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Short- and long-term associations between widowhood and mortality in the United States: longitudinal analyses

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ABSTRACT

Background Past research shows that spousal death results in elevated mortality risk for the surviving spouse. However, most prior studies have inadequately controlled for socioeconomic status (SES), and it is unclear whether this 'widowhood effect' persists over time.

Methods Health and Retirement Study participants aged 50+ years and married in 1998 ($n = 12\,316$) were followed through 2008 for widowhood status and mortality (2912 deaths). Discrete-time survival analysis was used to compare mortality for the widowed versus the married.

Results Odds of mortality during the first 3 months post-widowhood were significantly higher than in the continuously married (odds ratio (OR) for men = 1.87, 95% CI: 1.27, 2.75; OR for women = 1.47, 95% CI: 0.96, 2.24) in models adjusted for age, gender, race and baseline SES (education, household wealth and household income), behavioral risk factors and co-morbidities. Twelve months following bereavement, men experienced borderline elevated mortality (OR = 1.16, 95% CI: 1.00, 1.35), whereas women did not (OR = 1.07, 95% CI: 0.90, 1.28), though the gender difference was non-significant.

Conclusion The 'widowhood effect' was not fully explained by adjusting for pre-widowhood SES and particularly elevated within the first few months after widowhood. These associations did not differ by sex.

Keywords widowhood, spousal loss, mortality, longitudinal studies, socioeconomic status

Introduction

Marital status is thought to influence health via multiple mechanisms, including health behaviors[1], socioeconomic status (SES)[2] and physiologic responses to social interactions.[1,3] Spousal loss through widowhood may similarly influence health through these pathways and induce health consequences related to grief and bereavement.[4] Elevated mortality among widowed men and women has been documented in many contexts, with recent meta-analyses suggesting modest relative risks in the range of 1.1 to 1.3.[5,6] There is evidence that the association varies by gender such that widowhood is more toxic for men than women.[5,6]

Despite the strength of the evidence on widowhood and mortality, two important gaps remain. First, although SES is likely to be a strong confounder of the widowhood–mortality association, prior research has been hampered by inadequate information on SES. Adjustment for SES is likely to be especially important in countries such as the United States, with very marked socioeconomic inequalities in health. We consider four individual-level measures of adult SES: education, income, wealth and occupation; all measures capture slightly different aspects of SES, and each has strengths and weaknesses.[7–10] Further, it has been argued that different measures of SES may capture SES at different points in the lifecourse.[11,12] For these reasons, some epidemiologists argue

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that inclusion of multiple measures of adult SES is necessary to fully adjust for this important covariate in health research.[7–12] However, many prior studies on the 'widowhood effect' include only limited adjustment for SES. This gap is in part attributable to the data sources in which widowhood has been studied. Medicare data, which have been used in several key papers,[13–16] include limited individual SES assessments based only on Medicaid eligibility. Even studies with relatively comprehensive individual-level data often include only education and brief income assessments, without adequate consideration of wealth or occupational history.[2,17–19] Wealth, which has the benefit of time-variation, capturing inter-generational transfers and a negative and positive range, is a particularly relevant SES indicator for elderly people experiencing bereavement.[20–22]

Second, it is thought that the widowhood effect attenuates with time since spousal loss, but studies typically present the effects averaged across multiple time periods. Many studies enroll individuals who are already widowed and do not specifically evaluate time since bereavement. Because most widowed individuals at any given time lost their spouse one or more years earlier, this 'average' model may produce a lower or higher estimate of the widowhood effect than models based on 'incident' widowhood; there is a lack of clear empirical evidence on whether the widowhood effect is short- or long-term, though some work suggests a short-term spike is likely.[23–25] Using a nationally representative, cohort study sample of Americans aged 50+ years, with rich socioeconomic characterization, we investigated the short- and long-term association between widowhood and mortality, to what extent they are explained by SES, and whether these associations differed between men and women.

Methods

Data source

Data are from the nationally representative, longitudinal Health and Retirement Study (HRS), described elsewhere.[26] Enrollment year depended on birth cohort with enrollments in 1992, 1993 and 1998, based on respondent and spouse's birth year. We began our follow-up in 1998, the earliest year when the sample was representative of all birth cohorts through 1947. Biennial interviews (or proxy interviews for decedent participants) were conducted through 2008, by telephone or in person. We included HRS participants born 1900 to 1947 who participated in the 1998 wave and follow them to 2008. Retention rates through 2008 were above 80%. The HRS was approved by the University of Michigan Health Sciences Human Subjects Committee, and these analyses were determined exempt by Harvard School of Public Health Office of Human Research Administration.

Study population and sample size

From 13 086 married, age-eligible HRS respondents in 1998, we excluded 344 (2.6%) without follow-up information, 136 (1.0%) with missing or implausible dates of widowhood and 290 (2.2%) who were missing values on other covariates, leaving 12 316 individuals (5840 women and 6476 men) in the final analytic sample (Table 1); because there was a relatively large number of people with missing data on number of depressive symptoms (1146 or 9.3% of the analytic sample), we set their value to the mean, 1.28, so they would not be excluded from the analysis and introduce possible selection bias. Mean follow-up through 2008 was 106 months.

Outcome

HRS includes data on both spouses for the majority of couples, including the death dates. The HRS verification procedure to confirm the death and the timing of a participant's death relies on proxy informants, the Social Security Death Index and a subscription to Insight databases to determine vital status of all participants. These death records are periodically validated with the National Death Index (NDI). HRS routinely confirms death dates against the NDI report by comparison with the proxy reported death dates. For deceased participants, the month and year of death are recorded in the database.

Exposure

Death of a spouse was assessed through self-report. The same processes used to identify the timing of the outcome (individual's death) were used to identify the timing of spouses' deaths (widowhood). For the small number of widows whose spouses were not in the sample, we relied only on self-report. We censored 344 respondents when they became divorced and were therefore no longer susceptible to the exposure and death of a spouse. We also censored descendants in the wave after their death was reported, as usual in survival analyses. We calculated 'time since widowhood' in months, using the month and the year of spouses' deaths given in HRS. We defined short- and long-term as 0–3 months and 3+ months, respectively; past literature has defined short term as 0–6 months.[24,27–29] We tried both 6-month and 3-month cutpoints and found the acute effect was concentrated in the first 3 months following spousal loss.

Table 1 Baseline characteristics of HRS participants, by gender (weighted): Health and Retirement Study, United States, 1998

	Overall (married)		*Women (married)*		*Men (married)*	
	n/*mean*	%	n/*mean*	%	n/*mean*	%
N	12,316	100	5840	100	6476	100
Mean months of follow-up (SD)	106.4	(0.34)	110.0	(0.4)	103.4	(0.4)
Total person-months of follow-up	1 292 063		638 190		653 873	
Number of deaths	2912		1003		1909	
Number of Widows	2373		703		1670	
Core demographic variables						
Mean age at enrollment (SD)	63.3	(0.2)	62.6	(0.2)	63.9	(0.2)
White	9987	81.1	4746	81.3	5241	80.9
Black	1218	9.9	578	9.9	640	9.9
Hispanic	894	7.3	420	7.2	474	7.3
Other race	217	1.8	96	1.6	121	1.9
Adult SES risk factors						
Mean years of education (SD)	12.6	(0.1)	12.5	(0.1)	12.7	(0.1)
Median income in $1000 s (25th, 75th percentile)	40.5	(23.9, 69.6)	39.7	(23.5, 67.6)	41.4	(24.3, 71.0)
Median wealth in $1000 s (25th, 75th percentile)	182.0	(70.0, 411.5)	183.0	(70.0, 414.0)	181.8	(70.0, 409.6)
Behavioral risk factors						
Overweight	5093	41.4	1978	33.9	3115	48.1
Obese	2623	21.3	1234	21.1	1389	21.4
Moderate alcohol use	1905	15.5	779	13.3	1126	17.4
Heavy alcohol use	2148	17.4	700	12.0	1448	22.4
Current Smoker	1811	14.7	786	13.5	1025	15.8
Past smoker	7458	60.6	2713	46.5	4745	73.3
Chronic cardiovascular conditions						
CES-D $\geq$3	2106	17.1	1244	21.3	862	13.3
Hypertension	5519	44.8	2596	44.5	2923	45.1
Diabetes	1681	13.7	682	11.7	999	15.4

Some categories do not sum to 100% because of rounding. Sample members were all married couples at baseline (1998). White, Black and Hispanic do not add up to total because 384 (1.92%) 'others' are not presented separately but are included in the total.
CES-D, 8-item Centers for Epidemiologic Studies Depression scale; SD, standard deviation; IQR, inter-quartile range (25th–75th percentile).

Covariates

We categorized race/ethnicity as: non-Hispanic white ('whites'), non-Hispanic black ('blacks'), non-Hispanic 'other race' (further race details were unavailable for this subgroup) or Hispanic. Additional covariates include years of completed education (0–8, 9–11, 12, >12 years), total household income and total household wealth, which was calculated as total assets minus debt, at baseline (1998). Values for income and wealth were equalized for the number of household members by dividing by the square root of the number of household members, and then divided into quartiles. We also adjusted for baseline age (linear and quadratic) and gender.

Additional covariates included various behavioral risk factors and co-morbidities, as reported in 1998. Health risk factors consisted of smoking status (current and ever/never); body mass index in kg/m^2 categorized as: overweight (25 to <30) or obese ($\geq$30) and alcohol use in the last 2 weeks (never, moderate as 0–2 drinks per day and heavy as $\geq$3 drinks per day). Co-morbidities included self-reported diagnoses of hypertension, diabetes and elevated depressive symptoms, which were measured with a modified 8-item Center for Epidemiological Studies Depression (CES-D) Scale, (dichotomized at <3, $\geq$3), as well as a missing indicator for CES-D score. We added groups of covariates sequentially in all models, beginning with core demographic variables (age, gender and race/ethnicity) and then adding adult characteristics (SES, behavioral risk factors and co-morbidities). We added covariates sequentially to distinguish confounders from potential partial mediators of the effect of interest, such as health behaviors. We used values of

potentially time-varying covariates—health behavior and co-morbidities—at baseline (1998) to avoid controlling for factors that are consequences of widowhood; inclusion of these covariates will also mitigate potential selection bias arising from couples sharing similar risky health behaviors.

Analysis

We used discrete-time survival analyses based on pooled logistic regression models to compare death rates by widowhood status from 1998 to 2008 (time interval in months). Respondents contributed person time until they were no longer susceptible to the exposure, at which point they were censored (i.e. after their own death, or termination of their marriage for reasons other than widowhood, such as divorce). Analyses were conducted in SAS 9.3 (Cary, NC) PROC SURVEYLOGISTIC, to correct for the potential design effect induced by the complex sample design used in HRS, and weighted to make the population representative of the 1998 US population aged 50+ years.

We compared mortality rates among individuals categorized by months since widowhood (first 3 months, 3 to <6 months, 6 to <12 months and 12+ months) to mortality rates among individuals who remained continuously married; we defined the first 3 months as short term. Our analysis assessed the main effect of widowhood on risk of mortality by modeling mortality as a function of time elapsed since widowhood and observed characteristics of individuals. We present the results for four analytic models for three subpopulations: the average population (collapsed over all time points), demarcated by time since widowhood, and sex-stratified and time-demarcated. The base models for all populations are adjusted for time since baseline in months, baseline age, time since widowhood in months and demographic characteristics, such as gender and race/ethnicity. Subsequent models added potential time-varying covariates to the base model, as assessed in 1998, the baseline year. In our second model, to fully understand the potential confounding role of adult SES, we added education, household income and household wealth. The final two models added health behaviors and co-morbidities, respectively, in order to adjust for potential confounding by these characteristics. We also tested for effect modification by sex with an interaction term.

Results

Over an average of 106.4 months (8.9 years) of follow-up, there were 2912 deaths, resulting in 2373 widows and 539 deaths among widows (Table 1). Among the widowed, 23 (3.3%) women and 27 (1.6%) men died within 3 months of widowhood, 17 women (2.4%) and 9 men (0.5%) died between 3 and 6 months, 24 women (3.4%) and 20 men (1.2%) died between 6 and 12 months, and 236 women (33.6%) and 183 men (11.0%) died after 12 months following spousal bereavement. On average, adjusted for age, sex and race, widowhood was associated with elevated odds of mortality compared with those who were still married (odds ratio (OR) = 1.29, 95% CI: 1.17, 1.43); controlling for adult SES (education, income and wealth), behavioral risk factors and co-morbidities attenuated the association, which remained significant (OR = 1.14, 95% CI: 1.02, 1.28) (Table 2).

In the first 3 months following bereavement, widows experienced significantly elevated mortality compared with the continuously married (fully adjusted OR = 1.66, 95% CI: 1.16, 2.38) (Table 3). Adjusting for SES did not fully attenuate the short-term association between widowhood and mortality; when adult SES was added to the model, the estimate slightly attenuated from 1.85 (95% CI: 1.29, 2.64) to 1.72 (95% CI: 1.20, 2.45). For those widowed 3–6 months previously, the point estimate of the age-, sex- and race-adjusted model declined and was no longer statistically significant (OR = 1.27, 95% CI: 0.82, 1.98). The model additionally

Table 2 Mortality risk by widowhood, on average: Health and Retirement Study, United States, 1998–2008

	OR (ref = married)	*(95% CI)*
Model 1: demographic characteristics		
Overall	1.29	(1.17, 1.43)
Women	1.26	(1.07, 1.49)
Men	1.30	(1.14, 1.48)
Model 2: Model 1 + adult SES		
Overall	1.18	(1.07, 1.31)
Women	1.13	(0.96, 1.34)
Men	1.22	(1.07, 1.39)
Model 3: Model 2 + behavioral risk factors		
Overall	1.15	(1.04, 1.28)
Women	1.10	(0.93, 1.31)
Men	1.17	(1.02, 1.33)
Model 4: Model 3 + co-morbidities		
Overall	1.14	(1.02, 1.28)
Women	1.12	(0.95, 1.32)
Men	1.16	(1.01, 1.32)

All models are adjusted for linear for age at baseline, linear and squared. OR = odds ratio. Demographic characteristics include sex, race and age at baseline. Adult SES includes education, household income and household wealth. Behavioral risk factors include BMI (overweight/obese), drinking and smoking. Co-morbidities include self-reported elevated depressive symptoms and self-reported diagnoses of hypertension and diabetes.

Table 3 Widowhood effect by Duration of Bereavement: Health and Retirement Study, United States, 1998–2008

	First 3 months		*3–6 months*		*6–12 months*		*12 months+*	
	OR (ref = married)	*(95% CI)*	*OR (ref = married)*	*(95% CI)*	*OR (ref = married)*	*(95% CI)*	*OR (ref = married)*	*(95% CI)*
Model 1: demographic characteristics								
Overall	1.85	(1.29, 2.64)	1.27	(0.82, 1.98)	1.05	(0.75, 1.48)	1.27	(1.15, 1.40)
Women	1.62	(1.06, 2.49)	1.74	(1.01, 3.02)	1.12	(0.75, 1.69)	1.22	(1.02, 1.45)
Men	2.07	(1.41, 3.05)	0.78	(0.40, 1.50)	0.97	(0.61, 1.56)	1.30	(1.12, 1.51)
Model 2: Model 1 + adult SES								
Overall	1.72	(1.20, 2.45)	1.18	(0.76, 1.84)	0.98	(0.69, 1.37)	1.16	(1.05, 1.28)
Women	1.49	(0.98, 2.28)	1.59	(0.91, 2.77)	1.02	(0.68, 1.53)	1.09	(0.91, 1.29)
Men	1.96	(1.33, 2.88)	0.73	(0.38, 1.42)	0.92	(0.57, 1.48)	1.22	(1.05, 1.42)
Model 3: Model 2 + behavioral risk factors								
Overall	1.67	(1.17, 2.38)	1.15	(0.73, 1.79)	0.95	(0.67, 1.34)	1.13	(1.02, 1.25)
Women	1.45	(0.95, 2.23)	1.55	(0.90, 2.67)	0.99	(0.66, 1.50)	1.06	(0.89, 1.26)
Men	1.89	(1.29, 2.75)	0.71	(0.36, 1.37)	0.88	(0.55, 1.43)	1.17	(1.01, 1.36)
Model 4: Model 3 + co-morbidities								
Overall	1.66	(1.16, 2.38)	1.14	(0.73, 1.79)	0.94	(0.66, 1.33)	1.12	(1.00, 1.25)
Women	1.47	(0.96, 2.24)	1.56	(0.90, 2.71)	1.00	(0.66, 1.52)	1.07	(0.90, 1.28)
Men	1.87	(1.27, 2.75)	0.70	(0.36, 1.35)	0.87	(0.54, 1.42)	1.16	(1.00, 1.35)

All models are adjusted for linear for age at baseline, linear and squared. OR = odds ratio. Demographic characteristics include sex, race and age. Adult SES includes education, household income and household wealth. Behavioral risk factors include BMI (overweight/obese), drinking and smoking. Co-morbidities include self-reported diagnoses of depression, hypertension and diabetes.

adjusting for adult SES, behavioral risk factors and co-morbidities during 3–6 months was also not statistically significant (OR = 1.14, 95% CI: 0.73, 1.79). In formal tests of effect modification, we found these associations did not differ by sex.

In the sex-stratified models adjusted for age, sex and race only, we found men had an OR of 1.30 (95% CI: 1.14, 1.48) whereas women had an OR of 1.26 (95% CI: 1.07, 1.49) (Table 2). Adjusting for adult SES attenuated the OR slightly more for females (from 1.26 to 1.13) than for males (from 1.30 to 1.22). After controlling for adult SES, behavioral risk factors and co-morbidities, on average, men had 16% elevated risk (OR = 1.16, 95% CI: 1.01, 1.32), whereas women had 12% elevated risk of mortality (OR = 1.12, 95% CI: 0.95, 1.32); the estimate was statistically significant for men and borderline significant for women. During the first 3 months, widowhood was adversely associated with mortality for both women (OR = 1.62, 95% CI: 1.06, 2.49) and men (OR = 2.07, 95% CI: 1.41, 3.05) in the model adjusted for age and race (Table 3). Additionally, adjusting for adult SES attenuated the effect estimate for the first 3 months after widowhood from 1.62 to 1.49 among women and from 2.07 to 1.96 among men; the association remained statistically significant for men and was borderline significant for women. The magnitudes of the effect estimates were fairly similar after adjusting for behavioral risk factors and co-morbidities during the first 3 months for women (OR = 1.47, 95% CI: 0.96, 2.24) and men (OR = 1.87, 95% CI: 1.27, 2.75). In the model adjusted for adult SES, behavioral risk factors and co-morbidities 3–6 months following bereavement, the point estimates for both women and men were statistically non-significant (OR = 1.56, 95% CI: 0.90, 2.71 for women, OR = 0.70, 95% CI: 0.36, 1.35 for men). All co-morbidities as well as current and ever smoking were associated with increased odds of death (Supplementary Table 1).

Discussion

Main findings of this study

In this longitudinal, nationally representative sample of Americans aged 50+ years, we find mortality almost doubled in the first 3 months following widowhood and then tapered dramatically. Robust adjustment for SES did not fully attenuate the association between widowhood and mortality, which did not differ between the sexes.

What is already known on this topic

Although the widowhood effect has long been recognized,[30,31] it has been difficult to establish causality or to elucidate relevant mechanisms, though some papers have suggested a causal relationship.[24,32] Researchers typically attribute the widowhood effect to the difference between the salubrious qualities of marriage and the detrimental consequences of widowhood.[14] While married spouses benefit from emotional support, spousal promotion of healthy behaviors,[1] economic stability[2] and possibly superior health care utilization[33], widowed individuals typically lose these benefits.[34]

Prior findings from cross-sectional and longitudinal studies also indicate that the widowhood effect is particularly acute immediately following spousal loss[14,24,25,35] and attenuates with increasing time since widowhood[13,27–29,36–38], which was also reflected in a recent meta-analysis.[5] Existing longitudinal studies put the long-term excess risk of death associated with widowhood at ∼15% whereas estimates of short-term effects during the first few months immediately post-widowhood range from 50 to 90%.[28,35]

Social and financial resources are considered important confounders in the relationship between widowhood and mortality. SES may confound widowhood effects because it influences marriage formation, likelihood of spousal death and own health. For example, education and financial resources improve marriage market options, for both men and women.[39,40] There is also evidence suggesting that the SES-marriage association is itself due to the selection of healthy individuals into marriage, i.e. persons exhibiting poor health or unhealthy behaviors are less likely to attract a partner or maintain a marital relationship compared with healthy individuals.[41–43] However, our review of the widowhood literature reveals that most prior studies do not adequately control for confounding by SES, typically incorporating only coarse measures in one or two domains, while ignoring others.[13,17,31,38,44]

Gender differences have also been reported in prior research. Women are more likely to survive their spouses, and prior findings from meta-analyses suggest that widowhood is more toxic for men.[5,6] Prior research shows an estimated 80% increased risk of mortality for men and 60% increase for women during the first year following spousal loss, compared with married individuals.[45] Some studies report similar effects for men and women, and it is unknown whether this is due to insufficient statistical power or true population differences in the gendered impact of widowhood.[46]

What this study adds

We performed a more robust control for SES than previous researchers, by controlling for wealth in addition to income and education; wealth is considered a particularly important metric of socioeconomic status among older adults,[20,22] many of whom have retired and are no longer earning an income. We found that after robust adjustment for SES, the association between widowhood and excess mortality is sharply elevated in the first months after bereavement, consistent with past research. However, contrary to the existing evidence explicated thus far suggesting widowhood is more toxic for men than women, our formal testing for effect measure modification showed no difference between the sexes. It is possible that prior research was subject to residual confounding by SES, which may explain these discrepant results.

Limitations of this study

Although the HRS is well-suited to investigate the widowhood effect, the following limitations should be considered. HRS gives the month and the year of both death and widowhood, thus when both spouses died in the same month, it is not possible to tell which death occurred first. Secondly, important health behavior and co-morbidity characteristics are self-reported rather than independently verified; in particular, health conditions such as heart disease and hypertension are subject to misclassification and have been shown to be imperfectly correlated with clinically verified outcomes in other studies.[47,48] Thirdly, in some strata, there were few events and effect estimates are therefore imprecise, as indicated by the wide confidence intervals. Nonetheless, confidence intervals suggest that our primary conclusions are robust: short-term effects are large and long-term effects, if any, are modest. Finally, it is possible that the attenuation in the widowhood effect after the first 3 months following bereavement is partially attributable to a 'culling' effect, in which the vulnerable widows die in the first three months and the survivors are a hardier population. We believe this bias is small, however, because overall mortality is low, even in the recently widowed.

Contributions

S.V.S., M.M.G. and J.R.M. conceptualized the study. J.R.M. led the data analysis, interpreted the results and wrote the first draft of the paper. S.Y.L. contributed to the data analysis and interpretation. S.V.S., M.M.G. and J.R.M. contributed to the design of the analysis; A.M.V. contributed to the interpretation and writing of the manuscript. All authors reviewed and approved the final manuscript.

Supplementary data

Supplementary data are available at *PUBMED* online.

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