RESEARCH REPORT

Effect of conjugal bereavement on mortality of the bereaved spouse in participants of the Renfrew/Paisley Study

Carole L Hart, David J Hole, Debbie A Lawlor, George Davey Smith, Tony F Lever

J Epidemiol Community Health 2007;**61**:455–460. doi: 10.1136/jech.2006.052043

See end of article for authors' affiliations

Correspondence to: Dr C L Hart, Public Health and Health Policy, Division of Community Based Sciences, University of Glasgow, 1 Lilybank Gardens, Glasgow G12 8RZ, UK; c.l.hart@udcf.gla.ac.uk

Accepted 31 August 2006

Objectives: To investigate how loss of a spouse affects mortality risk in the bereaved partner.
Design and setting: Prospective cohort study in Renfrew and Paisley in Scotland.
Participants: 4395 married couples aged 45–64 years when the study was carried out between 1972 and 1976.
Methods: The date of bereavement for the bereaved spouse was the date of death of his or her spouse. Bereavement could occur at any time during the follow-up period, so it was considered as a time-dependent exposure variable and the Cox proportional hazards model for time-dependent variables was used. The relative rate (RR) of mortality was calculated for bereaved versus non-bereaved spouses and adjusted for confounding variables.
Main outcome measures: Causes of death to 31 March 2004.
Results: Bereaved participants were at higher risk than non-bereaved participants of dying from any cause (RR 1.27; 95% CI 1.2 to 1.35). These risks remained but were attenuated after adjustment for confounding variables. There were raised RRs for bereaved participants dying of cardiovascular disease, coronary heart disease, stroke, all cancer, lung cancer, smoking-related cancer, and accidents or violence. After adjustment for confounding variables, RRs remained higher for bereaved participants for all these causes except for mortality from lung cancer. There was no strong statistical evidence that the increased risks of death associated with bereavement changed with time after bereavement.
Conclusions: Conjugal bereavement, in addition to existing risk factors, is related to mortality risk for major causes of death.

Since Ciocco[1] reported high correlations between lifespan in married couples in 1940, there have been several studies on the effects of bereavement on the widowed spouse. In general, studies report an increased risk of mortality in the bereaved spouse, compared with non-bereaved spouses.[2–7] However, it is not clear whether the increased risk is due to a direct effect of the shock and grief of the bereavement or due to the bereaved spouse's own risk factors. These risk factors may be similar to the deceased spouse's risk factors, since many couples share lifestyles and thus share risk factors, such as diet and smoking. This could also be due to people marrying similar people, rather than due to sharing a common environment.[8] Consequently, their deaths may occur at closer intervals than expected. Studies on bereavement from populations in Finland,[2–4] Belgium[5] and Israel[6] have used census data. These have the advantage of large numbers of participants in the studies, but the disadvantage of having a limited amount of data on risk factors. Variables such as education, household size and family income are available, but personal variables such as smoking habit and blood pressure are not. In this study, a dataset is used, which has many individual risk factors and a long-term follow-up of over 4000 married couples. A previous study that included individual risk factors reported on bereavement in a large cohort in northern California.[7] This study analysed all-cause mortality only, finding an increased risk in those who were bereaved, whereas in this study, several causes of mortality are available for analysis.

In this paper, all the samples were married couples at the time of screening—that is, none were widowed. After screening, one spouse could have died, leaving the other spouse bereaved. The term bereavement is used here to denote the effect of the death of the spouse, not the death of another relative or friend. The effect of bereavement on the mortality of the bereaved spouse would be investigated, adjusting for individual risk factors and looking at different causes of death. It is possible that inadequate adjustment for risk factors in previous studies has incorrectly suggested that there is a higher risk of bereavement, and that a more complete adjustment may show that there is no real effect of bereavement on mortality.

METHODS

The Renfrew/Paisley Study was conducted between 1972 and 1976.[9] Residents of the towns of Renfrew and Paisley aged between 45 and 64 years were invited to take part in a health-screening study and a 78% response rate was obtained. Participants completed a questionnaire, which was checked by a trained member of staff at the screening examination. Examinations were held in clinics specially set up in community centres in different areas of Renfrew and Paisley. The questionnaire included questions on smoking habit, home address from which the Carstairs deprivation category was derived[10] and occupation from which the Registrar General's social class classification was derived.[11] The social class of women was coded according to their own occupation, unless they responded as ''housewife'', in which case their husband's social class was used. The definition of angina was derived from the Rose Angina Questionnaire, with angina defined as definite or possible codes for this analysis.[12] Report of a severe chest pain lasting ⩾30 min was considered as evidence of a previous myocardial infarction (MI).[12] Bronchitis, from the Medical Research Council Questionnaire, was defined as having persistent and infective phlegm and being breathless.[9] The

Abbreviations: CHD, coronary heart disease; CVD, cardiovascular disease; FEV_1, forced expiratory volume in 1 s; ICD, International Classification of Diseases; MI, myocardial infarction

screening examination included measurement of systolic and diastolic blood pressure, with diastolic pressure being recorded at the disappearance of the fifth Korotkoff sound. A non-fasting blood sample was taken and plasma cholesterol measured.[9] Height and weight were measured, enabling calculation of the body mass index. Forced expiratory volume in 1 s (FEV_1) was measured with the participant standing. Adjusted FEV_1 was calculated as the percentage of the actual FEV_1 divided by the expected FEV_1, with the expected FEV_1 being derived from a regression analysis of healthy never-smokers with no report of lung problems.[13] A six-lead ECG was taken with the subject seated and coded according to the Minnesota system with any of the codes 1.1–1.3, 4.1–4.4, 5.1–5.3 and 7.1 being considered as evidence of ischaemia.[9] Ethics approval was granted by the University of Glasgow Medical Faculty Ethics Committee, Glasgow, UK.

Follow-up for mortality was provided by the National Health Service Central Registry in Edinburgh, UK, where participants were flagged at study inception. Dates and causes of death were provided. Deaths from screening to the end of March 2004 were included. This date was taken as the end of the follow-up. Causes of death were defined as all cause, cardiovascular disease (CVD; International Classification of Diseases (ICD)9 codes 390–459, ICD10 codes I00–I99, G45, R58, M30.0 and M30.3), coronary heart disease (CHD; ICD9 410–414, ICD10 I20–I25), stroke (ICD9 430–438, ICD10 I60–I69 and G45), all cancer (ICD9 140–208, ICD10 C00–C97), lung cancer (ICD9 162, ICD10 C33–C34), smoking-related cancer (ICD9 140–151, 155, 157, 160–163, 188–189 and 205, ICD10 C00–C16, C22, C25, C30–C34, C38.4, C64–C68, and C92), non-smoking-related cancer (codes for all cancer excluding smoking-related cancer), accidental and violent (ICD9 E800–E999, ICD10 S00–Y98) and alcohol related (ICD9 291, 303, 571 or E860 (there were no deaths from the equivalent ICD10 codes)).

Since the study took place in a defined geographical area, and owing to the age range of the participants, there were 4462 married couples. In all, 16 couples with one member lost to follow-up, 49 couples in which one or both members embarked from the UK during the follow-up period and two couples in which both members died on the same day were excluded from the analysis. Couples in which both members died within a week were checked for causes of death to ensure that both were not involved in an accident (but did not die immediately[4]) but none were found. The analysis was therefore based on 4395 married couples (8790 participants). It was assumed that the couples remained married until the death of the first spouse. A random sample of 100 death certificates of married participants (50 men and 50 women) showed none recorded as being divorced at the time of death, suggesting that divorce was not a common occurrence in this particular population.

Table 1 Numbers, row percentages and column percentages of bereaved and dead in 4395 married couples from the Renfrew/Paisley Study

	Not bereaved	Bereaved	Total
Men			
Alive	591 (61.2%) (18.4%)	375 (38.8%) (31.5%)	966 (100%) (22%)
Dead	2615 (76.3%) (81.6%)	814 (23.7%) (68.5%)	3429 (100%) (78%)
Total	3206 (72.9%) (100%)	1189 (27.1%) (100%)	4395 (100%) (100%)
Women			
Alive	591 (30%) (33.2%)	1382 (70%) (52.8%)	1973 (100%) (44.9%)
Dead	1189 (49.1%) (66.8%)	1233 (50.9%) (47.2%)	2422 (100%) (55.1%)
Total	1780 (40.5%) (100%)	2615 (59.5%) (100%)	4395 (100%) (100%)

The date of bereavement for the bereaved spouse was the date of death of his or her spouse. Bereavement could occur at any time during the follow-up period (as opposed to being an exposure which was measured on all participants at screening), so it was considered as a time-dependent exposure variable and the Cox proportional hazards model for time-dependent variables was used for the analysis, using the computer package SAS V.9.1. The relative rate (RR) of mortality was calculated for bereaved versus non-bereaved spouses. RRs of mortality were first adjusted for age of the spouse and then adjusted for other confounding variables. Social class, deprivation category, systolic blood pressure, cholesterol, body mass index, height, adjusted FEV_1 and the number of cigarettes smoked per day (for current and former smokers) were added as continuous variables with a 0/1 variable added to denote current or former smokers. The presence of angina, previous MI, bronchitis or ischaemia on ECG were also added as 0/1 variables. The small numbers of participants with missing values were allocated the sex-specific mean or mode. The time until bereavement in days was calculated from the date of screening to the death of the spouse. This was entered into the model as it was running, and used to calculate the time-dependent variable ''bereavement'' for bereaved participants. Until the participant was bereaved, the bereavement variable took the value 0. This was the case at the beginning of the follow-up period as all the couples were married and both members were alive. After the spouse's death, the bereavement variable took the value 1. Participants who were not bereaved had 0 for their bereavement variable throughout all analyses.

Analyses were first conducted separately for men and women and a test for difference in effect by sex (test for statistical interaction) was computed by including an interaction term between sex and bereavement in models that included both men and women. There was no strong evidence of sex differences, so results are presented for men and women combined.

The analyses were repeated, dividing the time after bereavement into two time periods—the first 5 years and >5 years, and into four time periods—the first 6 months, 6–12 months, 12–24 months and >24 months. Small numbers of events meant that these two analyses could not be performed for the alcohol-related causes. Tests of differences in effects by follow-up time were conducted for each cause of death using interaction terms of bereavement and survival time.

RESULTS

More than twice the number of women than men had been bereaved during the follow-up period (59.5% women compared with 27.1% men; table 1). In all, 68.5% men and 47.2% women who were bereaved during the follow-up period subsequently died later in the follow-up period.

Bereaved participants had a higher risk of dying from any cause than non-bereaved participants (RR 1.27; 95% CI 1.2 to 1.35; table 2).

After adjustment for confounding variables, the increased RR remained, but was attenuated. There were raised RRs for bereaved participants dying of CVD, CHD, stroke, all cancer, lung cancer, smoking-related cancer, and accidents or violence. After adjustment for confounding variables, RRs remained higher for bereaved participants for all these causes, except for lung cancer. There were no robust differences for bereaved compared with non-bereaved participants for

Table 2 Relative rate of mortality for bereaved versus non-bereaved in 4395 married couples from the Renfrew/Paisley Study

	Not bereaved	Bereaved
Number of men and women	4986	3804
All cause		
Number of deaths	3804	2047
RR_1	1	1.27 (1.2 to 1.35)
RR_2	1	1.19 (1.12 to 1.27)
CVD		
Number of deaths	1911	996
RR_1	1	1.26 (1.16 to 1.38)
RR_2	1	1.18 (1.08 to 1.29)
CHD		
Number of deaths	1228	536
RR_1	1	1.29 (1.15 to 1.45)
RR_2	1	1.22 (1.08 to 1.37)
Stroke		
Number of deaths	423	317
RR_1	1	1.27 (1.08 to 1.5)
RR_2	1	1.2 (1.01 to 1.42)
Cancer		
Number of deaths	1181	538
RR_1	1	1.19 (1.06 to 1.34)
RR_3	1	1.12 (1 to 1.26)
Lung cancer		
Number of deaths	389	156
RR_1	1	1.35 (1.1 to 1.67)
RR_3	1	1.18 (0.96 to 1.45)
Smoking-related cancer		
Number of deaths	673	285
RR_1	1	1.3 (1.12 to 1.52)
RR_3	1	1.18 (1.01 to 1.38)
Non-smoking-related cancer		
Number of deaths	508	253
RR_1	1	1.07 (0.9 to 1.26)
RR_3	1	1.06 (0.89 to 1.26)
Alcohol related		
Number of deaths	24	10
RR_1	1	2.31 (0.99 to 5.35)
RR_3	1	2.14 (0.92 to 4.97)
Accidents and violence		
Number of deaths	69	39
RR_1	1	1.81 (1.14 to 2.88)
RR_3	1	1.68 (1.06 to 2.68)

CHD, coronary heart disease; CVD, cardiovascular disease; FEV_1, forced expiratory volume in 1 s; MI, myocardial infarction
RR_1, relative rate adjusted for age and sex; RR_2, relative rate adjusted for age, sex, systolic blood pressure, smoking, cholesterol, body mass index, height, social class, deprivation category, adjusted FEV_1, angina, ischaemia on ECG, previous MI and bronchitis; RR_3, relative rate adjusted for age, sex, systolic blood pressure, smoking, cholesterol, body mass index, height, social class, deprivation category and adjusted FEV_1.

non-smoking-related cancer. RR were double for bereaved participants for alcohol-related mortality, but these results were estimated imprecisely.

When the time after bereavement was subdivided into the first 5 years and >5 years, there was a tendency for higher risk of deaths from CVD and CHD in the first 5 years, whereas for deaths from stroke and cancers the risk was higher after 5 years (table 3). For all-cause mortality, the risks were similar in the first and second periods. Similar results were seen after adjustment for risk factors.

With the time after bereavement divided into smaller intervals, there was some evidence of high risks of all-cause mortality in the first 6 months after bereavement (table 4). This effect was driven by non-smoking-related cancer and possibly CVD mortality, and remained after adjustment for confounders. The other causes had highest risks in the period from 2 years after bereavement. Formal tests of interaction with time gave significant results for mortality from lung cancer only ($p = 0.028$).

DISCUSSION

This study has shown that conjugal bereavement has an effect on mortality, which is additional to the effect of existing risk factors. There was no strong statistical evidence that the effect of bereavement on mortality differed by time since bereavement. The higher proportion of women than of men who were bereaved was probably because of the longer lifespan of women, on average, compared with men. The higher proportion of bereaved men than of bereaved women who themselves died in the follow-up period was probably because of the same reason.

The fully adjusted RR of all-cause mortality found in this study was 1.19 (1.12 to 1.27) for bereaved compared with non-bereaved participants. Other studies have reported similar RRs, although these have not been adjusted for individual risk factors. These similar RRs were seen in studies from Israel[6] (1.25 for men and 1.26 for women), from Finland[4] (1.18 for men and 1.08 for women) and in a recent report on elderly American couples[14] (1.21 for men and 1.17 for women).

There were higher risks in bereaved than in non-bereaved participants for most of the specific causes of death. Only non-smoking-related cancer did not show higher risks for bereaved compared with non-bereaved participants. Accidental and violent deaths were particularly high, as was also found in a large Finnish study.[3] The accidental and violent death category includes suicides, which have been found to be higher after bereavement in other studies,[2 3 15 16] but the number of suicides in this study was too small for analysis. Adjusting for risk factors attenuated the RRs, but they still remained higher for bereaved than for non-bereaved participants. It is possible that other unmeasured risk factors, such as diet and exercise or social support, could have had an additional effect on mortality and cancelled out the increased risk in the bereaved in all the causes of death.

There were no clear differences in the effect of time after bereavement except for lung cancer where higher risks were seen after 5 years of bereavement. That we saw no clear differences could be because of small numbers of deaths for some time periods and causes, but reports from other studies on time after bereavement have varied. An Israeli study reported highest RRs for all-cause mortality in the first 6 months for both men and women.[6] In a large Finnish study, mortality was greater in the first 6 months after bereavement for men and women.[3] In that study, rates for circulatory diseases, accidental or violent deaths in men and women, and cancer in men were higher in the first 6 months. The US National Longitudinal Mortality Study reported that mortality remained increased in the bereaved for at least 5 years.[17] This was true for cardiovascular causes and other (non-cancer, non-cardiovascular) causes. In particular, risks were highest in the first year after bereavement. In the northern California study, which adjusted for individual risk factors, the highest RRs were found in the period 7–12 months after bereavement.[7] In women, this remained true after adjusting for risk factors, whereas in men, it was true after adjustment for men with only few health problems. It was not the case for men with many health problems, when the adjusted RRs associated with bereavement were reduced. A study in Finland of widowed people only,

Table 3 Relative rate of mortality following bereavement divided into two time periods since bereaved

	Number of deaths	RR adjusted for age and sex	RR fully adjusted*
All cause			
Not bereaved	3804	1	1
Bereaved			
First 5 years	720	1.26 (1.16 to 1.37)	1.19 (1.09 to 1.29)
After 5 years	1327	1.28 (1.19 to 1.38)	1.19 (1.11 to 1.28)
CVD			
Not bereaved	1911	1	1
Bereaved			
First 5 years	364	1.28 (1.14 to 1.44)	1.21 (1.08 to 1.36)
After 5 years	632	1.25 (1.13 to 1.39)	1.16 (1.05 to 1.29)
CHD			
Not bereaved	1228	1	1
Bereaved			
First 5 years	212	1.33 (1.15 to 1.55)	1.27 (1.09 to 1.48)
After 5 years	324	1.26 (1.10 to 1.45)	1.18 (1.03 to 1.35)
Stroke			
Not bereaved	423	1	1
Bereaved			
First 5 years	96	1.19 (0.94 to 1.49)	1.13 (0.9 to 1.42)
After 5 years	221	1.33 (1.10 to 1.6)	1.24 (1.02 to 1.50)
Cancer			
Not bereaved	1181	1	1
Bereaved			
First 5 years	182	1.10 (0.93 to 1.29)	1.04 (0.89 to 1.22)
After 5 years	356	1.26 (1.10 to 1.44)	1.18 (1.04 to 1.36)
Lung cancer			
Not bereaved	389	1	1
Bereaved			
First 5 years	48	1.05 (0.77 to 1.43)	0.93 (0.68 to 1.26)
After 5 years	108	1.6 (1.26 to 2.03)	1.37 (1.08 to 1.75)
Smoking-related cancer			
Not bereaved	673	1	1
Bereaved			
First 5 years	96	1.14 (0.92 to 1.42)	1.04 (0.83 to 1.3)
After 5 years	189	1.43 (1.19 to 1.72)	1.28 (1.07 to 1.54)
Non-smoking-related cancer			
Not bereaved	508	1	1
Bereaved			
First 5 years	86	1.04 (0.82 to 1.32)	1.04 (0.82 to 1.31)
After 5 years	167	1.08 (0.89 to 1.32)	1.08 (0.88 to 1.32)
Accidents and violence			
Not bereaved	69	1	1
Bereaved			
First 5 years	14	1.78 (0.97 to 33.25)	1.66 (0.91 to 3.04)
After 5 years	25	1.84 (1.07 to 3.17)	1.70 (0.99 to 2.93)

CHD, coronary heart disease; CVD, cardiovascular disease; FEV_1, forced expiratory volume in 1 s; MI, myocardial infarction.
*All cause, CVD, CHD and stroke adjusted for age, sex, systolic blood pressure, smoking, cholesterol, body mass index, height, social class, deprivation category, adjusted FEV_1, angina, ischaemia on ECG, previous MI and bronchitis. Other causes were adjusted for age, sex, systolic blood pressure, smoking, cholesterol, body mass index, height, social class, deprivation category and adjusted FEV_1.

found higher mortality in the first week after bereavement, especially for CHD.[2]

Advantages of this study were that it was a big study with information on a large range of individual risk factors, which other studies lack. Information on risk factors was given by each individual. Most other studies on bereavement could not adjust for individual confounders such as blood pressure, although some were able to use census variables.[2 4–6] The bereavement study, which did have individual risk factors only reported on all-cause mortality.[7] This study was able to report on several causes of mortality and additionally divide the time after bereavement into periods of different length.

Limitations of this study were that there was no information available on remarriage after bereavement. Also, the assumption was made that the couples remained married until bereavement or until the end of the follow-up period, as divorce was rare in this cohort. However, this could have been incorrect and resulted in some measurement error in the exposure variable. There was also no information on changes in risk factors after screening or after bereavement. Bereavement has been found to cause changes in behaviour; for example, Lee *et al*[18] found that women from the Nurses' Health Study who became widowed compared with women who stayed married ate fewer fresh vegetables, were less likely to quit smoking and

Table 4 Relative rate of mortality following bereavement divided into four time periods since bereaved

	Number of deaths	RR adjusted for age and sex	RR fully adjusted*
All cause			
Not bereaved	3804	1	1
Bereaved			
First 6 months	87	1.38 (1.11 to 1.71)	1.31 (1.06 to 1.62)
6–12 months	67	1.09 (0.86 to 1.39)	1.04 (0.81 to 1.32)
12–24 months	136	1.14 (0.96 to 1.35)	1.08 (0.91 to 1.28)
>24 months	1757	1.29 (1.21 to 1.38)	1.2 (1.13 to 1.29)
CVD			
Not bereaved	1911	1	1
Bereaved			
First 6 months	41	1.31 (0.96 to 1.78)	1.25 (0.92 to 1.71)
6–12 months	35	1.15 (0.82 to 1.61)	1.1 (0.78 to 1.53)
12–24 months	67	1.13 (0.89 to 1.45)	1.08 (0.84 to 1.38)
>24 months	853	1.28 (1.17 to 1.4)	1.19 (1.09 to 1.31)
CHD			
Not bereaved	1228	1	1
Bereaved			
First 6 months	22	1.23 (0.81 to 1.88)	1.18 (0.77 to 1.8)
6–12 months	20	1.16 (0.74 to 1.8)	1.11 (0.71 to 1.72)
12–24 months	40	1.2 (0.88 to 1.65)	1.15 (0.84 to 1.58)
>24 months	454	1.31 (1.16 to 1.48)	1.23 (1.09 to 1.4)
Stroke			
Not bereaved	423	1	1
Bereaved			
First 6 months	11	1.27 (0.7 to 2.31)	1.23 (0.67 to 2.24)
6–12 months	8	0.94 (0.47 to 1.9)	0.91 (0.45 to 1.83)
12–24 months	15	0.9 (0.53 to 1.51)	0.86 (0.51 to 1.44)
>24 months	283	1.33 (1.12 to 1.58)	1.24 (1.04 to 1.48)
Cancer			
Not bereaved	1181	1	1
Bereaved			
First 6 months	25	1.36 (0.91 to 2.02)	1.29 (0.87 to 1.92)
6–12 months	15	0.84 (0.5 to 1.39)	0.8 (0.48 to 1.33)
12–24 months	36	1.04 (0.74 to 1.45)	0.98 (0.7 to 1.37)
>24 months	462	1.22 (1.08 to 1.38)	1.15 (1.02 to 1.3)
Lung cancer			
Not bereaved	389	1	1
Bereaved			
First 6 months	5	0.96 (0.4 to 2.33)	0.85 (0.35 to 2.06)
6–12 months	6	1.18 (0.52 to 2.64)	1.04 (0.46 to 2.33)
12–24 months	9	0.93 (0.48 to 1.81)	0.83 (0.43 to 1.61)
>24 months	136	1.44 (1.16 to 1.79)	1.25 (1 to 1.55)
Smoking-related cancer			
Not bereaved	673	1	1
Bereaved			
First 6 months	10	1.05 (0.56 to 1.97)	0.96 (0.52 to 1.8)
6–12 months	11	1.19 (0.66 to 2.17)	1.09 (0.6 to 1.98)
12–24 months	20	1.13 (0.72 to 1.76)	1.03 (0.66 to 1.61)
>24 months	244	1.35 (1.14 to 1.59)	1.21 (1.03 to 1.43)
Non-smoking-related cancer			
Not bereaved	508	1	1
Bereaved			
First 6 months	15	1.68 (1 to 2.81)	1.67 (1 to 2.8)
6–12 months	4	0.46 (0.17 to 1.22)	0.45 (0.17 to 1.21)
12–24 months	16	0.93 (0.56 to 1.54)	0.93 (0.56 to 1.53)
>24 months	218	1.08 (0.9 to 1.29)	1.08 (0.9 to 1.29)
Accidents and violence			
Not bereaved	69	1	1
Bereaved			
First 6 months	2	2.16 (0.53 to 8.9)	2.04 (0.5 to 8.38)
6–12 months	0	—	—
12–24 months	6	3.61 (1.54 to 8.46)	3.36 (1.43 to 7.88)
>24 months	31	1.7 (1.03 to 2.8)	1.57 (0.95 to 2.59)

CHD, coronary heart disease; CVD, cardiovascular disease; FEV_1, forced expiratory volume in 1 s; MI, myocardial infarction.
*All cause, CVD, CHD and stroke adjusted for age, sex, systolic blood pressure, smoking, cholesterol, body mass index, height, social class, deprivation category, adjusted FEV_1, angina, ischaemia on ECG, previous MI and bronchitis. Other causes were adjusted for age, sex, systolic blood pressure, smoking, cholesterol, body mass index, height, social class, deprivation category and adjusted FEV_1.

What is already known

- Studies have shown that conjugal bereavement increases mortality risk, from all causes and specific causes of death.
- Only one study has been able to adjust for individual risk factors, such as smoking and blood pressure, which are likely to be similar for spouses and would therefore tend to make the timing of their deaths similar.
- The one study to take these individual factors into account reported all-cause mortality only.

What this paper adds

- This study was able to adjust for many individual risk factors and investigate several causes of death.
- Bereavement was also found to be a risk factor in addition to individual risk factors, for most major causes of death.

Policy implications

- Extra support could be considered for bereaved spouses.
- More research of a qualitative nature could inform the best type of support (medical, social services, lay) and its extent.

more likely to relapse or start smoking. This could increase the mortality risk.

To conclude, we have shown that bereavement does have an effect on mortality risk in addition to that of individual risk factors (which had a fairly small influence) and that the effects are persistent.

ACKNOWLEDGEMENTS

Victor Hawthorne conducted the original Midspan studies and Pauline MacKinnon is the Midspan administrator.

Authors' affiliations

Carole L Hart, David J Hole, Tony F Lever, University of Glasgow, Glasgow, UK
Debbie A Lawlor, George Davey Smith, University of Bristol, Bristol, UK

Funding: This study was supported by the Chief Scientist Office of the Scottish Executive. DAL is funded by a UK Career Scientist Award. The authors' work is independent of the funders.

Competing interests: None.

REFERENCES

1 **Ciocco A**. On the mortality in husbands and wives. *Hum Biol* 1940;**12**:508–30.
2 **Kaprio J**, Koskenvuo M, Rita H. Mortality after bereavement: a prospective study of 95,647 widowed persons. *Am J Public Health* 1987;**77**:283–7.
3 **Martikainen P**, Valkonen T. Mortality after the death of a spouse: rates and causes of death in a large Finnish cohort. *Am J Public Health* 1996;**86**:1087–93.
4 **Martikainen P**, Valkonen T. Mortality after death of spouse in relation to duration of bereavement in Finland. *J Epidemiol Community Health* 1996;**50**:264–8.
5 **Lusyne P**, Page H, Lievens J. Mortality following conjugal bereavement, Belgium 1991–1996: the unexpected effect of education. *Popul Stud* 2001;**55**:281–9.
6 **Manor O**, Eisenbach Z. Mortality after spousal loss: are there socio-demographic differences? *Soc Sci Med* 2003;**56**:405–13.
7 **Schaefer C**, Quesenberry C, Wi S. Mortality following conjugal bereavement and the effects of a shared environment. *Am J Epidemiol* 1995;**141**:1142–52.
8 **Sackett DL**, Anderson GD, Milner R, *et al*. Concordance for coronary risk factors among spouses. *Circulation* 1975;**52**:589–95.
9 **Hawthorne VM**, Watt GCM, Hart CL, *et al*. Cardiorespiratory disease in men and women in urban Scotland: baseline characteristics of the Renfrew/Paisley (Midspan) Study population. *Scott Med J* 1995;**40**:102–7.
10 **Carstairs V**, Morris R. *Deprivation and health in Scotland*. Aberdeen: Aberdeen University Press, 1991:1–13.
11 **General Register Office**. *Classification of occupations 1966*. London: HMSO, 1966:1–148.
12 **Hart CL**, Watt GCM, Davey Smith G, *et al*. Pre-existing ischaemic heart disease and ischaemic heart disease mortality in women compared with men. *Int J Epidemiol* 1997;**26**:508–15.
13 **Hole DJ**, Watt GCM, Davey Smith G, *et al*. Impaired lung function and mortality risk in men and women: findings from the Renfrew and Paisley prospective population study. *BMJ* 1996;**313**:711–16.
14 **Christakis NA**, Allison PD. Mortality after the hospitalization of a spouse. *N Engl J Med* 2006;**354**:719–30.
15 **Helsing KJ**, Comstock GW, Szklo M. Causes of death in a widowed population. *Am J Epidemiol* 1982;**116**:524–32.
16 **Li G**. The interaction effect of bereavement and sex on the risk of suicide in the elderly: an historical cohort study. *Soc Sci Med* 1995;**40**:825–8.
17 **Johnson NJ**, Backlund E, Sorlie P, *et al*. Marital status and mortality: the National Longitudinal Mortality Study. *Ann Epidemiol* 2000;**10**:224–38.
18 **Lee S**, Cho E, Grodstein F, *et al*. Effects of marital transitions on changes in dietary and other health behaviours in US women. *Int J Epidemiol* 2005;**34**:69–78.