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Does widowhood increase mortality risk? Comparing different causes of spousal death to test for selection effects

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Summary

Objectives: We consider the effect of spousal bereavement on mortality by different types of spousal death. We expect some causes of death to be correlated with socioeconomic characteristics and others not to be. Equality in the 'bereavement effect' across different causes of death would suggest a causal effect of widowhood, while no bereavement effect for uncorrelated causes of death would suggest that selection effects have a role.

Methods: Data on 58,685 married men and 58,415 married women were drawn from the Scottish Longitudinal Study. We undertook three sets of analyses, separating causes of the spouse's death into 'informative' and 'uninformative', 'preventable' and 'unpreventable', and 'risky' and 'unrisky' deaths. We modelled mortality using Cox models, comparing outcomes for men and women by these different causes of death of their spouse.

Results: In separate models for men and women, in which we control for a range of individual- and household-level socio-economic characteristics, the risk of death rises following the death of a spouse, particularly in the first 6 months. This was the case regardless of the cause of death of the spouse.

Conclusions: Our analysis shows that the effect of widowhood on mortality is substantial for both men and women and this relationship varies little by the cause of death of the spouse, suggesting that this is a causal effect, rather than a result of selection. Health interventions to support widowed men and women should be a priority.

Keywords: Widowhood effect, Scottish Longitudinal Study, cause of death

1 Introduction

The 'widowhood' or 'bereavement' effect has been demonstrated in a number of historical and contemporary studies (Cox and Ford 1964, Farr 1858, Gove 1973, Lillard and Panis 1996, Manor and Eisenbach 2003, Parkes *et al.* 1969) . The broad consensus is that the death of a spouse raises the risk of mortality for the surviving spouse by about 10% to 40% (Elwert and Christakis 2006, 2008, Manzoli *et al.* 2007). This result appears to be reasonably consistent across different countries, datasets and methodological approaches (Hu and Goldman 1990, Martikainen and Valkone 1996, Gardner and Oswald 2004, Espinosa and Evans 2008).

That widowhood can shorten life expectancy is remarkably persuasive evidence that social circumstances influence mortality. The fact that losing a married partner can have such an effect is consistent with various studies which demonstrate the benefits to health and life expectancy that being married provides. Thus, the married live longer, suffer fewer chronic diseases and have better health behaviours than single people (Waite and Gallagher 2000, Schaefer *et al.* 1995, Martikainen and Valkone 1996; Espinosa and Evans 2008). Being widowed removes the protective effects of marriage, which may include social and financial support, health care and positive attitudes to healthy behaviours (Elwert and Christakis 2006), and if this effect is causal it is convincing evidence that social determinants may have a powerful role to play in mortality.

Given the theoretical importance of the widowhood effect, it is therefore important that these findings relating to the widowhood effect are robust. One problem with most previous studies of the widowhood effect is that they ignore potential selection effects (Kraus and Lilienfeld 1959, Martikainen and Valkonen 1996, Schaefer *et al.* 1995). It is possible that widowed people may share common characteristics with their deceased partners, making them more likely to die; for example, they may share similar health behaviours which makes them both prone to death. Hence it may not be the event of widowhood that causes the raised risk of mortality, but simply that couples are more likely to die at similar times because of their shared personal characteristics and ways of life.

Accounting for such selection effects is not simple, mainly because those datasets which include detailed information on health-related behaviours are not large enough to explore widowhood effects. One approach, which has been adopted in a small number of studies, is to compare the risk of mortality by the cause of death of the precedent spouse. Thus, if selection effects are important, we would expect a widowhood effect to occur when the spouse died from a cause of death which is associated with poor health behaviours, but not when the spouse died of a cause of death which is not so strongly associated with health behaviours.

This approach was first advocated by Martikainen and Vokonen (1996) who distinguished between risky and unrisky causes of death. Subsequently, Espinosa and Evans (2008) distinguished between informative and uninformative causes of death, while in a broader study, not focused on widowhood, Phelan *et al.* (2004) derived a classification of preventable and unpreventable causes of death showing that the former were much more strongly related to social factors than the latter. While there is some overlap between the three classifications, no previous study has explored all three approaches simultaneously.

In this study we utilise data on men and women from the Scottish Longitudinal Study (SLS) (Boyle *et al.* 2008). This is the first study which compares the three different classifications of the cause of death of the precedent spouse, providing a robust consideration of potential selection effects. Thus, we provide a comprehensive

analysis of whether selection effects have a significant impact on the widowhood effect.

2 Data and methods

The data are drawn from the Scottish Longitudinal Study (SLS) which collates information from the 1991 and 2001 national censuses as well as from vital statistics for a 5.3% sample of the Scottish population. The sample includes around 264,000 people in 1991 and we extracted those aged 16 and above who were in a married couple in 1991 (58,685 men and 58,415 women). During follow up 13,098 (22.3%) men and 8,240 (14.1%) women died. Information on the death of the spouse of the SLS member was only available if the spouse died before the member. Thus we can only study the effect of widowhood on mortality for SLS members, not their spouses. This means that the deaths and widowhoods are distinct sets of events, unlike the situation for some previous studies of the effect of widowhood on mortality.

Of the sample, 5,013 men (8.5%) and 9,646 women (16.5%) were widowed between 1991 and the end of the study (end of 2006). Forty percent of widowers and 26 percent of widows died in the follow-up period. Of these, 37 deaths occurred less than 10 days after the death of the spouse, 12 on the same day. Eight of these were related to external causes including murder, fire/accidents and car accidents and these were excluded from the study. In those cases where both partners died on the same day, but one was the result of suicide, it was assumed that the suicide represented a genuine widowhood effect[1].

A range of socio-economic variables were also included as time-consistent variables, captured from the 1991 census data. These include variables relating to a variety of individual characteristics, including age, qualifications, and ethnicity. Importantly, we also controlled for self-reported health status at the beginning of the period, based on a question in the census which asked whether respondents were suffering from a limiting long-term illness or not. In addition a small number of household variables were controlled for, including housing tenure, household size, central heating and car ownership. An area-based deprivation measure – the Carstairs score – was also included in the model, calculated for the 1003 postcode sectors in Scotland.

We modelled time to death using a Cox proportional hazards model. Widowhood was included as a time-varying covariate, while the remaining individual and household variables were time invariant. The results are presented as hazard ratios with 95% confidence intervals.

3 Results

In Table 1 we provide summary statistics for the variables in the analysis. Not surprisingly, given positive assortative mating, the variables matched closely for men and women. The sample members had an average age in the late forties, and were predominantly white with no higher qualifications and no long-term illness. Most resided as couples in owner occupied houses, with central heating, and a single car. The deprivation index was calculated such that approximately one fifth of all areas fell in each quintile.

1 A sensitivity analysis was conducted where all of these cases were excluded and the results remained consistent.

Table 1: Descriptive statistics (column %s except where stated)

Variable		Men (N=58,685)	Women (N=58,415)
Average age in 1991		48.6	46.3
With limiting long term illness in 1991			
	No	84.6	87.5
	Yes	15.4	12.6
Qualifications in 1991			
	None/unstated	83.8	85.5
	Other higher	8.1	9.8
	Degree and higher	8.1	4.7
Ethnicity			
	White	99.0	99.0
	Black	0.1	0.1
	South Asian	0.6	0.5
	Other Asian	0.2	0.2
	Other	0.2	0.1
Housing tenure in 1991			
	Owner occupied	65.0	64.5
	Private renting	7.5	7.6
	Social renting	27.5	27.9
Household size in 1991			
	2	39.8	38.9
	3	22.3	22.8
	4	25.1	25.8
	5	9.4	9.2
	6+	3.3	3.4
Cars in household in 1991			
	0	22.5	22.7
	1	51.4	51.3
	2+	26.1	26.0
Central heating in 1991			
	Yes	84.3	84.4
	No	15.7	15.6
Deprivation quintile in 1991			
	1 (least)	22.5	22.5
	2	21.3	21.4
	3	20.3	20.4
	4	19.5	19.6
	5 (most)	16.4	16.1
Widowed in follow up		N=5013	N=9645
	% of all cases	8.54	16.51
	Aged under 60	1.63	3.66
	Aged 60-69	2.34	5.31
	Aged 70-79	2.89	5.57
	Aged 80+	1.69	1.97

Table 2: Causes of death by classification (ICD9 codes in brackets)[a]

Unpreventable (Phelan et al, 2004, Espinosa and Evans, 2008)

Malignant neoplasm of gallbladder/extrhepatic bile ducts (156)
Multiple sclerosis (340)
Anterior horn cell disease (335)
Cardiomyopathy (425)
Disorder of lipid plasma protein metabolism (272)
Leukemia of unspecified cell type (208)
Lymphosarcoma and reticulosarcoma, (200)
Malignant neoplasm of brain (191)
Malignant neoplasm of ovary and other uterine adnexa (183)
Malignant neoplasm of pancreas (157)
Multiple myeloma and immunoproliferative neoplasms (203)
Myeloid leukemia (205)
Myoneural disorders (358)
Muscular dystrophies and other myopathies (359)
Polyartheritis nodosa and allied conditions (446)

Risky (Martikainen and Valkonen, 1996)
Alcoholic psychosis (291); alcoholism (303);
Alcoholic liver diseases and cirrhosis of the liver (5710-5713);
Alcoholic diseases of the pancreas (5770, 5771);
Cancer of the mouth and pharynx (140-149); cancer of the oesophagus (150);
Cancer of the larynx (161); lung cancer (162);
Chronic obstructive pulmonary disease (490-492);
Accidents and violence (E800-E999).

Uninformative (Espinosa and Evans, 2008)
Men
Pancreatic cancer (157)
Neoplasms of bone, connective tissue and skin (170–175);
Neoplasms of unspecified sites (190–199);
Benign neoplasms and carcinoma in situ (210–239).
Genital cancer (179–187)
Lymphoma, leukemia (200–208)
Cardiomyopathy (425)
Pneumonia (480–487)
Non-motor vehicle accidents, murder/suicide (800–807; 826–999)

Women
Other cancers (140–152;154–156; 157–161;163–173;175–178; 190–199)
Breast cancer (174)
Genitourinary cancer (179–189)
General circulatory disease (390–459)[b]
Accidents (800–999)

a ICD 9 codes are listed while equivalent ICD 10 codes are also used in the research. Uninformative and unpreventable causes of death are not expected to be related to health behaviour while risky causes of death is.

b These diseases include all general circulatory diseases except the following: acute myocardial infarction (410), other forms of chronic ischemic heart disease (414), other forms of heart disease (420–429), intracerebral hemorrhage (431), other and unspecified intracranial hemorrhage (432), and occlusion of cerebral arteries (434).

Table 2 provides the three different classifications of the cause of death of the spouse. Risky deaths were identified following Martikainen *et al.* (2004) as those associated with the risky behaviours of smoking, drinking and violence. Informative deaths were those due to causes found to be related to socioeconomic factors (Espinosa and Evans 2008). Preventable deaths were identified as those judged by two observers to be either related to health behaviours or preventable by appropriate treatment (Phelan *et al.* 2004). In this study we have selected a cut-off on the preventability scale that identifies the small group that are very unlikely to be preventable.

Table 3 cross-tabulates the deaths by these three causes. The proportions are very similar for deaths and widowhoods, noting that a male widowhood corresponds to the death of a woman and *vice-versa*. The unpreventable deaths are a very small category comprising fewer than 2% of male deaths and fewer than 7% of female deaths. The uninformative deaths include a larger proportion of around 17% of male deaths and around 37% of female deaths. The unrisky deaths are a wider category still that include over 80% of all deaths and widowhoods. All the risky deaths were also classified as preventable and the majority as informative. The informative grouping includes the major cardiovascular causes as well as other causes considered related to health behaviours such as diet and exercise. The risky group is restricted to those most clearly related to risky behaviour with the smoking related cancers of the lung and throat making up the majority for both men and women.

Table 3: Deaths and widowhoods by three types of cause for men and women

			Deaths of SLS members				Widowhoods of SLS members			
			Men		Women		Men		Women	
Classification of causes of death			**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**
Risky	Preventable	Informative	2129	16.3	766	9.3	526	10.5	1533	15.9
Risky	Preventable	Uninformative	172	1.3	352	4.3	177	3.5	115	1.2
Unrisky	Preventable	Informative	8716	66.5	4258	51.7	2416	48.2	6481	67.2
Unrisky	Preventable	Uninformative	1588	12.1	2407	29.2	1552	31.0	1105	11.5
Unrisky	Unpreventable	Informative	75	0.6	179	2.2	217	4.3	353	3.7
Unrisky	Unpreventable	Uninformative	418	3.2	278	3.4	125	2.5	59	0.6

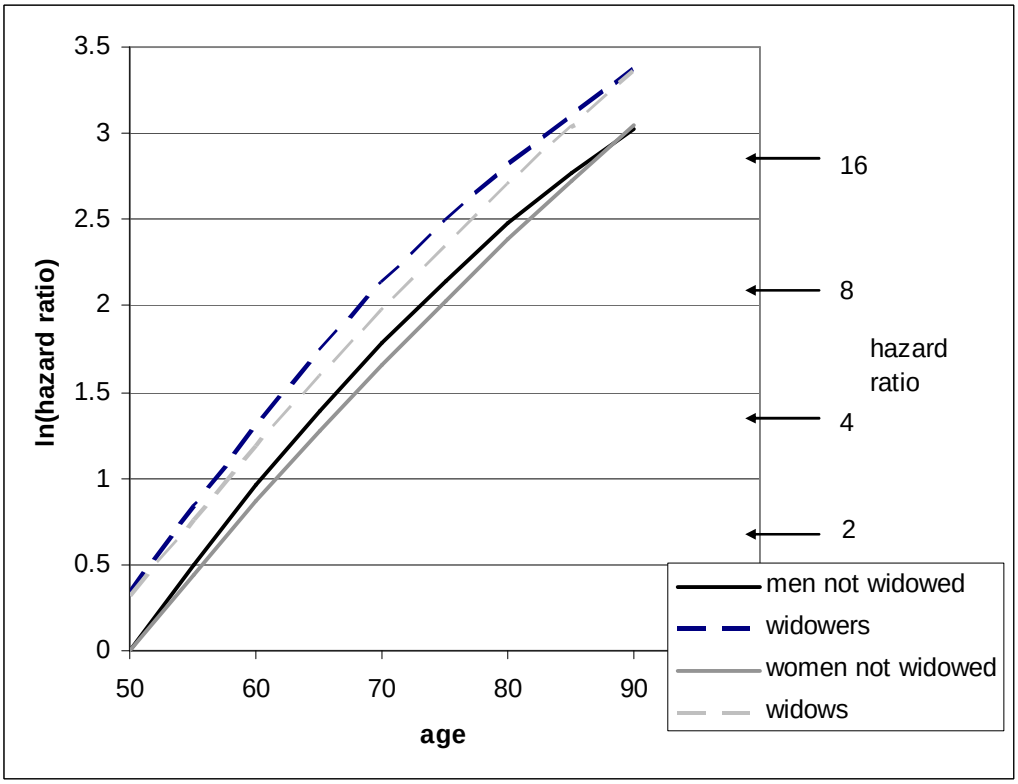
Table 4 provides the Cox model results for men and women in models that ignore the cause of death of the spouse. The base models include only age controls. The widowhood effect is large and significant for men and women, who experience 49% and 46% increases respectively in the hazard of dying following the event. Controlling for other socio-economic variables reduces this effect slightly to 41% and 37% respectively.

Table 4: Cox model results for men and women: hazard ratios with 95% confidence intervals

	Men		Women	
Variables	**Base model**	**Full model**	**Base model**	**Full model**
Widowed in follow up	1.493 (1.420-1.569)	1.407 (1.338-1.479)	1.457 (1.384-1.534)	1.366 (1.297-1.438)
Age in 1991	1.117 (1.114-1.120)	1.108 (1.105-1.112)	1.102 (1.099-1.105)	1.094 (1.091-1.098)
Age in 1991 squared	0.999 (0.999-0.999)	0.999 (0.999-0.999)	1.000 (1.000-1.000)	1.000 (1.000-1.000)
Limiting long term illness in 1991		1.646 (1.587-1.709)		1.855 (1.768-1.946)
Qualifications in 1991		base		base
None		0.810 (0.746-0.880)		0.855 (0.769-0.950)
Other higher		0.763 (0.695-0.836)		0.861 (0.724-1.024)
Degree and higher				
Housing tenure in 1991		base		base
Owner occupier		1.070 (1.001-1.145)		1.245 (1.146-1.353)
Private renting		1.173 (1.125-1.223)		1.345 (1.276-1.417)
Social renting				
Ethnicity		base		base
White		0.954 (0.307-2.960)		0.853 (0.213-3.416)
Black		0.722 (0.484-1.075)		0.998 (0.550-1.810)
South Asian		0.673 (0.350-1.295)		0.681 (0.283-1.638)
Other Asian		1.258 (0.628-2.517)		0.165 (0.023-1.169)
Other				
Household size in 1991		base		base
2		1.042 (0.993-1.093)		1.081 (1.016-1.150)
3		0.967 (0.903-1.036)		1.034 (0.945-1.132)
4		1.089 (0.984-1.204)		0.931 (0.805-1.077)
5		1.015 (0.871-1.182)		1.261 (1.046-1.520)
6+				
Cars in household in 1991		base		base
None		0.842 (0.807-0.878)		0.915 (0.869-0.965)
1		0.729 (0.683-0.779)		0.743 (0.681-0.811)
2+				
Central heating in 1991		1.095 (1.050-1.143)		1.020 (0.967-1.077)
No heating				
Deprivation quintile in 1991		base		base
1		1.038 (0.981-1.098)		0.980 (0.912-1.054)
2		1.036 (0.978-1.097)		1.087 (1.011-1.168)
3		1.098 (1.037-1.164)		1.081 (1.006-1.162)
4		1.155 (1.087-1.227)		1.146 (1.062-1.236)
5				

Another way in which to understand the effect of widowhood on survival is to compare the effect of widowhood with that of age at the time of the census on the hazard of dying during the follow up period. The baseline is a person aged 50 at the census during the period when they are not widowed. Figure 1 shows the increase in the log hazard with age for those not widowed (solid lines) and for widows of the same age after widowhood (dashed lines). Results are shown for the adjusted models presented in Table 3. The effect of widowhood is to shift the hazard of dying to one comparable to that of older, still cohabiting SLS members. The age difference corresponds to the horizontal distance between the hazard lines for the widowed compared to others. For both men and women the effect of widowhood at age 60 is to increase the hazard of death to that for a person who is not widowed and 3.7 years older. This effect increases slightly at older ages as the hazard per year of age increases more gradually as we age.

Figure 1: Effect of widowhood on the mortality hazard ratio in a Cox model, compared with the effect of age at the 1991 census, with age 50 as the baseline, adjusted for control variables as in Table 1



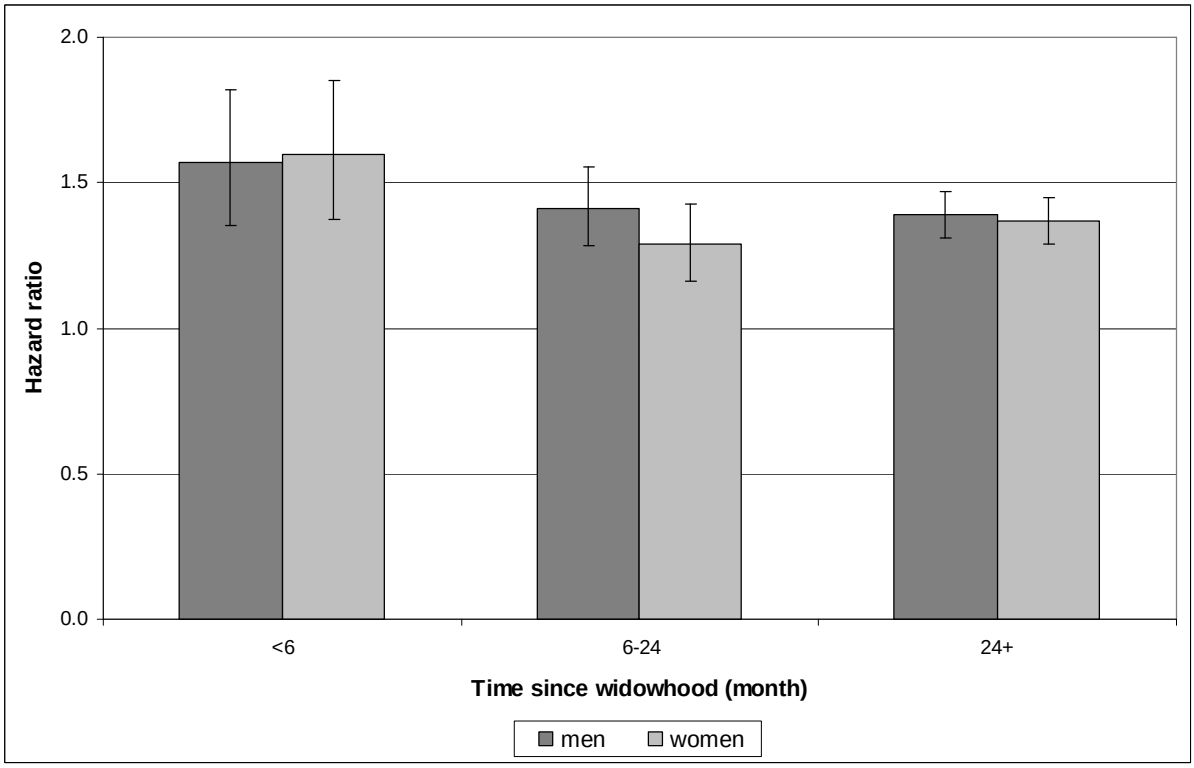
A further model was fitted to investigate whether the effect of widowhood on mortality differed when the SLS member was widowed at different ages. Adjusting for control variables, there was a significantly increased hazard of mortality within each of the age groups considered (Table 5). For men the hazard did not differ significantly by age group, but for women the effect of widowhood was greatest in the oldest age group ($p<0.05$ on a likelihood ratio test).

Table 5: Hazard ratios and 95% confidence intervals for the effect of widowhood according to the age at widowhood adjusted for control variables in Table 1

	Men			Women		
	N widows	hazard	95% CI	N widows	hazard	95% CI
Under 60	956	1.43	(1.18-1.75)	2,138	1.35	(1.15-1.58)
60-69	1,372	1.47	(1.34-1.63)	3,099	1.28	(1.17-1.39)
70-79	1,695	1.35	(1.25-1.45)	3,255	1.34	(1.25-1.44)
80+	990	1.44	(1.32-1.57)	1,153	1.60	(1.45-1.77)

The full models reported in Table 4 were extended to consider the time since widowhood and the effects are graphed in Figure 2. There were significantly raised risks in all three periods for both men and women. The risk of death is higher in the first 6 months after the death of the spouse, but not significantly higher than the 6-24 month and 24+ month periods.

Figure 2: Cox model results by time since widowhood for men: hazard ratios and 95% confidence intervals



Further models for men and women were fitted which distinguish between the different causes of death of the spouse, allowing us to consider possible selection effects (Table 6). These models include the full set of control variables and the hazards relating to the widowhood variable are presented for the different causes of death. The widowhood effect was significant for men and women regardless of the cause of death of the spouse, with the effect of widowhood evident even in the small subgroup where the spouse had died of an unpreventable cause. There was no evidence of a difference in the effect of widowhood on mortality for any of the different causes of death for women, but for men whose female partner had died from a risky cause the effect of widowhood on their subsequent death was greater ($p<0.05$ on a likelihood ratio test).

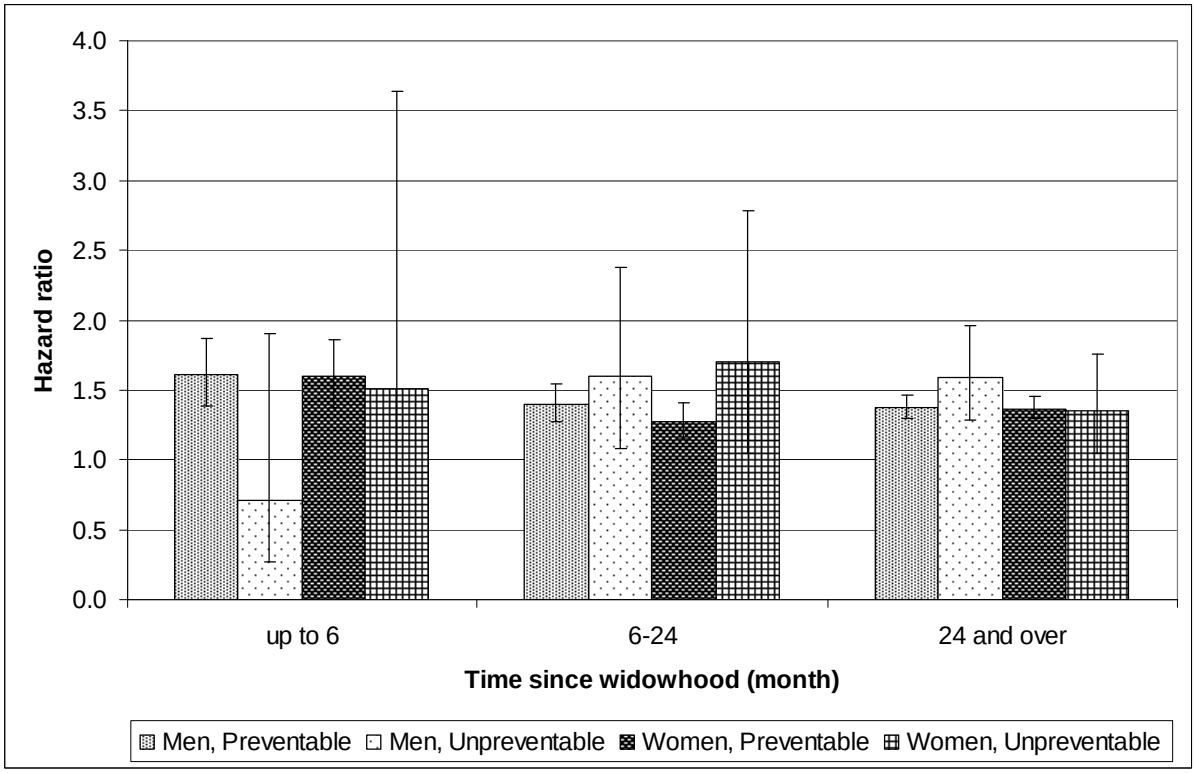
Table 6: Cox model results for men and women by cause of death of the spouse: hazard ratios and 95% confidence intervals adjusting for control variables in Table 1

Cause of death	Men	Women
Preventable	1.402 (1.332-1.475)	1.365 (1.297-1.439)
Unpreventable	1.530 (1.276-1.836)	1.422 (1.138-1.778)
Informative	1.423 (1.341-1.511)	1.363 (1.291-1.439)
Uniformative	1.384 (1.281- 1.494)	1.390 (1.256-1.541)
Risky	1.648 (1.454-1.867)	1.348 (1.209-1.503)
Unrisky	1.379 (1.308-1.454)	1.370 (1.299-1.447)

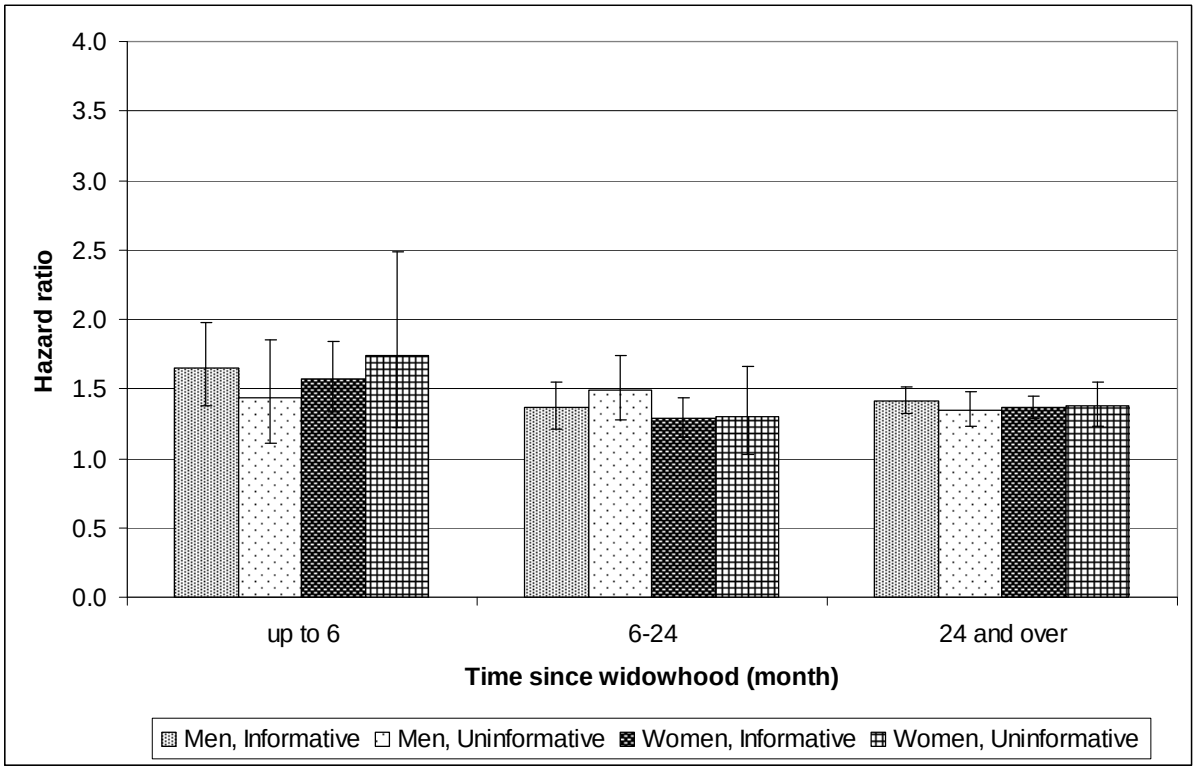
Finally, for each classification of cause of death we plot the risk of death by the time since widowhood. In virtually all time periods and for all causes there is a significantly raised risk following widowhood. For both men and women there was no significant rise in the risk of death in the first 6 months following the death of a spouse from an unpreventable cause of death, but these are based on only a small number of deaths. For men there was no significant rise in the risk of death in the first 6 months following the death of a spouse from an unrisky cause of death but, again, this was based on small numbers as risky deaths are less common for women. The model that included time-specific causes of death did not improve the fit to the data in any case, so we have no evidence that the effect of widowhood is affected differently by cause of death at different times following widowhood. However, it is interesting to note that the increased widowhood effect for men whose spouse had died from a risky cause is most evident at later times after widowhood.

Figure 3 a-c: Cox model results by time since widowhood by (a) preventable / unpreventable, (b) informative / uninformative, (c) risky / unrisky causes of death of the spouse, for men and women: hazard ratios and 95% confidence intervals

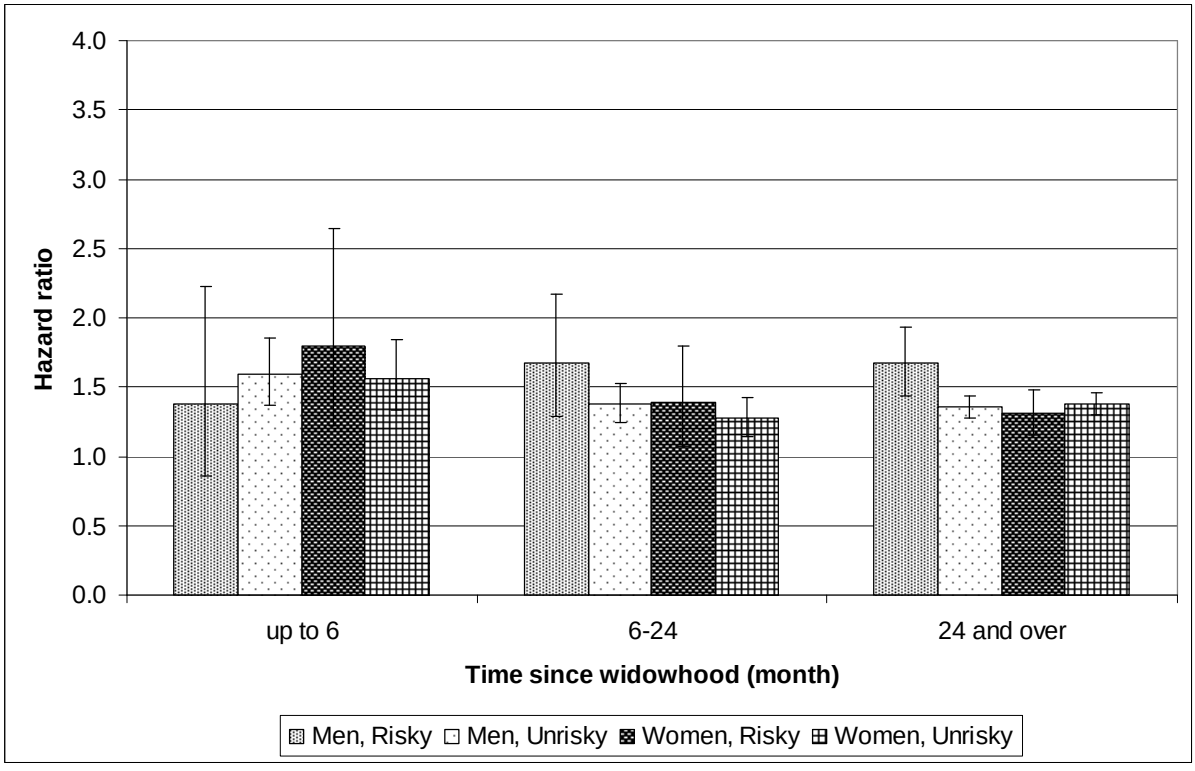
a) preventable / unpreventable



b) informative / uninformative



c) risky / unrisky



4 Discussion

Our results provide strong evidence that the widowhood effect is real and substantial. Previous studies have found an increased risk of death following the loss of a spouse between 10% and 40%; our results suggest that the effect is at least this large, if not slightly larger. Controlling for a range of individual- and household-level variables does not eradicate this effect. Some previous studies find particularly high risks in the period immediately after the death of a spouse (Lichtenstein *et al.* 1998). Although we find some evidence that these risks are higher in the 6 months immediately after the death of the spouse, both for men and women, the risk was not significantly different to the raised risks beyond 6 months[2].

Our results also suggest that while the effect of widowhood is slightly smaller for women, nonetheless it is substantial and significant. The widowhood effect has been previously shown to be reasonably consistent for men, but there is debate about whether surviving females are influenced in the same way (for example, Helsing and Szklo 1981 found no effect for women). This study provides strong evidence that the life expectancy of both men and women is influenced by the death of a spouse, with the effect being most pronounced for women at the oldest ages.

We also considered the influence of the cause of death of the spouse. The fact that people in couples tend to be more similar than we would expect at random means that it is possible that the widowhood effect may simply result from selection. We find little evidence for selection effects. If the cause of death is preventable by behaviour or lifestyle (risky, preventable or informative) we might expect selection effects to be more pronounced. Despite this, the risks of death were raised significantly for all causes of spousal death after the initial 6 months. The only cause of death that modified the effect of widowhood on mortality was a risky cause of death for men, as the effect of widowhood was considerably increased for men whose wives had died from risky causes compared to unrisky ones. While it is possible that this might be a selection effect another explanation is also possible. If the causal agent is smoking then the male partner's smoking may have contributed to their partner's death (Hirayama 1981) and it could be this that is also influencing their subsequent mortality (note that smoking related deaths make up a substantial part of risky deaths).

Thus, we have shown that there is a long-term risk of death following widowhood that does not appear to be explained by selection effects. Our results for men seem to support those of Espinosa and Evans (2008) who found no evidence of selection effects, but their results for women were less conclusive. Our results are relatively similar for men and women. The fact that the widowhood effect appears to be strongly related to mortality is convincing evidence of the influence of social factors on health and life expectancy. Most previous studies that have demonstrated this effect have ignored potential selection effects, which may be present if we assume that partners share more similar health-related behaviours than would be expected by chance. This is not an unreasonable supposition and some previous studies have attempted to address selection by testing whether the widowhood effect is consistent across different causes of death of the spouse. If selection is indeed a serious problem, we would not expect to find a widowhood effect in those cases where the spouse died from a cause which is not related to health behaviours. No previous study has compared the three different classifications used here and, overall, our results do not support the case for selection effects.

There are a number of limitations in this study. First, widowhood is recorded for those who are married. Some married couples may have been separated for some time, but

2 We also considered the risks within one month, from 1-3 months and 3-6 months after the death of a spouse and found similarly raised risks in each of these periods, but these were not significantly higher than the risks beyond 6 months.

they would still be recorded as widows were their previous partner to die. Given that the relationship between these pairs will be weaker than for married couples, we would expect that the inclusion of these in our analysis will make our results conservative. Second, we have only controlled for socio-economic circumstances at the beginning of the study. Even so, our approach is an improvement on many previous studies that control for a limited range of socio-economic characteristics.

Given these data are based on a large sample of reliable data drawn from national (compulsory) census data and vital events records, these results provide powerful evidence that the widowhood effect is causal. Indeed, the combination of our evidence and that from previous papers which deal with such potential selection effects (Elwert and Christakis 2008, Lillard and Waite 1996, Espinosa and Evans 2008) would seem to provide conclusive evidence that widowhood has a significant impact on life expectancy. As a consequence, health interventions should continue to be targeted at this group, as despite the fact that this effect was identified as long ago as the middle of the nineteenth century (Farr 1858), the effect continues to be significant and substantial.

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