of life expectancy for sub-populations, the mortality and morbidity data are needed to be disaggregated. Since annual life tables are usually produced by age, sex and race then for more specific subpopulations of interest such as family caregivers the mortality data is not available. Moreover, even if the mortality data for the sub-population of interest is available, the survey sample sizes are often too small to produce stable age-specific prevalence proportions in poor health for highly refined sub-populations (Lynch and Brown 2010). In contrast to Sullivan's method, the sample data is not aggregated in the multistate life table model. Instead, using hazard models, the transition probabilities among the states of interest (e.g., healthy, unhealthy and dead) are estimated. Then these probabilities are used to compute the life table quantities including HLE, ULE, TLE, and PLE for the covariates of interest.

Why the Bayesian Approach to the Multistate Life Table Technique?

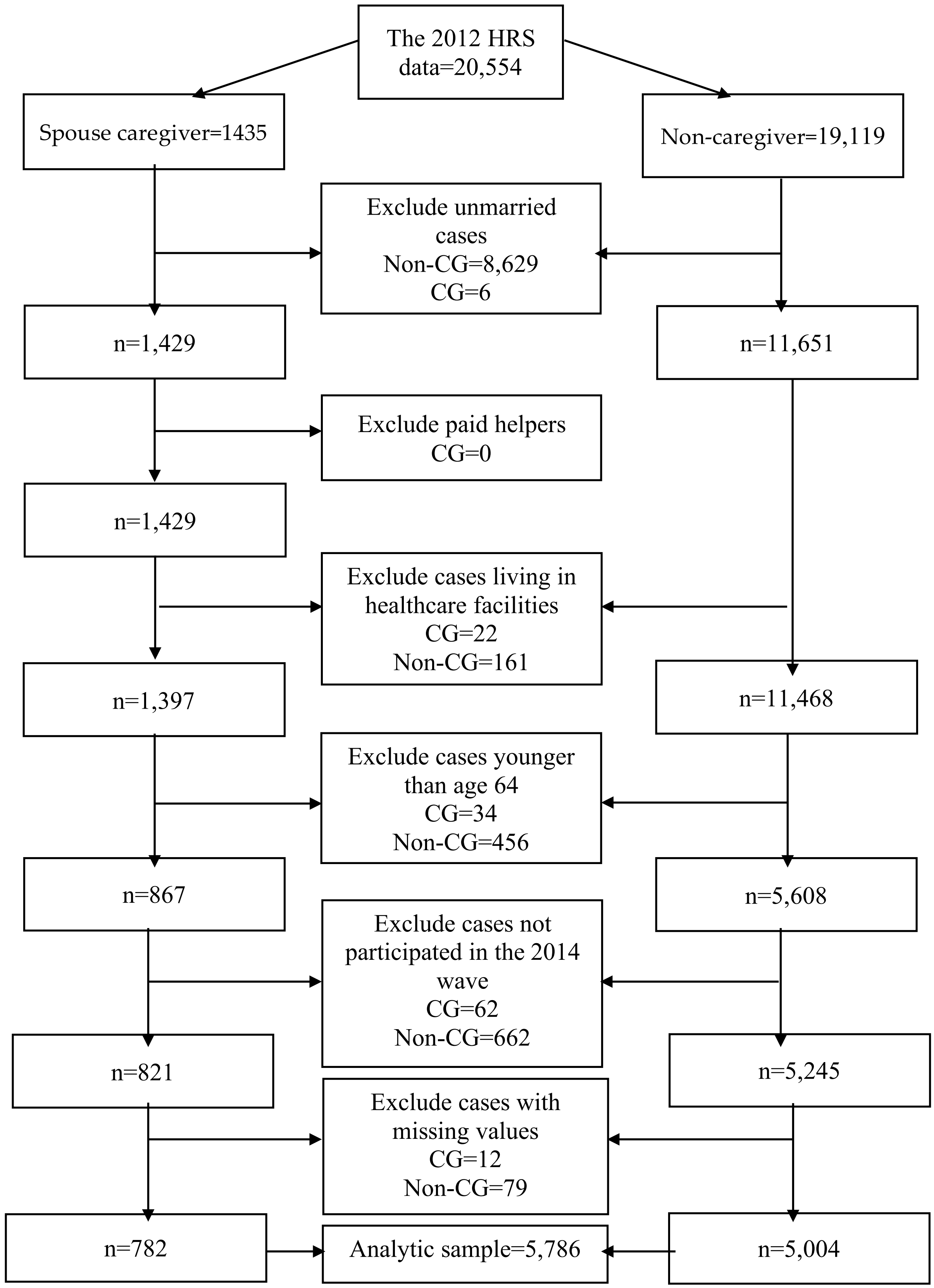
It is of note that although the multistate life table technique has clear advantages over Sullivan's method, the old approaches of the technique suffer from uncertainty issue. The issue happens because sample size in subpopulations of interest (e.g., male, black, caregivers of low income) might be too small to produce robust results. Recent approaches to multistate models including Bayesian and maximum likelihood methods address the uncertainty issue using Gibbs sampling and bootstrap techniques, respectively. Although both approaches address the uncertainty issue, Lynch and Brown (2005) argued that the Bayesian approach has advantages over the maximum likelihood approach. The key advantage is that interval estimates of life table quantities are constructed relatively simple in the Bayesian approach. In contrast, according to Lynch (2007), constructing interval estimates of the HLE, ULE, and TLE in the maximum likelihood approach is not straightforward because converting the estimated standard errors for the parameters to the standard errors for state expectancies (e.g., HLE, ULE, TLE) in the maximum likelihood approach is unclear. For this reason, researchers who utilized the results of hazard models in the maximum likelihood approach have simply reported point estimates for the life table quantitates rather than interval estimates. This indicates that the classical maximum likelihood approach is unable to quantify the uncertainty issue which is an integral aspect of using sample data to make the inference to the population. The Bayesian approach, in contrast, is flexible in constructing the interval estimates and therefore quantifying the uncertainty issue (Lynch 2007). Moreover, due to the Bayesian approach to probability, conducting formal hypothesis tests is more flexible in a Bayesian approach as compared to other approaches.

Sample Selection Process

Sample selection process involves excluding cases from caregiver and non-caregiver samples in order to identify the target sample of this study (i.e., spouse caregivers and married non-caregivers). The process consists of six steps: (1) excluding unmarried cases from non-caregiver sample, (2) excluding caregivers who provided care to someone other than spouse/partner (non-spouse caregivers), (3) excluding paid helpers, (4) excluding cases living in healthcare facilitates such as nursing homes, (5) excluding cases aged less than 64, (6) excluding cases who did not participate in the subsequent wave of the HRS (2014) for any reasons but death.

Figure 2 shows the selection process flowchart of the 2012-2014 HRS data. The original sample in the 2012 HRS data includes 25,333 cases consisting of 19,119 non-caregivers and 6,214 caregivers. After excluding the cases due to mentioned six reasons, the sample size reduced to 10,353 cases consisting of 9,211 married non-caregivers and 1,142 spouse caregivers. Of 10,353 remaining cases, 12 spouse caregivers and 79 non-caregivers with missing values in the key characteristics -age, sex, race, education, SRH, and mortality- were excluded. This reduced the analytic sample size of the study to 1,130 spouse caregivers and 9,132 married non-caregivers in 2012-2014.

Figure 2. Sample selection process of the 2012-2014 HRS data

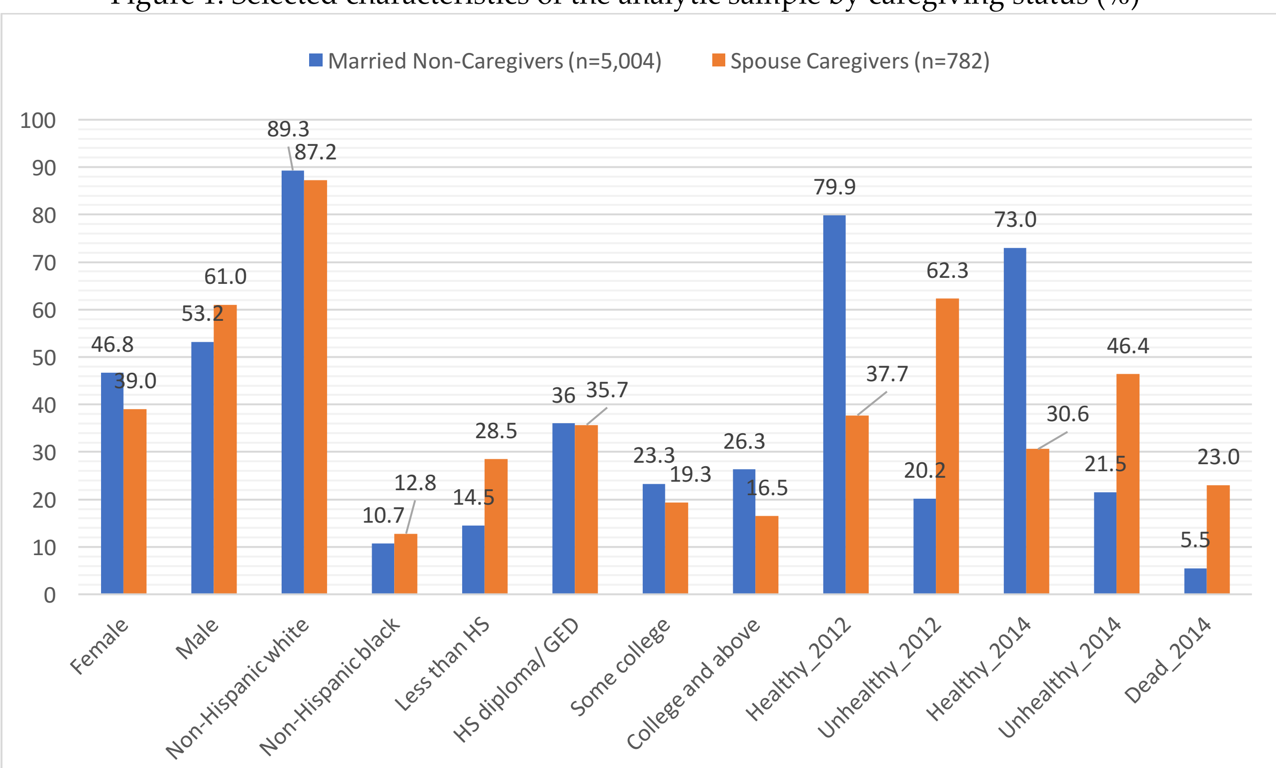


Preliminary Results

The analytic sample of this study includes 5,786 individuals aged 64 or over consisting of 782 spouse caregivers and 5,004 married non-caregivers. Married non-caregivers are, on average, around 73 years old (SD=6.38) with a median of 73. Their age ranges from 64 to 96 years with 25% older than 77. Spouse caregivers are, on average, three years older than married non-caregivers. They have a mean age of around 76.6 years (SD=7.3) with a median of 76. Spouse caregivers age ranges from 64 to 100 with 25% older than 82.

As shown in Figure 1, married non-caregivers are healthier than spouse caregivers in both 2012 and 2014, and the percentage of occurrence of death is lower among married non-caregivers as well. Around 53% of married non-caregivers are males. Most of the married caregivers are non-Hispanic whites, and have a high school diploma/GED. In the case of spouse caregiver, 61% are male. Most of the spouse caregivers are non-Hispanic whites and about 36% have a high school diploma/GED. Although the percentage of spouse caregivers and married non-caregivers with a high school diploma/GED are almost the same, the percentage of married non-caregivers with some college degree or college and above is higher than spouse caregivers. In contrast, the percentage of spouse caregivers with a less than high school years of education is higher than married non-caregivers.

Figure 1. Selected characteristics of the analytic sample by caregiving status (%)



Source: Author's calculations based on the HRS 2012 and 2014.

As shown in Table 1, married non-caregivers at age 64-65, on average, can expect to live an additional 22.7 years of which 71% (6.5 years) should be healthy years. These figures are 11 years and 57% among caregiver counterparts, respectively. This indicates that married non-caregivers live longer and spend a higher proportion of their remaining life in the healthy state as compared to spouse caregivers.

Results also show that the gap in HLE, ULE, TLE, and PLE between married non-caregivers and spouse caregivers are evident after controlling for sex, race, and education. For example, black male non-caregivers at age 64-65 with 12 years of schooling can expect to spend 56% of their additional expected years of life (20 years) in the healthy state which is 14% higher than their caregiver peers. In the case of black females with 12 years of schooling, the gap in HLE, ULE, TLE, and PLE are 10 years, 4.4 years, 13.3 years and 13% in favor of married non-caregivers, respectively. While white male non-caregivers with 12 years of schooling can expect to live an additional 20 years of which 70% should be healthy years, their caregiver counterparts can live an additional 10 years of which 54% is expected to be spent in the healthy state. Likewise, whilst white female non-caregivers can expect to spend 70% of their TLE in the healthy state, their caregiver counterparts can expect to spend 57% proportion of TLE in the healthy state.

Table 1. HLE, ULE, TLE, and PLE by caregiving status at age 64-65 in the US (2012-2014)

Profile*	HLE		ULE		TLE		PLE (%)	
	Non-caregiver	Caregiver	Non-caregiver	Caregiver	Non-caregiver	Caregiver	Non-caregiver	Caregiver
All*	14		6.1		20.2		70	
All*	16	6.2	6.5	4.7	22.7	11	71	57
Black males with 12 years schooling†	11.3	4	8.7	5.7	20	10	56	42
Black females with 12 years schooling†	15	5	11	6.6	26	11.7	57	44
White males with 12 years schooling†	14	5.4	6	4.6	20	10	70	54
White females with 12 years schooling†	18	6.8	7.7	5	26	12	70	57

Source: Author's calculations based on the HRS 2012 and 2014.
*None of the covariates are controlled.
†Education is controlled by setting its value to 12 years of schooling.

Conclusion

This ongoing study seeks to resolve the paradox of poorer health and lower mortality risk among spouse caregivers by examining the "living- longer- but-unhealthier" hypothesis. This hypothesis speculates that the survival advantages of caregiving, as the healthy caregiver hypothesis argues, can be accompanied by a higher prevalence of chronic physical and mental diseases, as stress theory speculates. The results of the present study, however, did not provide sufficient evidence to support this hypothesis by revealing that spouse caregivers have a lower life expectancy and live a greater proportion of life expectancy in the unhealthy state as compared to married non-caregivers. This finding also does not support the healthy caregiver hypothesis. Instead, it is consistent with stress theory which speculates that informal caregiving is deleterious to caregivers' physical and mental health, which in turn can increase their mortality risks.

Another possible explanation for the findings of this study could be age differences between spouse caregivers and married non-caregivers; that is spouse caregivers are older than married non-caregivers in the 2012-2014 HRS data. This speculation can be supported by the age-as-leveler hypothesis which argues that as people age they are more likely to report having fair or poor health. In other words, this hypothesis posits that the age dependence of health is stronger among older adults as opposed to the younger adults (Lynch 2003). Further draft of this paper will scrutinize this hypothesis.

There are two main limitations to this research that warrant mention. First, while previous studies have linked caregiving intensity, type of care (ADL or IADL), religiosity/spirituality, depressive symptoms and perceived stress to informal caregivers' health and mortality, due to time limitation the present draft of this study did not include these covariates. Further draft of this paper will address this limitation by estimating HLE, ULE, TLE, and PLE by the mentioned covariates for spouse caregivers and married non-caregivers. Second, confounding factors such as preexisting health measures (e.g., history of stroke, lung disease, diabetes) as well as health-related behaviors such as physical activity, smoking, and alcohol consumption will be controlled in further analyses.

References

Bennett J.M., Fagundes C.P., Kiecolt-Glaser J.K. (2013). The Chronic Stress of Caregiving Accelerates the Natural Aging of the Immune System. In: Bosch J., Phillips A., Lord J. (eds) Immunosenescence. Springer, New York, NY

Brown, S. L., Smith, D. M., Schulz, R., Kabeto, M. U., Ubel, P. A., Poulin, M., & Langa, K. M. (2009). Caregiving behavior is associated with decreased mortality risk. *Psychological Science*, 20, 488–494.

Burton, L. C., Zdaniuk, B., Schulz, R., Jackson, S., & Hirsch, C. (2003). Transitions in spousal caregiving. *The Gerontologist*, 43, 230–241.

Capistrant, B. D., Berkman, L.F., Glymour, M.M. (2014) Does duration of spousal caregiving affect risk of depression onset? Evidence from the health and retirement study. *Am J Geriatr Psychiatry*; 22: 766-770.

Capistrant, B. D., Moon, J. R., Berkman, L. F., & Glymour, M. M. (2012a). Current and long-term spousal caregiving and onset of cardiovascular disease. *J Epidemiol Community Health*, 66: 951-956.

Capistrant, B. D., Moon, R., & Glymour, M. M. (2012b). Spousal caregiving and incident hypertension. *American Journal of Hypertension*, 25: 437-443.

Crimmins, E. M., & Hayward, M. D. and Saito, Y. (1996). Differentials in active life expectancy in the older population of the United States. *Journal of Gerontology: SOCIAL SCIENCES*, Vol. 5IB. No. 3. SIII-SI2O.

Fredman, L. & Lyons, J. G. & Cauley, J. A. & Hochberg, M. and Applebaum, K. M. (2015). The Relationship Between Caregiving and Mortality After Accounting for Time-Varying Caregiver Status and Addressing the Healthy Caregiver Hypothesis. *Journals of Gerontology: Medical Sciences*; Vol. 70, No. 9, 1163–1168.

Fredman, L., & Doros, G., Ensrud, K. E., & Hochberg, M., and Cauley, J. A. (2009). Caregiving intensity and change in physical functioning over a 2-year period: Results of the caregiver-study of Osteoporotic fractures. *American Journal of Epidemiology*, 170, 203-210.

Fredman, L., Cauley, J. A., Hochberg, M., Ensrud, K. E., & Doros, G. (2010). Mortality associated with caregiving, general stress, and caregiving-related stress in elderly women: Results of caregiver- study of osteoporotic fractures. *Journal of the American Geriatrics Society*, 58, 937–943.

Health and Retirement Study, ([insert Product Name]) public use dataset. Produced and distributed by the University of Michigan with funding from the National Institute on Aging (grant number NIA U01AG009740). Ann Arbor, MI, (year).

HRS (2008). Sample Evolution: 1992-1998. Available at: http://hrsonline.isr.umich.edu/sitedocs/surveydesign.pdf

Idler, E. L. and Benyamini, Y. (1997). Self-Rated Health and Mortality: A Review of Twenty-Seven Community Studies. *Journal of Health and Social Behavior*, Vol. 38, No. 1, pp. 21-37.

Lee S., Colditz G.A., Berkman L.F., Kawachi I. (2003) Caregiving and risk of coronary heart disease in U.S. women: a prospective study. *Am J Prev Med*, 24:113–119.

Lin, I.-F., Holly, H. R., & Wu, H. S. (2012). Negative and positive caregiving experiences: A closer look at the intersection of gender and relationship. Family Relations, 62, 343–358.

Lynch, S. M. (2003) Cohort and Life-Course Patterns in the Relationship Between Education and Health: A Hierarchical Approach. *Demography*, Vol. 40: 309-331.

Lynch, S. M. (2007). Introduction to Applied Bayesian Statistics and Estimation for Social Scientists. New York: Springer.

Lynch, S. M. & Brown, J. S. (2005). A new approach to estimating life tables with covaritate and constructing interval estimates of life table quantities. *Sociological Methodology*, 35, 177-225.

Lynch, S. M. & Brown, J. S. (2010). Obtaining multistate life table distributions for highly refined subpopulations from cross-sectional data: a Bayesian extension of Sullivan's method. *Demography*, 47, 1053-1077.

Lynch, S. M., Brown, J.S. (2008). Gibbs Sampler for Multistate Life Tables Software (GSMLT v.91), Available at: https://reves.site.ined.fr/fichier/s_rubrique/20183/lynch_brown_gsmltmanual.en.pdf

O'Reilly, D. & Rosato, M. & Maguire, A. and Wright, D. (2015). Caregiving reduces mortality risk for most caregivers: a census-based record linkage study. *International Journal of Epidemiology*, 2015, 1959–1969.

O'Reilly, D., Connolly, S., Rosato, M., & Patterson, C. (2008). Is caring associated with an increased risk of mortality? A longitudinal study. *Social Science & Medicine (1982)*, 67, 1282–1290.

Pearlin, L. I., Mullan, J. T., Semple, S. J., & Skaff, M. M. (1990). Caregiving and the stress process: An overview of concepts and their measures. *The Gerontologist*, 30, 583–594.

Pinquart, M., & Sörensen, S. (2003). Differences between caregivers and non-caregivers in psychological health and physical health: A meta-analysis. *Psychology and Aging*, 18, 250–267.

Pinquart, M., & Sorensen, S. (2011). Spouses, adult children, and children-in-law as caregivers of older adults: A meta-analytic comparison. *Psychology and Aging*, 26, 1-14.

Ramsay, S., Grundy, E., & O'Reilly, D. (2013). The relationship between informal caregiving and mortality: An analysis using the ONS Longitudinal Study of England and Wales. *Journal of Epidemiology and Community Health*, 67, 655–660.

RAND HRS Data, Version P. Produced by the RAND Center for the Study of Aging, with funding from the National Institute on Aging and the Social Security Administration. Santa Monica, CA (August 2016).

Reinhard, S. C., Feinberg, L. F., Choula, R., & Houser, A. (2015). Valuing the invaluable:

2015 update. Washington, DC: AARP Public Policy Institute.

Roth, D. L., Fredman, L., & Haley, W. E. (2015). Informal caregiving and its impact on health: A reappraisal from population-based studies. *The Gerontologist*, 2015, Vol. 55, No. 2, 309–319.

Schulz, R., & Beach, S. R. (1999). Caregiving as a risk factor for mortality: The Caregiver Health Effects Study. *JAMA*, 282, 2215–2219.

StataCorp. (2015). Stata Statistical Software: Release 15. College Station, TX: StataCorp LP.

Sorensen, S., Pinquart, M., & Duberstein, P. (2002). How effective are interventions with caregivers: An updated meta-analysis. *Gerontologist*, 42, 356 –372.

Sullivan, D. F. (1971) A single index of mortality and morbidity. *HSMHA Health Rep.*, 86:347–54.

Zang, E. and Lynch, S. M. (2018). Bayesian multistate life table methods for complex, high-dimensional state spaces: Development and illustration of a new method. Paper presented at the 2018 Population Association of America's Conference. Available at: https://paa.confex.com/paa/2018/meetingapp.cgi/Paper/21556