Bereavement, Health, and Mortality among the Elderly*

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Abstract

Bereavement, i.e. the death of a partner, is rated as one of the most traumatic experience one can have. Being bereaved severely affects the production of health within the household and has been associated with an increased risk of mental and physical health problems, as well as an increased risk of death. Bereavement may also lead to increased long-term care expenditures for the elderly. Yet, few studies to date have examined whether the "bereavement effect" reflects a causal effect or just merely a correlation. In this paper, the aim is to estimate the causal effect of bereavement on morbidity and mortality in a large sample of Swedish elderly. We specify a model where the lifetime of the respondent is a function of time-varying bereavement. The model is estimated using data from the ULF-survey on 18,000 Swedish couples aged 60 and above, who have been followed for at most 20 years. These data have been linked to both the Swedish mortality register as well as to the hospital inpatient register. Using the latter data, we observe multiple hospital and non-hospital spells for each individual, allowing us to use fixed effects estimation within a duration analysis framework. In this manner, we are able to deal with the endogeneity of spousal death. Moreover, we use multi-state models, where different causes of deaths are considered. In the estimations, we control for standard socio-economic and demographic information, as well as for initial health conditions. Preliminary results, using stratified partial likelihood analyses, suggest a negative relation between bereavement and the morbidity hazard. Concerning the mortality hazard, a strong positive bereavement effect is obtained among males. The effect is strongest for during the first 6 months after bereavement and then shrinks in magnitude. Among females, no evidence of any bereavement effect is obtained.

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1 Introduction

Health becomes more unevenly distributed at advanced ages. While some individuals remain healthy, other face severe cognitive and physical problems. Such health disparities, to a great extent, reflect events that occurred and decisions that people have made during the course of the life cycle. At the same time, major life events at advanced ages, like the loss of a partner, having an accident, or facing a sudden drop in income, can have severe health consequences. For policy purposes, it is important to know how important such events are, whether there are differential effects for different subgroups, and what kind of interventions limit the effects of such adverse shocks.

In this paper, we focus on a specific event occuring at advanced ages: the loss of a partner, i.e bereavement. Losing a partner is an inevitable event that will happen to all couples that remain together. Bereavement has also been rated as the most traumatic experience one can have (Holmes & Rahe, 1967). It has been associated with an increased risk of mental and physical health problems as well as an increased risk of death (e.g. Bowling, 1987; Bowling, 1994; Lichtenstein, Gatz, & Berg, 1998; Chen et al., 1999; Nystedt, 2002; Ott & Lueger, 2002; van den Berg et al., 2006).[1]

While a large number of studies have found a positive correlation in morbidity and mortality among spouses, few studies have convincingly estimated a causal effect of bereavement. The basic problem is that several, very different, stories may explain a correlation in morbidity or mortality among spouses. First of all, the death of a beloved one may have a direct adverse effect on the health of the surviving partner, thereby increasing his or her mortality risk. Increased stress levels or an impaired immune system following bereavement have been suggested as explanations (Parkes et al., 1969; Jones & Goldblatt, 1987; Kaprio et al., 1987; Stroebe & Stroebe, 1993). More generally, the death of a partner may lead to losses in economics of scale and specialization within the household, leading to reduced consumption possibilities, and thereby adversely affecting the health of the surviving partner (Nystedt, 2002). Yet another suggested explanation is that the death of a spouse reduces the supply of informal care and social support, provided either by the deceased partner or the household's joint social network. It is well known that the spouse is the most important informal care-giver among elderly people. Social support networks have been found to be a buffer against stressful life events (Harlow et al., 1991; Shye et al., 1995).

While these theories suggest a causal effect of bereavement on morbidity and mortality, a second strand of theories highlight the role of non-causal mechanisms. It is well known, for instance, that individuals tend to marry people with similar tastes and characteristics. Such positive assortative matching in the marriage market along dimensions such as health and health-related behaviour may therefore induce a positive correlation in morbidity and mortality risk between spouses (e. g. Jones & Goldblatt, 1987; Lichtenstein et al., 1998). Moreover, married couples share a variety of exogenous risk factors. Sharing the

[1] In the Webster's II New College Dictionary (1999) bereavement is defined as being deprived of something that one holds dear.

same degree of pollution, facing the same neighbourhood characteristics, and being exposed to the same disease environment may again induce a correlation in morbidity and mortality risk between spouses.

Naturally, understanding the sources of spousal correlation in morbidity and mortality risks is important for policy purposes. Designing appropriate policies is dependent on having knowledge about the causal effect of bereavement on the health of the remaining partner. Understanding the mechanism behind the "bereavement effect" is also important for the general understanding of health disparities and health dynamics at advanced ages.

In this paper, our aim is to estimate the causal effect of bereavement on morbidity and mortality. Our empirical anaysis is based on a data set covering about 18,000 married couples aged 60 and over during the period 1980-2000. The data originate from the Swedish Longitudinal Study on Living Conditions (ULF). These data have been linked to both the Swedish mortality register and the hospital inpatient register. The former collects information on the date and cause of death for both the main respondent and his/her spouse, whereas the latter records the dates and causes of all hospital discharges over a 20 year period for the main respondent. Using the latter data, we observe multiple hospital and non-hospital spells for each individual. We therefore specify models that allow for unobserved individual effects in a flexible way. Similar to Lindeboom & Kerkhofs (2000), where sickness and work spells of teachers within the same school are allowed to be related by a latent common factor, we allow hospital and non-hospital spells of the same individual to be related by a latent common factor. We will use a stratified partial-likelihood approach to estimate the regression coefficients of this model, which allows for nonparametric baseline hazards that may be different for each individual and each type of transition. In this manner, we are able to adress some of the potential endogeneity of the bereavement variable. In the regressions, we control for standard socio-economic and demographic information, as well as for initial health conditions.

Our results suggest very different effects of bereavement on morbidity and mortality. For morbidity, the results from the stratified partial likelihood models in most cases suggest a negative relationship between bereavement and the morbidity hazard. This actually suggests a lowered risk of morbidity following bereavement. One interpretation of this result is that bereavement reduces the care-giving burden of the surviving partner and thus improves health. For all-cause morbidity, the effect is found only for the first 6 months following bereavement. Examining separate causes, however, reveals that the effect of bereavement differ by cause. For circulatory diseases, for instance, the relationship between bereavement and the hazard is negative for the first 6 months following bereavement, but then turns positive and significant for 12 or more months after bereavement for females. For mental and behavioural disorders, however, bereavement seems to reduce the hazard for all periods after bereavement for females.

The results for the transition away from morbidity, i.e. from hospital to non-hospital, suggest a different pattern. Being bereaved is now negatively related to the hazard of leaving hospital. Since individuals at hospital may be the ones being taken care of, there is no reduced care-giving burden for these individuals and, hence, no increased risk of leaving hospital.

For mortality, the results suggest a strong bereavement effect among males. The effect is strongest during the first 6 months and then gradually declines. Considering separate causes of death, the effect is especially pronounced for myocardial infarction and cancers. Among females, no evidence of any bereavement effect on mortality is obtained.

The structure of the paper is as follows: Section 2 provides some background to our study, while Section 3 introduces the data used. Section 4 introduces the empirical method and the empirical results are then discussed in Section 5. Section 6 concludes.

2 Background

Some of the empirical findings in the bereavement literature may be interpreted within a simple household economics framework. First of all, we note that some of the benefits of marriage, compared to living as single, has been attributed to the expansion of consumption possibilities (Becker, 1991). In line with this, marriage has been found to correlate with improved health, as well as a variety of positive outcomes, such as income, wealth and overall life satisfaction (Hu and Goldman, 1990; Coombs, 1991; Joung et al. 1994; Waite and Gallagher, 2000; Van Poppel and Joung, 2001). Some of these benefits relate to the degree of specialisation within the household and to the utilisation of economics of scale.

As widowed, any specialisation that generated consumption gains as married may instead constitute a disadvantage. The disadvantage is directly related to the degree of specialisation, since a higher degree of specialisation within the household also will increase the divergence between the optimal behaviour as married compared to being single. Such divergence requires more or less adaption to take place once bereaved, possibly affecting health through stress and accidents (Nystedt, 2002). Psychological stress has been found to be associated with heart disease, arrythmias (irregular heartbeat), as well as changes in the pulse rate, blood pressure, stroke volume, clotting time, and cardiac output (Parkes et al., 1969). Households with a stronger degree of specialisation could therefore be expected to suffer more following bereavement and experience more stress-related health impairments.

Naturally, the partner that is less specialised in skills that are important for running a single-person household would suffer the most following bereavement. The traditional division of labour typically assigns the wife the role of the home-maker and home producer and the husband the role of the breadwinner. If skills in household production are important in a single-person household, widows are typically better equipped for a life as singles compared to widowers. This is consistent with empirical evidence, suggesting that males are at greater risk than females following bereavement (Jones & Goldblatt, 1987; Kaprio et al., 1987; Bowling, 1994). Older widowers commonly experience difficulties in performing housekeeping chores like cookin or cleaning, which may lead to insufficient caloric intake and otherwise unhealthy living conditions. In line with this, it has been suggested that the higher relative mortality risk of males compared to females following bereavement is partly due to the "loss of a homemaker and housekeeper" (Bowling, 1987). For females, the evidence is mixed as to whether or not there exists any bereavement effect at all. It should be noted, though, that females may suffer from a greater loss of income following bereavment, since the husband typically is the breadwinner in the household (e.g. Hurd & Wise, 1989; Bernheim et al., 2003).

Gender differences in mortality risks at advanced ages also suggest an unequal distribution of health within elderly couples. Typically, the husband is in worse shape than his wife, meaning that the burden of caregiving will be disproportionaly put on the wife. Bereavement will in this case be more damaging to the husband than the wife, providing an additional explanation for the mortality risk gender gap. For the surviving wife, the death of a partner may, although painful, actually reduce the caregiving burden and thereby be beneficial for health (Schultz et al., 1995).

Greater *age* has been found to reduce the effect of bereavement on mortality (Kaprio et al., 1987; Lichtenstein et al., 1998). Expectations may play a role here. With higher age, widowhood is more anticipated, meaning less stress and more time to prepare for a life as a widow. At younger age, bereavement is less expected and causing more intense grief symptoms. It should be noted, though, that the ability to adapt to changing living conditions may also decrease with age, making the effect of age on the bereavement effect an empirical issue.

Little evidence exists for any *socio-economic* differences in the effect of bereavement on mortality risk. The few studies that have taken socio-economic differences into account find no evidence for any such differential effects (Parkes et al., 1969; Bowling, 1994; van den Berg et al., 2006). While greater income and/or education may provide the surviving spouse with resources to cope with some of the negative effects of bereavement, there may be opposite effects as well. The same factors may be related to the quality of the match and to the distribution of resources between the spouses, making clear-cut predictions difficult.

A comment on re-marriage is warranted. While re-marriage following bereavement was common in the 19th century in Sweden, today's re-marriage rates for people above 60 are very low. There are several possible explanations for this. In the 19th century and early 20th century, re-marriage was in many cases a necessity for surviving in the absence of social security systems, whereas today's widows are able to claim widow retirement benefits. Moreover, widows re-marrying in Sweden lose their right to claim widow retirement benefits, providing a strong disincentive to re-marry at old ages.

3 Data

In our analyses, we use data from the Swedish Study of Living Conditions (ULF) for the period 1980-2000. The ULF study consists of annual interviews of about 7,000 individuals, conducted by Statistics Sweden. Interviews are conducted mainly through face-to-face interviews but telephone interviews are also used in a smaller number of cases. The sampling population consists of all adults aged 16-84 that are permanently living in Sweden and the interview objects are randomly drawn from the Total Population Register. At each wave, about 40% of the respondents are included in a rotating panel in which respondents are re-interviewed in 8 year intervals. The total number of interviews for the period 1980-2000 is 132,867 and the response rate in the ULF waves is typically about 80 percent.

The ULF database provides extensive socio-economic and demographic information, as well as detailed information on health and health-related behaviour. Although ULF is not a household survey, certain information about the spouse is provided.

The information provided through the interviews has been complemented with register data by Statistics Sweden. Especially useful for our purpose is the linkage to the National Causes of Death Register, which records all deaths of individuals who have a permanent residence in Sweden. The register includes the date of death, place of death, underlying cause of death (through the International Classification of Diseases, ICD), and up to the 6th contributing cause of death for the whole period 1980-2000. This allows us to follow changes in vital status of the respondent from the date of his/her first interview up until the year 2001. The same information is provided for the respondent's spouse.

The interview data has also been linked to data from the National Hospital Patient Register. This register provides information on all hospital discharges at Swedish hospitals and includes information on date of admission and discharge. Moreover, it includes both main diagnosis and contributing causes according to the International Classification of Diseases. Unfortunately, no information is provided on the spouse's hospital discharges. The information from the Hospital Patient Register is available for the period 1980-2000 for all respondents, with some exceptions.[2]

From the 132,867 observations in ULF, we first restricted our sample to those aged 60 and above and those who were married at any interview during the period 1980-2000. We did not include individuals co-habitating, since no information on the death of the partner was given for these individuals. For those interviewed only once we have to assume that marital status was unchanged until own death, death of the spouse, or to the end of the observation window in 2001. For individuals being interviewed two or three times, we are able to examine if the individual is still married with the same person at the second and

[2] There are some exceptions, since complete coverage by the hospital register was not reached until 1987. During the 1980s, Sweden was divided into 25 counties. In 1980, 8 of these were not covered by the hospital register. The number of counties then increased year by year and in 1986 only 1 county was not covered.

third follow-ups. After that, we cannot, again, observe any changes in marital status. The age limit of 60 was chosen, since divorce and re-marriage is very uncommon above this age.

Imposing the age limit of 60 left us with 36,177 observations, where 35,959 remained after deleting missing responses to some of the explanataroy variables. Out of these, roughly one third, or 21,930 observations, were selected, since they referred to individuals having been married at some occasion during the period 1980-2000. For individuals reporting being married, but having reported being unmarried at earlier interviews, we only included the former observations, resulting in a drop of 40 observations. We also dropped observations on individuals reported being married, but that on later follow-ups reported being divorced, leading to a drop of 95 observations. In 8 cases we could observe the widow cohabitating at a later wave after his/her spouse's death. These observations were dropped. This left us with 21,787 observations

Since our analysis require the exact date of death, as well as date of interview, we had to delete 17 observations were the date was mis-coded or missing. In addition, we dropped all observations were the interview was conducted after 1/1 2001. The reason is that the mortality data in ULF is recorded until 1/1-2001 and any deaths after that date is not recorded. This resulted in a loss of 69 observations.

In some cases, the death of the spouse occured at the same year as the interview, but before the actual date of the interview. In these cases, the main person was still registered as married, since widowhood is not registered in the population register until the following year. Since we were unable to tell if the individual actually had re-married the same year or if it just reflected that widowhood was not registered until the next year, we dropped these 123 observations.

In three cases, the spouses died on the exact same date. Since it was impossible to tell who died first in these cases, we deleted these observations. This leaves us with 21,575 observations, or 17,653 individuals. The number of females counted to 7,739 and the number of males to 9,914. For the analysis of hospital spells we also had to drop the respondents were information was not given in the hospital register. This resulted in a loss of 1,290 observations.

About 39% of the sample, or 6,897 individuals, were observed to die during the sample period. Out of these, 2,400 were females and 4,497 were males, with the average age of death being 79.8 and 80.6, respectively. In 3,837 cases were both the main respondent and his/her spouse observed to die. The main respondent was observed to die before his/her spouse in 1,996 cases, whereas the opposite was true for 1,871 cases. In the latter case, the average number of years alive following bereavement was 4.5 for males and 5.9 for females. In 3,060 cases were the spouse still alive when the main respondent died. We observe 6,345 cases where the spouse of the main respondent dies (3,664 widows and 2,681 widowers). The average age of bereavement was 77.6 and 82 for females and males, respectively. The average follow-up time, until death or censoring was 8.8 years.

Regarding hospital spells, 71% of the respondents have at least one recorded hospital spell during the period. The average number of hospital spells was 3.3 and among those having at least one hospital spell, the average was 4.7.

3.1 Variables

Besides the information given in the Hospital Patient Register, all ULF-waves provide information on the presence and number of diseases (according to ICD), such as infectious diseases, tumours, diabetes, blood diseases, mental diseases, eyes diseases, ear diseases, allergies, and about 20 more. Information is also included on damage due to accidents or violence, such as fractures. For each cause, information is provided on the age of onset of the disease and whether or not the individual receives regular medical treatment for the disease. In addition, information is given on self-reported health, any reduced work capacity due to long-term disease, degree of reduced work capacity (to pensioners; reduced capacity in any leisure activities), being able to run short distances, being able to walk in stairs, being able to get on a bus, being able to walk briefly, reduced eye-sight, and impaired hearing. All waves also include certain information on health-related behaviour, such as smoking and exercise.

In the empirical analysis we reduce the number of disease and accident categories to five major ones and one category that represents other diseses. We create 6 dummy variables, indicating the presence of any cancer, any respiratory diseases, any circulatory diseases, any mental disorders, any damage due to accidents and violence, and any other diseases. Moreover, we create a dummy variable indicating the presence of any activity limitation (whether or not the person could run a short distance, 100 meters, if in a hurry).

In ULF, information on *income* is based on register data from the National Tax Register. This includes information on wage earnings, self-employment earnings, disposable income and various benefits, such as pensions, sickness benefits, and social assistance. In our analyses, we use a measure of disposable income, provided by Statistics Sweden, that is consistent for the period 1980-2000.

Education was derived from a question where respondents were asked to assign their highest attained level of education. We then created a binary variable, indicating whether or not the individual had a university level education. The classification was based on the Swedish SUN79 classification of education.

The *number of children* have been found to be an important predictor of the amount of informal care received (Bolin, Lindgren, Lundborg 2007). A greater number of children could therefore be expected to increase the supply of informal care, possible making the effect of bereavement less severe. We used a variable indicating the total number of children in the household of the respondent.

Country of birth may relate to cultural differences in coping with bereavement and to the available social network. We created a binary indicator of whether or not the respondent was born in Sweden.

Table 1 shows the mean of the main socio-economic and demographic variables.

Table 1: Demographic and socio-economic characteristics of the main responent.

Variables	**Mean (in %)**
Female	44.1
Age	68.8
University education	10.5
Disposable income (in SEK)	594.3
Number of children at home	0.1
Born in Sweden	92.3
Cancers	2.5
Endocrine diseases	9.5
Mental disorders	2.5
Circulatory diseases	34.6
Outer violence and accidents	4.6
Other diseases	44.6
Activity limitations	37.6
Observations	16,693

4 Empirical model

In our empirical analyses, we focus on the duration of hospital and non-hospital spells. The individual, i, may either be in hospital (H) or not in hospital (N). A hospital spell may end either when the individual leaves hospital or when the individual dies. We define $\theta^{H,N}$ as the transition from hospital to non-hospital and $\theta^{H,D}$ as the transition from hospital to death. In the same manner, a non-hospital spell may end either by leaving for hospital or by dying. Let $\theta^{H,N}$ and $\theta^{H,D}$ denote the exit rates associated with these transitions. We assume the transition rates to be of the mixed proportional hazard type (MPH) and take it as:

$$\theta^{K,L}(t;x,\eta_i^{K,L},\beta^{K,L}) = \theta_0^{K,L}(t,\eta_i^{K,L}) \cdot \theta_1^{K,L}(x;\beta^{K,L}), \tag{1}$$

where $K, L \in \{H, N, D\}$ and $K \neq L$. The explanatory variable x includes socio-demographic factors, health, and an indicator variable of bereavement. The $\eta_i^{K,L}$ term is unobserved and specific to individual i. Moreover, it may differ for each of the hazard rates considered. While the baseline hazard θ_0 is an arbitrary function of unobserved individual-specific heterogeneity and duration dependence, θ_1 is a function of observed characteristics x.

The individual exit times in each of the states considered can be treated as independent, under the assumption that all individual differences are fully captured by x and $\eta_i^{K,L}$. A nice feature is that the total-likelihood function then factorises into separate parts, where each part is associated with one of the transitions considered. The next step is to decide upon the estimation strategy, which to a large extent depends on the assumptions made regarding the baseline hazard, $\theta_0^{K,L}(t,\eta_i^{K,L})$.

Concerning the transition from being non-hospitalised to becoming hospitalised, and the other way around, we will apply the stratified partial likelihood approach, as described by Ridder & Tunali (1999). The baseline function is here treated as an arbitrary function of t and $\eta_i^{K,L}$. The baseline hazard may then be written as $\theta_0^{m;K,L}(t)$, a flexible duration dependence function for each individual. This approach applies the traditional partial likelihood approach to strata, representing units, such as firms, schools, familes, or individuals. In our case, the risk sets are replaced by individual-specific risk sets. This also means that all time-invariant fixed effects at the individual level will cancel out from the expression for the likelihood. The likelihood of a transition from state K to L may then be written as:

$$\mathcal{L}_{spl}^{K,L} = \prod_{j=1}^{N_K} \left(\frac{\theta_1^{K,L}(x_i;\beta^{K,L})}{\sum_{K,L} \theta_1^{K,L}(x_i;\beta^{K,L})} \right)^{\delta_j^{k,L}} \tag{2}$$

This model controls for some of the endogeneity of bereavement, since the latter is likely to be related to unobserved factors, reflecting marital sorting, common household and/or environmental effects, that also may relate to the probability of being hospitalised for the main respondent.

To apply the stratified partial likelihood estimator, we need a multivariate extension of the weak exogeneity assumption. In our case, this means that the covariate process must be independent of the occurence of exit of the same individual at some later date. This requires that the death of the spouse is not dependent on the occurence of exit by the main respondent at a later date. While this assumption is likely to be fulfilled in most cases, it may fail, at least theoretically, in some situations. If the main respondent has a lethal cancer, for instance, and know that he/she most likely may not survive one additional year, this information may cause the spouse to lose the life geist and even die before the main respondent. Such anticipation effects are likely to be weak, however, since such certain deaths are unusual and there exist uncertainty about the timing of the event.

5 Results

5.1 Bereavement and morbidity

In this section we will consider the relationship between bereavement and morbidity. We implement this by examining the transitions from being non-hospitalised to hospitalised, and vice versa, as a function of time-varying bereavement. First, we will estimate ordinary partial-likelihood models, where we also include controls for education, income, number of children, country of birth, and health variables as regressors. We will then contrast the results from the partial-likelihood models with those obtained using the stratified partial likelihood model. In the latter model, unobserved time constant facors will cancel out as they captured in the strata-specific baseline hazard.

Before moving into our empirical work, we also have to deal with the fact that the first observed spell of each respondent does not accurately describe the onset of risk. In other words, the onset of risk is in most cases at an earlier point in time than the time of the interview. This means that we have to deal with delayed entry, i.e. respondents becoming at risk at an earlier date but only being fully observed from the point of the interview. Since we have information from the hospital register on all hospital discharges for the respondents during the period 1980-2001, however, we can in many cases trace the onset of risk backward in time. To give an example; we observe a respondent being non-hospitalised at the date of the interview, lets say on the 10th of January 1988. When did he or she become at risk for being hospitalised? Almost surely it was not on the 10th of January 1988, but rather at some earlier date. Through the hospital register we may find out that the respondent was discharged from hospital on the 1th of January 1988, which then becomes the onset of risk. While we are able to use the information from the hospital register to identify the onset of risk in many cases, it was not possible if the onset of risk was before 1980. In this case, we are no longer able to identify the individuals in the hospital register. In these cases, we deleted the first spell, resulting in a loss of 8,506 spells. This still left us with 119,696 spells, making the loss amounting to less than 7% of all spells.

5.1.1 Non-hospital $\longrightarrow$ hospital

In Table 2, we show the results from both the ordinary partial likelihood model and the stratified partial likelihood, where the transition from non-hospital to hospital is examined. Starting with males, the estimates from the partial likelihood model shows a negative association between being bereaved during the first 6 months and the hazard. For periods longer than 6 months of bereavement, however, no signficant correlations were obtained. For females, a negative assocation between bereavement and the hazard was also obtained. Here, the effect was even greater and also lasted up until 12 months after bereavement.

Most of the other explanatory variables show expected and similar effects among males and females. Age, income, education, and the health indicators are all significantly related to the non-hospital duration for both males and females. Age and income are positively associated with the hazard, while the opposite effect is obtained for education. The health indicators are all positively related to the hazard, while being born in Sweden is negatively related

Turning to the stratified likelihood estimates, the assocation between bereavement and the hazard becomes less in magnitude. Still, the assocation is significant and the sign does not change. For females, there is no longer any significant correlation after 6 months. The effect of age increases both for males and females. No estimates can be obtained for the other explanatory variables, since they are constant over time. To summarise, the estimates from the stratified partial likelihood model are not very different from those obtained with the ordinary partial likelihood model.

The negative effect of bereavement on the morbidity hazard may seem counter-intuitive. There are, however, several possible interpretations. Among females, in particular, being bereaved will most often reduce the care-giving burden. The period before being bereaved may involve extensive care-giving tasks and the period after bereavement may therefore substantially reduce this care-giving load and actually improve health. For males, a more likely interpretation is that bereavement immediatly increases the death hazard and therefore reduce the risk of hospitalisation.

We next consider the relationship between cause-specific morbidity and bereavement. For this purpose, we investigate three different diagnoses; circulatory diseases, mental and behavioural disorders, and cancers. The results from the stratifed partial likelihood model are shown in Table 4, where only the coefficients of the bereavement variables are shown in order to preserve space. For males, the association between the beravement variables and morbidity due to circulatory diseases is negative but never significant. For females, however, several of the bereavement variables are significant. The variable indicating 0-6 months after bereavement is negatively and significantly related to the hazard of circulatory disease. The sign of the effect changes, however, after being bereaved for 12 months or more. Now, there is a significant and positive relationship, in accordance with the "broken heart" hypothesis.

Bereavement may lead to depression and thus trigger morbidity due to mental and behavioural disorders. For males, however, no evidence for any such effects were obtained, however. Among females, a negative and significant effect was obtained after being bereaved for 12 months or more.

5.1.2 Hospital $\longrightarrow$ non-hospital

Table 3 shows the results for the transition out of morbidity, i.e. from hospital to non-hospital. For males, there is a negative and significant assocation between the variable indicating months 12-48 after bereavement and the hazard of leaving hospital. For females, such a negative correlation is obtained only for months 0-6 after bereavement. This effect switches after being bereaved for 48 months or more and becomes positive and significant.

Among the other explanatory variables, age is negatively related to the hazard of leaving hospital for both males and females, while income shows a positive correlation with the hazard. For females, higher education is positively related to the hazard. As expected, most of the health variables show a negative correlation with the hazard of leaving hospital.

Next, employing the stratified likelihood model brings on some changes in the results. For males, the three variables indicating 6-12 months after bereavement, 12-48 months after bereavement, and 48 or more months after bereavement are now significantly and negatively related to the hazard of leaving hospital. For females, there is now also a negative correlation between the variables indicating months 12-48 and months 48 and more after bereavement and the hazard.

The results in this section are quite as expected. Being sick at hospital means that there will be no reduced care-giving burden for the respondent following bereavement. More likely is that the hospitalised respondent was the one receiving care. This may reduce the hazard of leaving hospital, since the supply of care-givers at home has been reduced.

5.2 Bereavement and mortality

Next, we examine the correlation between bereavement and subsequent mortality, using first the ordinary partial likelihood method. Here, as in the previous section, bereavement is measured through 4 dummy variables indicating time after bereavement. Moreover, to start with, we make no distinction between hospital or non-hospital spells.

Table 5 shows the regression results. We perform separate regressions by gender, since previous studies suggest gender differences in the correlation between bereavement and mortality. Moreover, we control for the same set of variables as in the previous section. These variables are measured at the baseline, i.e. prior to experiencing bereavement.

We first consider the association between bereavement and all-cause mortality. As shown in Table 5, bereavement is associated with a significant and positive death hazard among men. The effect is greatest during the first 6 months after bereavement and then gradually declines in magnitude. The effects are still significant during all time periods after bereavement, though. This time pattern is consistent with the findings in many prior studies.

Among women, the correlation between bereavement and the mortality hazard is negative during most time periods after bereavement. The correlation never reaches statistical significance, however. Thus, there seems to be no significant effect of bereavement on mortality among females in our sample. Gender differences in the effects are typically found in the literature and women are commonly found to be less affected by bereavement.

Next, we separately consider the three major disease groups; circulatory diseases, cancer, and respiratory diseases. For circulatory diseases, a significant and positive effect on the death hazard is found for males during months 6-12 after bereavement. No effect is obtained for women. An analysis of the subgroups of myorcardial infarction and ischemic heart disease (not shown) reveal that the effect bereavement on circulatory diseases work mainly through these diagnoses. For cancer, a strong effect of bereavment on the death hazard is obtained for males during months 0-6 after bereavement and months 12-48. Among females, again, no signficant effect is obtained. For both genders, no significant effect of bereavement on deaths from respiratoy diseases is obtained.

Table 2: Association between bereavement and morbidity. Transition from non-hospital to hospital.

	Ordinary partial likelihood		Stratified partial likelihood	
Variables	**Males**	**Females**	**Males**	**Females**
Months 0-6	-0.436***	-0.609***	-0.243***	-0.329***
	(0.055)	(0.047)	(0.079)	(0.065)
Months 6-12	-0.035	-0.158***	0.033	0.014
	(0.054)	(0.046)	(0.076)	(0.065)
Months 12-48	0.005	-0.023	0.069	0.069
	(0.025)	(0.022)	(0.049)	(0.042)
Months 48-	0.017	-0.028	0.091	0.056
	(0.028)	(0.022)	(0.067)	(0.056)
Age	0.031***	0.034***	0.090***	0.073***
	(0.001)	(0.001)	(0.003)	(0.003)
Education	-0.042**	-0.212***		
	(0.020)	(0.034)		
Income	0.000**	0.000***		
	(0.000)	(0.000)		
Number of children	0.005	0.015		
	(0.014)	(0.028)		
Born in Sweden	-0.070***	0.011		
	(0.024)	(0.028)		
Cancers	0.276***	0.365***		
	(0.033)	(0.037)		
Endocrine diseases	0.166***	0.214***		
	(0.020)	(0.020)		
Mental disorders	0.079**	0.127***		
	(0.040)	(0.031)		
Circulatory diseases	0.113***	0.151***		
	(0.012)	(0.015)		
Outer violence and accidents	0.119***	0.180***		
	(0.026)	(0.030)		
Other diseases	0.059***	0.061***		
	(0.012)	(0.015)		
Activity limitations	0.227***	0.127***		
	(0.013)	(0.015)		
Observations	39598	33531	39598	33531

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 3: Association between bereavement and morbidity. Transition from hospital to non-hospital.

	Ordinary partial likelihood		Stratified partial likelihood	
Variables	**Males**	**Females**	**Males**	**Females**
Months 0-6	-0.014	-0.092*	0.065	-0.120*
	(0.056)	(0.047)	(0.080)	(0.067)
Months 6-12	-0.084	-0.038	-0.144*	-0.017
	(0.057)	(0.047)	(0.080)	(0.067)
Months 12-48	-0.053**	-0.025	-0.177***	-0.089**
	(0.026)	(0.022)	(0.052)	(0.044)
Months 48-	0.009	0.072***	-0.153**	-0.130**
	(0.029)	(0.021)	(0.069)	(0.058)
Age	-0.013***	-0.016***	-0.024***	-0.013***
	(0.001)	(0.001)	(0.003)	(0.004)
Education	0.022	0.063*		
	(0.019)	(0.032)		
Income	0.000***	0.000***		
	(0.000)	(0.000)		
Number of children	0.004	-0.010		
	(0.014)	(0.028)		
Born in Sweden	-0.006	-0.025		
	(0.023)	(0.027)		
Cancers	-0.044	-0.075**		
	(0.033)	(0.038)		
Endocrine diseases	-0.127***	-0.033*		
	(0.020)	(0.020)		
Mental disorders	-0.074*	-0.157***		
	(0.040)	(0.031)		
Circulatory diseases	0.023*	0.028*		
	(0.012)	(0.014)		
Outer violence and accidents	0.027	-0.041		
	(0.026)	(0.030)		
Other diseases	-0.078***	-0.033**		
	(0.012)	(0.014)		
Activity limitations	-0.074***	-0.086***		
	(0.013)	(0.015)		
Observations	33225	22693	33225	22693

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 4: Association between bereavement and cause-specific morbidity. Stratified partial likelihood estimates.

Causes of morbidity	**Morbidity (males)**		**Morbidity (females**	
Variables	**Coefficient**	**(Std. Err.)**	**Coefficient**	**(Std. Err.)**
Circulatory diseases (ICD I00-I99)				
Months 0-6	-0.260	(0.147)	-0.323**	(0.143)
Months 6-12	-0.085	(0.146)	0.175	(0.130)
Months 12-48	-0.037	(0.091)	0.273**	(0.088)
Months 48-	0.072	(0.123)	0.234*	(0.118)
All cancers (ICD C00-D48)				
Months 0-6	-0.346	(0.236)	-0.775**	(0.201)
Months 6-12	-0.242	(0.238)	-0.219	(0.225)
Months 12-48	0.010	(0.144)	-0.270	(0.146)
Months 48-	-0.278	(0.212)	-0.195	(0.205)
Mental and behaviour (ICD F00-F99)				
Months 0-6	0.205	(0.402)	-0.291	(0.307)
Months 6-12	0.369	(0.391)	0.026	(0.346)
Months 12-48	-0.183	(0.303)	-0.474*	0.231
Months 48-	-0.612	(0.571)	-1.128**	(0.325)

Table 5: Association between bereavement and all-cause mortality

Variables	**Mortality (Males)**		**Mortality (Females)**	
	Coefficient	**(Std. Err.)**	**Coefficient**	**(Std. Err.)**
Months 0-6	0.374***	(0.120)	-0.212	(0.159)
Months 6-12	0.274**	(0.129)	-0.132	(0.154)
Months 12-48	0.109*	(0.062)	0.068	(0.064)
Months 48-	0.109*	(0.066)	-0.017	(0.065)
Age	0.217***	(0.044)	0.069	(0.060)
Age square	-0.001***	(0.000)	0.000	(0.000)
Education	-0.057	(0.057)	-0.314***	(0.120)
Income	-0.000***	(0.000)	-0.000***	(0.000)
Number of children	-0.036	(0.045)	0.103	(0.084)
Born in Sweden	-0.167**	(0.069)	0.045	(0.092)
Cancers	0.581***	(0.090)	0.934***	(0.108)
Endocrine diseases	0.408***	(0.054)	0.500***	(0.062)
Mental disorders	0.070	(0.111)	0.250***	(0.093)
Circulatory diseases	0.314***	(0.033)	0.321***	(0.045)
Outer violence and accidents	0.077	(0.074)	0.196**	(0.095)
Other diseases	0.093***	(0.033)	0.072	(0.045)
Activity limitations	0.491***	(0.035)	0.290***	(0.047)
Observations	13634		16409	
R^2	.			

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 6: Association between bereavement and mortality.

	Mortality (males)		Mortality (females)	
Variables	**Coefficient**	**(Std. Err.)**	**Coefficient**	**(Std. Err.)**
Circulatory diseases (ICD I00-I99)				
Months 0-6	0.220	(0.174)	-0.380	(0.234)
Months 6-12	0.333*	(169)	-0.280	(0.223)
Months 12-48	0.106	(0.084)	0.027	(0.089)
Months 48-	0.143	(0.088)	-0.116	(0.090)
All cancers (ICD C00-D48)				
Months 0-6	0.678**	(0.222)	-0.069	(0.322)
Months 6-12	0.074	(0.304)	0.371	(0.266)
Months 12-48	0.281*	(0.125)	0.218	(0.132)
Months 48-	-0.196	(0.164)	-0.074	(0.144)
Respiratory diseases (ICD C00-D48)				
Months 0-6	0.220	(0.415)	-0.687	(0.716)
Months 6-12	-0.139	(0.506)	-0.284	(0.589)
Months 12-48	-0.220	(0.232)	-0.144	(0.243)
Months 48-	0.122	(0.207)	0.020	(0.234)

6 Conclusions

In this paper, we examined the relationship between spousal bereavement and morbidity and mortality among elderly people. Our results suggest very different effects of bereavement on morbidity and mortality. The results show a negative relationship between bereavement and the morbidity hazard, suggesting a lowered risk of morbidity following bereavement. This would happen, for instance, if being bereaved reduces the care-giving burden of the surviving partner and thus improves health. For males, however, the effect most likely reflects a strong effect of bereavement on mortality. For all-cause morbidity, the effect is found only for the first 6 months following bereavement. The effect varies by cause, however. Examining circulatory diseases, the relationship between bereavement and the hazard is negative for the first 6 months following bereavement, but then turns positive and significant for 12 or more months after bereavement for females. This is in contrast to mental and behavioural disorders, where bereavement seems to reduce the hazard for all periods after bereavement for females.

Being bereaved while in reduced health, i.e. being at hospital, is a different story. Here, being bereaved is negatively related to the hazard of leaving hospital. This results is expected, since already frail individuals will not face any health-enhancing reduced care-giving burden following bereavement.

Considering mortality, our results show a strong bereavement effect among males. The effect gradually decreases over time. The effect is especially pronounced for myocardial infarction and cancers. Among females, no evidence of any bereavement effect on mortality is obtained.

Some caveats should be noted. For most respondents we are not able to control for possible re-marriage following bereavement. It should be noted, however, that the greatest effect of bereavement generally occurs during the first 6 months following bereavement, where re-marriage is unlikely to have occured yet. While later re-marriage may function as a buffer against an increased risk following bereavement, and may therefore partly explain the declining effect, re-marriage rates are very low above the age of 60. Moreover, re-marriage is more common among men at these ages, which, in that case, would bias the effects for males downwards. Yet, the effect of bereavement is mostly found among males.

Our results suggest that being bereaved may have some beneficial health effects among females. For males, however, the results suggest a potential for policies aimed at newly bereaved males. Carefully monitoring and providing help for bereaved males may be important for their remaining length of life.

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