Mortality Differences by Partnership Status in England and Wales: The Effect of Living Arrangements or Health Selection?

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Abstract This article investigates the relationship between partnership status and mortality in England and Wales. Using data from the Office for National Statistics Longitudinal Study for the period between 2001 and 2011, we examine whether married people have lower mortality levels than unmarried individuals; whether individuals who cohabit have mortality levels similar to those of married or single persons; and how much the fact that married couples live with someone rather than alone explains their low mortality. Our analysis shows first that married individuals have lower mortality than unmarried persons. Second, men and women in pre-marital unions exhibit mortality levels similar to those of married men and women, whereas mortality levels are elevated for post-marital cohabitants. Third, controlling for household size and the presence of children reduces mortality differences between married and unmarried non-partnered individuals, but significant differences persist. The study supports both protection and selection theory. The increase in mortality differences by age between never-married cohabitants and married couples is likely a sign of the long-term accumulation of health and wealth benefits of marriage. Similar mortality levels of cohabiting and married couples at younger ages suggest that healthier individuals are more likely to find a partner.

Keywords England and Wales · Survival analysis · Mortality differences · Marital status · Cohabitation · ONS LS

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1 Introduction

The relationship between health and partnership status has been of interest to social scientists for a long time. Previous research in European and other industrialised countries shows that married persons have a lower risk of mortality than non-married individuals (e.g. Dupre et al. 2009; Johnson et al. 2000; Guner et al. 2014; Murray 2000; Ben-Shlomo et al. 1993; Blomgren et al. 2012; Murphy et al. 2007; Brockmann and Klein 2004). These differences are typically greater for men than for women (Murphy et al. 2007; Hu and Goldman 1990; Wu and Hart 2002) and persist in industrialised countries even when socio-demographic and socio-economic differences are controlled for (Murphy et al. 2007; Staehelin et al. 2012). The results raise a number of questions. For instance, are healthier people more likely to marry and to stay married? Do widowed people suffer from poor health because of the loss of a spouse or because their own poor health was the main reason for marrying a person of poor health? Does marriage provide better health protection than cohabitation?

A large body of the literature investigates these questions from a variety of perspectives and in various contexts. Espinosa and Evans (2008), Joung et al. (1998) and Guner et al. (2014) examined the dynamics of partnership status with the focus on assortative mating—the process of choosing a mate similar to oneself. Other researchers such as Lillard and Panis (1996), Cheung (1998), Cheung and Sloggett (1998) and Joung et al. (1998) studied positive and adverse selection. Still others included partnership histories to control for the immediate and cumulative effect of marriage (Blomgren et al. 2012; Brockmann and Klein 2004; Dupre and Meadows 2007; Dupre et al. 2009; Grundy and Tomassini 2010). Underlying all of these approaches are two competing theories: selection and protection. The selection theory states that healthier people are more likely to get married and stay married, whereas the protection theory claims that marriage provides a subset of advantages that improve health.

To date cohabitation has been included in only a few mortality studies which either look almost exclusively at older populations (e.g. Scafato et al. 2008; Lund et al. 2002) or at Scandinavian countries (Drefahl 2012; Koskinen et al. 2007). Most of this literature shows higher mortality for cohabitants than for married individuals, as expected, because cohabitants belong either to the group of never-married or to the groups of divorced or widowed.

This paper examines mortality differences by partnership status in England and Wales between 2001 and 2011 using the ONS Longitudinal Study, a one-per cent sample of the population of England and Wales. The decline in marriages and increase in other partnership forms in the last decades as well as the decrease in mortality rates pose two questions: (a) “Does the decrease in marriages also lead to a decrease in the marital health and mortality advantage?” and (b) “How does the mortality of individuals in the ‘new’ (or ‘non-conventional’) partnership forms compare to those in the ‘old’ (or ‘conventional’) marital statuses?”.

We extend previous research in the following ways. First, we include in our study cohabitants whose proportion has significantly increased in the last two

decades in all industrialised countries, both among young adults and older populations (Thomson 2014). Individuals who appear as ‘single’, ‘divorced’ or ‘widowed’ in the official statistics are thus divided into those living with a partner and those living alone. Whereas previous research considering cohabitants has analysed them as one group (e.g. Drefahl 2012; Kilpi et al. 2015; Scafato et al. 2008), we analyse premarital cohabitants and post-marital cohabitants separately. Post-marital cohabitants include ‘divorced (including separated)’ and ‘widowed’ people who live with a partner, whereas premarital cohabitants are all ‘single (never-married)’ individuals with a partner. The inclusion of cohabitants is an important step to adjust for the changing realities but also to properly consider the effect of relationships on mortality patterns. This is the first contribution of this study. A similar approach has only been used in a Finnish study (Koskinen et al. 2007).

Second, we include a set of variables to examine the extent to which household size and structure explain mortality differences by partnership status. It is important to consider household structure and the presence of other individuals in the household when investigating mortality differences between married and unmarried people (Drefahl 2012). Depending on age, different kinds of living arrangement are possible; therefore, we conduct a separate analysis of three different age groups: 30–49, 50–64 and 65–85. This is another contribution of our study. Finally, we use large-scale longitudinal data allowing for the detailed study of mortality variation by partnership status in a contemporary industrialised society. We conduct two types of sensitivity analyses. We investigate the sensitivity of the results to unregistered emigration, which is a component of all panel and longitudinal studies. We also examine the sensitivity of the results to the length of the observation window. The latter is necessary as marital status in the ONS Longitudinal Study is measured only at the time of the population census.

2 Background and Literature Review

2.1 Mortality and Health Differences by Marital Status

Research shows that mortality differences by marital status are partly affected by health differences and, further, that health differences can be attributed to a reduction in negative health behaviours (e.g. Rendall et al. 2011; Waite 1995). However, it remains far from clear whether these reductions occur as a result of marriage or are a prerequisite of marriage, i.e. whether healthier individuals opt into marriage and unhealthy individuals remain single (Goldman 2001; Lillard and Panis 1996). The literature on mortality differences by marital status starts from two main theories (or hypotheses): selection theory and protection theory.

Selection theory states that married people are individuals who have been selected by health from the entire population. Individuals who are physically and psychologically healthier have a greater chance of finding a partner and getting married and are less likely to get divorced than unhealthier people. Thus, the

married population is, on average, healthier than the unmarried population. In addition to health factors, there are other factors, e.g. income or health-related habits, which play a role in mate selection. For example, research shows that people who are obese, heavy drinkers or drug users are less likely to marry (Fu and Goldman 1996; Goldman and Hu 1993; Goldman 2001). Moreover, healthier men are more likely to marry; however, Lillard and Panis (1996) show that they are more likely to postpone marriage.

There may also be selection into widowhood. The deteriorated health among widowed people (e.g. see Cox and Ford 1964; Gove 1973; Lillard and Panis 1996; Manor and Eisenbach 2003) could be the result of the loss of their spouse, also known as bereavement effect. Alternatively, a person may marry an individual with poor health or the health of both spouses may deteriorate during the marriage for some common (e.g. environmental and behavioural) reasons (Joung et al. 1998). Because the measurement of relevant health variables is costly, especially in longitudinal studies, it is hard to control for selection by health. Measurements such as weight, height and BMI are easier to obtain (and with minimal error), than blood samples for hormone levels or simple blood pressure measurements, but their explanatory power may not be sufficient. Lillard and Panis (1996) were the first to use simultaneous equation models to control for unobserved selection into marriage and thus use a latent health variable to control for observed and unobserved health measures.

Protection theory holds that marriage provides a set of advantages which help to protect against various unhealthy activities; marriage discourages risk-taking behaviours, provides ways to cope with stress and provides emotional, medical and financial support (Goldman 2001; Rendall et al. 2011). For example, preparing a meal for two individuals requires fewer resources than preparing two meals for one person; it should be evident how marriage or having a partner would have a positive effect on one's finances. This is consistent with the idea of wealth accumulation of married couples. Research shows that men profit more from the reduction in risk-taking behaviour and women from the financial support (Lillard and Waite 1995). Additionally, married men earn more because of the 'marriage premium' (Wilcox et al. 2005). However, it is not yet clear whether this premium is due to the greater commitment of those men, greater support from home or other factors. It is also likely that the emotional support a stable partnership provides plays a role, as a partner can encourage, for instance, certain career moves as well as help to cope with work-related stress. Those protective effects seem to vanish (at least partly) after the dissolution of a union (Wu and Hart 2002; Rendall et al. 2011).

It is important to consider the effect of 'living together' and to distinguish between partners/cohabitants and living mates. Whereas the financial benefits of marriage and cohabitation may be different, the support of a partner while coping with stress should not. Mastekaasa (2006) shows that both marriage and cohabitation lead to stress reduction in Norwegian students in their early 20s and onward. In contrast, Gardner and Oswald (2004) did not find any evidence that married persons live longer due to reduced stress levels (Band and Weisz 1988).

In the last two decades, research has moved from the question ‘Selection OR protection?’ to ‘When is selection and when is protection responsible for the better health of married people?’. Studies by Waldron et al. (1996), Murray (2000) and Guner et al. (2014) supported both theories. They showed that health selection and assortative mating operate at younger ages, and health protection through an accumulation of (positive) health is important at older ages. Similarly, Brockmann and Klein (2004) argued that the protection effect of marriage is due to the ‘long-term accumulation of survival advantages’. Using data from Germany, they also showed that women usually benefit longer from those advantages, even after the end of a marriage. Lillard and Panis (1996) found that there is no immediate health benefit from entering a first marriage. Additionally, their analysis showed a health gain among divorced men who remarry, which is a sign of adverse selection. Horwitz et al. (1996) showed that significant benefits of marriage include, for example, a reduction in depression for women and a reduction in alcohol abuse for men. A recent study by Guner et al. (2014) supported earlier findings of Fu and Goldman (1994) showing that entry into a first marriage is delayed by unhealthy behaviour.

Analyses of mortality differences by marital status are usually conducted separately for men and women. Many studies have shown that mortality differences by marital status are larger for men than women (Lund et al. 2002; Waldron et al. 1996). These sex differences may be due to differences in the protective effect, i.e. married men profit more due to a reduction in risk-taking behaviour and women more due to financial support (Lillard and Waite 1995). Further, research suggests that the emotional support gained through being married is greater for men than for women, as women do not find social support solely from their partner (Shumaker and Hill 1991).

2.2 The Emergence of Cohabitation

Partnership patterns have significantly changed in Britain over the last 40 years, as elsewhere in Europe. These changes, which are likely to influence partner selection and union formation, include, among others, the role and rights of women in society; the acceptance of non-marital cohabitation; and technological advantages such as the spread of Internet and mobile phones, which affect the way people today form relationships and interact in their private lives. Some researchers refer to those changes as the ‘second demographic transition’ (McRae 1999; Lesthaeghe and Van de Kaa 1986).

Since the 1970s, household diversity has increased in England and Wales. While the typical family in the 1950s and 1960s consisted of a father, a mother and two children, the number of lone-parent families tripled between the mid-1960s and the mid-1990s; the prevalence of premarital cohabitation rose from 5% to 70% (McRae 1999: 16). The incidence of getting married because of an unplanned or premarital pregnancy declined (the so-called ‘shotgun’ marriage). The rise in divorce and separation rates explained the increase in lone-parent families and was one reason for the decline in the number of married couples.

Another reason has been the increase in premarital as well as post-marital cohabitation. On the one hand, the increase in the cohabitation rate has occurred because of changes in norms and values, and on the other hand, because low-income couples are generally less likely to marry (see Allan and Crow 2001; McRae 1999; Wilson and Stuchbury 2010).

In recent decades, young couples in the UK have preferred cohabitation as their first partnership, which still seem to be short-lasting and ending either in marriage or union dissolution (Ermisch and Francesconi 2000). This is supported by the fact that the share of ever-cohabited women at age 30 rose from just above 20% among the 1940–1949 cohort to 70% for the 1970–1979 and 1980–1989 cohorts (Hannemann and Kulu 2015). The postponement of first marriage and stable marriage rates suggest that cohabitation for most people is merely a transition state, either into marriage, back into the single state or into single parenthood (Ermisch and Francesconi 2000). Other research suggests that cohabitations are less stable than marriages (Hayward and Brandon 2010; Kennedy and Bumpass 2008) and that premarital cohabitation has a strong association with marital dissolution (Wagner and Weiß 2006). However, Kulu and Boyle (2010), controlling for observed and unobserved characteristics, found that the risk of marriage dissolution was in fact lower for premarital cohabitants than for their directly marrying counterparts. Soons and Kalmijn (2009) showed that, after married couples, cohabiting couples have the lowest mortality rates. Nevertheless, living in a relationship seems not to have the same impact as being married. Although research has identified different factors that could be responsible for the lower mortality rates of married persons relative to unmarried individuals, the contribution of each factor to mortality differences by marital status is far from clear. The never-married population has generally been considered as one group, without differentiating between people who live alone, people who live with a partner, or people who live with someone else, such as a parent. With regards to the protection theory, ‘living apart together’ is another form of partnership which provides the intimacy of a relationship, but where the partners are not living together because of practical reasons or personal preferences (Duncan and Phillips 2010).

While there is an increase in one-person households in all age groups (McRae 1999), one should not regard these just as people who live alone. An individual who lives in a one-person household may nevertheless be in a relationship. For example, even if a couple is living together (which could count as cohabiting), they may have a socio-economic arrangement which results in a strict separation of property and assets, thus being recorded as two one-person households, rather than as one two-person household. Another consideration is the idea of unobserved characteristics and past life histories. Grundy (2000) showed that a specific partnership history of an elderly person will influence the likelihood of living alone but also that living alone can have a different (positive, negative, or neutral) effect on different individuals. Therefore, we should be careful with assumptions such as ‘old and alone’ equals ‘poor health and higher mortality risk’.

3 Hypotheses

Based on previous research, we first expect to observe significant mortality differences by marital status, with lower mortality levels for married people. The differences should be greater for men than for women, because of the different protective effects for both sexes. Second, we also expect to find lower mortality for cohabitants, although an interesting question is whether and how much their mortality levels differ from those of married people and whether the patterns change by age. We anticipate that premarital cohabitants have similar mortality rates than married people, especially at younger ages, because here the same selection mechanisms should operate. That is, if married individuals find a partner due to better health, this should also apply to cohabitants. Third, we expect that living arrangements, the presence of children, and household size will explain some health advantages of individuals who are in partnerships compared to those who are not. Again, an interesting question is how much these factors explain initial mortality variation by partnership status. The answers will improve our understanding of the role of various factors in shaping population health and mortality.

4 Data

We use the Office for National Statistics Longitudinal Study (ONS LS) to analyse the mortality differences in England and Wales by partnership status. The ONS LS is a 1% sample of the population in England and Wales whose census records are linked, annually with life events, such as widowhood, death and births to sample mothers. The ONS started in 1974 with a sample population drawn from the 1971 census and had a sample size of 540,000 people in 2001 (Lynch et al. 2011). Our sample population comprises the ONS LS members aged 30–85 in 2001. This group consists of 329,767 people: 76,368 men and 79,408 women in ages 30–49 in 2001; 47,665 men and 49,076 women in ages 50–64; and 34,028 men and 43,222 women in ages 65–85. We excluded five individuals without a country of birth (COB). For other individuals without a COB in 2001, we used the COB of the most recent previous census or the 2011 census, if available. Further, we excluded ten individuals without marital status in 2001.

All individuals were followed until the event of death, emigration or censoring at the 2011 census, whichever came first. Each individual has four possible outcomes: (a) death; (b) leaving at a known embarkation date (i.e. registered emigration); (c) leaving at an unknown embarkation date (i.e. unregistered emigration); and (d) censored at the end of the observation interval (Fig. 1).

Table 1 shows that most individuals are married and, except for women over 65 years of age, the married group always forms more than 60% of the population. The single group of men and women in ages 30–49 are roughly three times larger than in the two other age groups. The proportion of the divorced/separated group over 65 years of age is only a half to one-third compared to the two younger age

Fig. 1 Lexis diagram with sample population; each individual has 4 possibilities of leaving the sample, 1 (solid line)—censored at the end of the observation interval, 2 (dotted line, diamond)—death, 3 (dash-dotted line, triangle)—leaving at a known embarkation date, 4 (dashed line, circle)—leaving at an unknown embarkation date

Table 1 Number of individuals by marital status, sex and age group

Marital status 2001	Aged 30–49				Aged 50–64				Aged 65–85			
	Male	%	Female	%	Male	%	Female	%	Male	%	Female	%
Single	19,349	25	14,322	18	3951	8	2414	5	2288	7	2505	6
Married	47,035	62	50,214	63	36,354	76	34,829	71	24,774	73	19,687	46
Divorced/ separated	9721	13	13,983	18	6235	13	7739	16	2063	6	2689	6
Widowed	263	<1	889	1	1125	2	4094	8	4903	14	18,341	42
Total	76,368		79,408		47,665		49,076		34,028		43,222	

Source: Authors' calculations based on the ONS LS

Percentages may not sum up to 100 due to rounding

groups. As expected, the widowed groups increase exponentially with age, so that they form the second largest group in ages 65–85.

After the identification of pre- and post-marital cohabitants, the single category becomes the second largest for the youngest age group, the divorced/separated category for the middle age group and the widowed category for the oldest age group. The share of cohabitants decreases by age. However, because pre- and post-marital cohabitants aged 65–85 each comprise <1% in their respective subpopulation, the groups are small, which leads to large confidence intervals in the analysis (Table 2).

Our main variable of interest is marital/partnership status. We first prepared a covariate *marital status* with the following categories: 'married (first marriage, as well as second and higher-order marriages)', 'single (never married)', 'divorced/separated' and 'widowed'. We then prepared a covariate *partnership status*, which divided the group of 'single' into 'single (not cohabiting)' and 'premarital

Table 2 Number of individuals by partnership status, sex and age group

Partnership status 2001	Aged 30–49				Aged 50–64				Aged 65–85			
	Male	%	Female	%	Male	%	Female	%	Male	%	Female	%
Single	13,264	17	9929	13	3537	7	2176	4	2264	7	2495	6
Married	47,035	62	50,214	63	36,354	76	34,829	71	24,774	73	19,687	46
Divorced/ separated	6228	8	10,322	13	4548	10	6364	13	1932	6	2627	6
Widowed	229	<1	770	1	988	2	3938	8	4863	14	18,296	42
Premarital cohab	6085	8	4393	6	414	1	238	<1	24	<1	<10	<1
Post-marital cohab	3527	5	3780	5	1824	4	1531	3	171	<1	107	<1
Total	76,368		79,408		47,665		49,076		34,028		43,222	

Source: Authors' calculations based on the ONS LS

Percentages may not sum up to 100 due to rounding

cohabitation', and the groups of 'divorced/separated' and 'widowed' in 'divorced/separated (not cohabiting)', 'widowed (not cohabiting)' and 'post-marital cohabitation'. We used the variable *household composition 2001* as an indicator for cohabitation.

We control for a set of demographic and socio-economic variables when investigating mortality differences by marital/partnership status. The covariates are as follows: Country of Birth ('England and Wales', 'Scotland or Northern Ireland' and 'Others'); Ethnicity ('White', 'White mixed', 'Asian', 'Black', 'Chinese' and 'Other'); Education ('No qualification', 'Low qualification'(Level 1 and 2), 'Medium qualification'(Level 3), 'High qualification'(Level 4/5) and 'Missing'); and Socio-economic status (SES) using the National Statistic Socio-economic classification, 2001 ('Higher managerial and professional occupations' (NS-SEC code 1-6), 'Lower managerial and professional occupations' (NS-SEC code 7-12), 'Intermediate occupations (clerical, sales, service)' (NS-SEC code 13-16), 'Small employers and own account workers' (NS-SEC code 17-20), 'Lower supervisory and technical occupations' (NS-SEC code 21-23), 'Semi-routine occupations' (NS-SEC code 24-30), and 'Routine occupations' (NS-SEC code 31-35) and Others). We also include in the analysis two variables on living arrangements: Household size ('1 person', '2 persons', '3 persons', '4 persons', '5 and more persons' and 'Unknown') and Dependent Children ('No children', 'Dependent children', 'Only non-dependent children', 'Not applicable').

Table 3 contains the person-months lived, the percentage compared to all person-months lived and the number of events for each covariate category. Each major category has a sufficient number of deaths (events), with only a few exceptions.

All variables have been measured in 2001 and are assumed to remain time constant until censoring in 2011 or prior due to embarkation or death. All control variables have been selected as having an effect on partnership status and thus

Table 3 Person-years at risk (PY) and number of events (*E*) by covariates, sex and age group

	30–85						30–49					
	Male			Female			Male			Female		
	PY	%	<i>E</i>	PY	%	<i>E</i>	PY	%	<i>E</i>	PY	%	<i>E</i>
<i>Marital status</i>												
Single	222,787.6	16.1	2555	172,902.2	11.2	1686	172,823.8	24.7	588	132,406.1	17.7	257
Married	964,568.5	69.6	15,000	965,061.3	62.6	9123	438,616.2	62.6	891	476,363.9	63.7	734
Divorced	155,486.5	11.2	2269	222,916.9	14.5	2009	86,608.3	12.4	359	130,590.5	17.5	305
Widowed	43,819.3	3.2	3304	180,361.3	11.7	9592	2392.5	0.3	11	8205.5	1.1	26
<i>Country of birth</i>												
England and Wales	1,199,386.7	86.5	20,361	1,332,929.7	86.5	19,893	600,969.1	85.8	1614	639,161.7	85.5	1137
Scotland and N. I.	35,428.2	2.6	703	35,764.2	2.3	635	16,784	2.4	49	16,237.1	2.2	33
Other	151,346.2	10.9	2054	172,357.9	11.2	1872	82,264.3	11.7	176	92,042.9	12.3	142
Missing	500.9	<0.1	<10	189.9	<0.1	<10	423.4	0.1	<10	124.3	<0.1	<10
<i>Ethnicity</i>												
White	1,283,571.4	92.6	22,233	1,430,118.1	92.8	21,734	635,057.7	90.7	1703	673,380.6	90.1	1197
White mixed	7479.1	0.5	66	8492.8	0.6	60	5669	0.8	11	6170.8	0.8	<10
Asian	65,581.7	4.7	569	63,753.3	4.1	390	40,192.6	5.7	89	41,511.6	5.6	61
Black	21,036.4	1.5	203	27,227.7	1.8	176	13,820.6	2	26	18,529.2	2.5	34
Chinese	5009.8	0.4	39	5308.8	0.3	31	3025.1	0.4	<10	3420.8	0.5	<10
Other	3983.5	0.3	18	6341.1	0.4	19	2675.9	0.4	<10	4553.2	0.6	<10
<i>Dep. children</i>												
None	322,833.2	23.3	2882	307,565.2	20	1654	115,098.5	16.4	229	115,298.8	15.4	227
Dependent	458,845.4	33.1	1583	528,224	34.3	1219	386,337.3	55.2	721	479,394.9	64.1	615
No dependent	193,476	14	2691	201,075.8	13	2505	75,709	10.8	310	72,921.4	9.8	212
Not applicable	411,507.3	29.7	15,972	504,376.7	32.7	17,032	123,296.1	17.6	589	79,950.9	10.7	268

Table 3 continued

	30–85						30–49					
	Male			Female			Male			Female		
	PY	%	E	PY	%	E	PY	%	E	PY	%	E
<i>Household size</i>												
1 person	187,456.8	13.5	5305	263,199.8	17.1	9159	88,629.1	12.7	419	55,629.3	7.4	173
2 persons	531,964.8	38.4	12,683	583,035.9	37.8	8928	146,683.6	20.9	365	167,085.8	22.4	344
3 persons	263,266.8	19	2557	281,682.7	18.3	1782	147,216.8	21	380	175,964.2	23.5	317
4 persons	255,439.5	18.4	1091	259,996.1	16.9	723	200,660.9	28.6	387	222,739.3	29.8	276
5+ persons	137,895.8	9.9	699	143,500	9.3	531	111,331.5	15.9	235	123,344.3	16.5	173
Unknown	10,638.2	0.8	793	9827.3	0.6	1287	5919	0.8	63	2803	0.4	39
<i>Education</i>												
No qualifications	408,706	29.5	8301	505,864.8	32.8	7360	136,153	19.4	622	153,282.6	20.5	508
Low qual.	563,341.7	40.6	4133	566,941.3	36.8	2530	353,961.3	50.5	833	375,755.6	50.3	537
Medium qual.	70,786.8	5.1	546	70,806.3	4.6	258	46,128	6.6	107	51,138.3	6.8	63
Degree level+	265,170.4	19.1	1655	264,780.6	17.2	1159	163,109.3	23.3	277	166,664.5	22.3	204
Unknown	78,657	5.7	8493	132,848.8	8.6	11,103	1089.2	0.2	<10	725	0.1	<10
<i>Partnership st.</i>												
Single	163,291	11.8	2430	129,267.1	8.4	1631	117,155.3	16.7	529	91,043.3	12.2	219
Married	964,568.5	69.6	15,000	965,061.3	62.6	9123	438,616.2	62.6	891	476,363.9	63.7	734
Divorced	107,566.7	7.8	1962	175,292.7	11.4	1825	54,754.9	7.8	273	96,171.3	12.9	235
Widowed	41,954	3	3270	177,483.2	11.5	9567	2080.5	0.3	11	7122.8	1	26
Premarital coh	59,496.6	4.3	125	43,635.1	2.8	55	55,668.5	7.9	59	41,362.8	5.5	38
Post-marital coh	49,785.2	3.6	341	50,502.4	3.3	209	32,165.4	4.6	86	35,501.9	4.7	70
SES												
Higher manag.	203,099.6	14.6	1318	73,620.4	4.8	225	118,927.5	17	210	51,984.6	7	51

Table 3 continued

	30–35						30–49					
	Male			Female			Male			Female		
	PY	%	E	PY	%	E	PY	%	E	PY	%	E
Lower manag.	300,606.3	21.7	2539	335,786.7	21.8	1715	168,958.3	24.1	313	197,966.2	26.5	281
Intermediate	65,881.1	4.8	586	253,628.9	16.5	1614	38,050.1	5.4	93	134,912.8	18	194
Small employers	189,211.3	13.6	1824	81,695.5	5.3	496	94,972.6	13.6	238	42,239.3	5.7	71
Lower supervis.	180,983.2	13.1	2294	80,876.8	5.2	686	95,374.8	13.6	267	41,821.7	5.6	78
Semi-routine	130,686.3	9.4	1711	296,776.6	19.3	2270	68,293.4	9.8	231	152,070.7	20.3	310
Routine	183,964.7	13.3	2720	172,684.4	11.2	1884	90,233.9	12.9	330	78,500.3	10.5	181
Other	53,852	3.9	1650	113,413.8	7.4	2423	24,781.8	3.5	157	47,341.6	6.3	146
Missing	78,377.6	5.7	8486	132,758.7	8.6	11,097	848.4	0.1	<10	729	0.1	<10
Total	1,386,661.9		23,128	1,541,241.7		22,410	700,440.8		1849	747,566		1322
65–85												
50–64												
	Male			Female			Male			Female		
	PY	%	E	PY	%	E	PY	%	E	PY	%	E
	PY	%	E	PY	%	E	PY	%	E	PY	%	E
Marital status												
Single	34,169.8	7.9	699	21,773.8	4.8	270	15,793.9	6.2	1268	18,722.3	5.5	1159
Married	335,473	77.4	3430	325,253.9	71.6	2254	190,479.3	75.3	10,679	163,443.4	48.2	6135
Divorced	54,069.7	12.5	909	70,630.8	15.5	767	14,808.5	5.9	1001	21,695.7	6.4	937
Widowed	9696	2.2	222	36,678.8	8.1	535	31,730.8	12.6	3071	135,477.1	39.9	9031
Country of birth												
England and Wales	377,088.6	87	4630	393,252.3	86.6	3301	221,329	87.5	14,110	300,515.8	88.6	15,452
Scotland and N. I.	12,265.8	2.8	180	11,429.3	2.5	134	6378.3	2.5	469	8097.8	2.4	460

Table 3 continued

	50–64						65–85					
	Male			Female			Male			Female		
	PY	%	E	PY	%	E	PY	%	E	PY	%	E
Other	44,023.8	10.2	440	49,611.5	10.9	381	25,058	9.9	1430	30,703.5	9	1340
Missing	30.3	<0.1	<10	44.3	<0.1	<10	47.3	<0.1	<10	21.3	<0.1	<10
<i>Ethnicity</i>												
White	407,069.3	93.9	5000	427,157.8	94	3624	241,444.4	95.5	15,520	329,579.7	97.1	16,902
White mixed	1307.6	0.3	12	1592.5	0.4	13	502.5	0.2	40	729.6	0.2	40
Asian	18,104.2	4.2	173	16,935.7	3.7	126	7284.9	2.9	304	5306	1.6	195
Black	4513.3	1	52	5794.9	1.3	43	2702.5	1.1	122	2903.6	0.9	91
Chinese	1364.3	0.3	13	1340.4	0.3	<10	620.4	0.2	21	547.6	0.2	24
Other	1049.8	0.2	<10	1515.9	0.3	<10	257.8	0.1	12	272	0.1	<10
<i>Dep. children</i>												
None	195,139.6	45	2206	184,895.1	40.7	1243	12,595.1	5	447	7371.3	2.2	184
Dependent	65,938	15.2	516	41,655.2	9.2	271	6570.2	2.6	346	7173.9	2.1	333
No dependent	93,389.2	21.5	975	96,930.9	21.3	702	24,377.8	9.6	1406	31,223.5	9.2	1591
Not applicable	78,941.8	18.2	1563	130,856.1	28.8	1610	209,269.5	82.8	13,820	293,569.7	86.5	15,154
<i>Household size</i>												
1 person	52,686.9	12.2	1058	70,714.6	15.6	929	46,140.8	18.3	3828	136,855.8	40.3	8057
2 persons	213,931	49.4	2533	248,779.7	54.8	1948	171,350.2	67.8	9785	167,170.4	49.3	6636
3 persons	93,000.7	21.5	913	85,669.8	18.9	576	23,049.4	9.1	1264	20,048.8	5.9	889
4 persons	49,434.2	11.4	416	32,532.7	7.2	190	5344.4	2.1	288	4724.1	1.4	257
5+ persons	21,967.2	5.1	207	15,017.8	3.3	108	4597.2	1.8	257	5137.9	1.5	250
Unknown	2388.6	0.6	133	1622.8	0.4	75	2330.6	0.9	597	5401.4	1.6	1173
<i>Education</i>												

Table 3 continued

	50–64						65–85					
	Male			Female			Male			Female		
	PY	%	E	PY	%	E	PY	%	E	PY	%	E
No qualifications	171,649.8	39.6	2812	213,663.8	47	2290	100,903.2	39.9	4863	138,918.3	40.9	4554
Low qual.	165,023.8	38.1	1680	150,979.2	33.2	1004	44,356.6	17.5	1615	40,206.5	11.8	987
Medium qual.	18,705	4.3	177	15,587	3.4	104	5953.8	2.4	261	4080.9	1.2	90
Degree level+	77,810.3	18	581	73,860.8	16.3	418	24,250.8	9.6	796	24,255.3	7.1	536
Unknown	219.7	0.1	<10	246.4	0.1	<10	77,348.2	30.6	8484	131,877.4	38.9	11,095
<i>Partnership st.</i>												
Single	30,495.4	7	644	19,569.6	4.3	256	15,640.3	6.2	1257	18,654.2	5.5	1153
Married	335,473	77.4	3430	325,253.9	71.6	2254	190,479.3	75.3	10,679	163,443.4	48.2	6135
Divorced	39,102.2	9	726	57,926.3	12.7	671	13,709.6	5.4	963	21,195	6.2	919
Widowed	8442.4	1.9	204	35,250.7	7.8	523	31,431.1	12.4	3055	135,109.8	39.8	9014
Premarital coh	3674.4	0.8	55	2204.3	0.5	14	153.7	0.1	11	68.1	<0.1	<10
Post-marital coh	16,221.1	3.7	201	14,132.5	3.1	108	1398.7	0.6	54	868	0.3	31
<i>SES</i>												
Higher manag.	62,277.8	14.4	458	17,619.6	3.9	96	21,894.3	8.7	650	4016.3	1.2	78
Lower manag.	95,454.3	22	926	103,014.4	22.7	653	36,193.7	14.3	1299	34,806.1	10.3	776
Intermediate	20,510.4	4.7	213	82,198.4	18.1	570	7320.6	2.9	280	36,517.8	10.8	850
Small employers	72,433.6	16.7	796	30,461.6	6.7	220	21,805.1	8.6	789	8994.6	2.7	204
Lower supervis.	57,480.9	13.3	760	27,333.5	6	243	28,127.4	11.1	1263	11,721.6	3.5	364
Semi-routine	45,318.1	10.5	678	105,129.3	23.1	914	17,074.8	6.8	801	39,576.6	11.7	1046
Routine	68,471.4	15.8	1138	63,883.3	14.1	673	25,259.3	10	1251	30,300.9	8.9	1029

Table 3 continued

	50–64				65–85			
	Male		Female		Male		Female	
	PY	%	E		PY	%	PY	E
Other	11,189.3	2.6	281	447	17,880.9	7.1	41,650.7	12.3
Missing	272.7	0.1	<10	<10	77,256.5	30.6	131,754	38.8
Total	433,408.5		5260	3826	252,812.6		339,338.4	17,262

Source: Authors' calculations based on the ONS LS

Percentages may not sum up to 100 due to rounding

would alter the mortality estimates, if not controlled for. Education and socio-economic status are well known determinants of health and mortality (Drefahl 2012). Changes in household structures make it necessary to include household compositions to control for the effect of cohabitation or lone parenthood (Drefahl 2012). In addition to ethnicity, which has been shown to affect mortality by partnership status (e.g. Johnson et al. 2000), we further include COB to control for the healthy migrant effect (Wallace and Kulu 2014a, b).

5 Methods

In our analysis, we used the Cox proportional hazards model to estimate the mortality differences by marital status. The Cox model is defined as:

$$h_i(t) = h_0(t) \exp(\beta_1 x_{i1} + \beta_2 x_{i2} + \dots + \beta_k x_{ik})$$

The individual hazard rate h_i is defined as the product between the baseline hazard rate h_0 and a set of covariates $x_1, x_2, \dots, x_k$ (Fox 2002). The Cox model was chosen because the shape of the baseline function can be left unspecified. The Cox model assumes proportional hazards, i.e. that the effect of partnership status on mortality is similar by age; however, if this assumption is not met, then the results can still be viewed as average hazard rates (Allison 2010).

The process time in our model is an individual's age in months. The impact of age on mortality is thus controlled for in our models, although the shape of the baseline (i.e. the effect of age on mortality) is left unspecified. Alternatively, one could fit a parametric survival model; we also fitted a model with the Gompertz baseline, and the main results were identical to those obtained by using the Cox model.

Our modelling strategy is the following. Our first model [model 1 (MS)] contains the two covariates *marital status* and *country of birth*. Because our main focus is on the population born in England and Wales, we decided to combine all foreign-born individuals into one group; we assumed that migrants are a select sub-group of their home population, on average with better health. An exception to this rule is people born in the neighbouring countries of Scotland and Northern Ireland (Popham and Boyle 2011; Wallace and Kulu 2014a, b). The 43 individuals who reported 'UK' or 'Britain' as their country of birth were assigned to be born in 'England and Wales'. As such, the inclusion of COB in the analysis prevents an underestimation of mortality differences.

The second model [model 1 (PS)] uses *partnership status* instead of *marital status*. Due to the different proportions of cohabiting groups regarding their non-cohabiting counterparts and the entire population, we decided to split the cohabiting population into a premarital cohabiting group and a post-marital cohabiting group, rather than using a single cohabitation dummy variable. In the next step [model 2 (PS)], we include a set of demographic and socio-economic covariates (ethnicity, SES, education). The last model [model 3 (PS)] includes covariates measuring the effect of living arrangement: *household size* and *dependent children*. We decided to

use the two-person household as reference group because married couples typically live in pairs. We derived our *dependent children* covariate from the 'household composition 2001' variable.

We fit each model for both men and women, first to the whole study population (individuals in ages 30–85) and then separately to the age groups 30–49, 50–64 and 65–85. We censor all emigrants after 3.9 years, following the findings by Wallace and Kulu (2014b) on average duration of stay for prospective return migrants in their destination country. However, we also conduct sensitivity analyses to determine whether the mortality differences are over- or under-estimated given the length of the observation window and the uncertainty of the emigration dates among people who leave the country (both included at the end of the results section).

6 Results

Model 1 (MS) controls for COB. All unmarried men have a significantly higher mortality risk than married men (Table 4, Model 1). Single men have a 75% higher mortality risk; divorced/separated men have a 58% higher mortality risk; and widowed men have a 35% higher mortality risk. The results are similar for women, although mortality differences between married and unmarried women are smaller (Table 5, Model 1). Single women have a 43% higher mortality risk; divorced/separated women have a 37% higher mortality risk; and widowed women have a 26% higher mortality risk. Model 1 (PS) distinguishes between unmarried people who cohabit and those who do not cohabit. While mortality levels of individuals remain high for those who are neither married nor cohabit, cohabitants show lower mortality levels. Those who have not been previously married exhibit mortality levels similar to those of married individuals. However, post-marital cohabitants have still significantly higher mortality levels. This applies both to males and females.

Model 2 controls for ethnicity, socio-economic status and educational level. Mortality differences between married and unmarried individuals decline slightly, with the exception of single women (Tables 4, 5, Model 2). Model 3 additionally controls for household size and the presence of dependent children. Mortality differences between married and unmarried individuals stay on the same level or further decline, particularly for males, but significant differences persist (Tables 4, 5, Model 3). Mortality levels remain high among men and women who are neither married nor cohabit and among post-marital cohabitants. Interestingly, the inclusion of additional covariates (especially those related to living arrangements) leads to a decline in the mortality differences of non-married people without a partner.

To gain a better understanding of mortality variation by partnership status, we separately analysed individuals aged 30–49, 50–64 and 65–85. The analysis by age groups reveals that mortality differences by marital status are the largest for the population aged 50–64 and lowest for the population aged 65–85, with the exception of 'widowed' individuals. Once we controlled for cohabitation, the patterns changed for men. The most interesting finding is the difference between the single and premarital cohabitation groups for the two younger age groups. Single

Table 4 Relative risk of mortality by marital and partnership status in England and Wales for men aged 30–85

	Model 1 (MS)			Model 1 (PS)			Model 2 (PS)			Model 3 (PS)		
	RR	Sign	CI	RR	Sign	CI	RR	Sign	CI	RR	Sign	CI
<i>Marital status</i>												
Married	1			1			1			1		
Single	1.75	***	(1.68–1.83)	1.81	***	(1.73–1.89)	1.67	***	(1.6–1.74)	1.42	***	(1.34–1.5)
Divorced/separated	1.58	***	(1.51–1.65)	1.66	***	(1.58–1.74)	1.57	***	(1.5–1.65)	1.44	***	(1.35–1.53)
Widowed	1.35	***	(1.3–1.41)	1.36	***	(1.31–1.42)	1.31	***	(1.26–1.36)	1.23	***	(1.16–1.3)
Premarital cohab				0.99		(0.82–1.18)	0.96		(0.81–1.16)	1.00		(0.84–1.2)
Post-marital cohab				1.17	**	(1.05–1.3)	1.17	**	(1.05–1.31)	1.23	***	(1.1–1.37)
<i>Country of birth</i>												
England and Wales	1			1			1			1		
Scotland and N. Ireland	1.17	***	(1.08–1.26)	1.17	***	(1.09–1.26)	1.19	***	(1.1–1.28)	1.18	***	(1.09–1.27)
Other	0.91	***	(0.87–0.95)	0.91	***	(0.87–0.95)	0.96		(0.91–1.02)	0.95		(0.9–1.01)
Missing	0.71		(0.23–2.2)	0.70		(0.23–2.17)	1.15		(0.34–3.91)	0.41		(0.12–1.37)
<i>Ethnicity</i>												
White							1			1		
White mixed							1.10		(0.86–1.4)	1.11		(0.87–1.42)
Asian							0.84	***	(0.76–0.93)	0.87	**	(0.79–0.97)
Black							0.74	***	(0.64–0.86)	0.76	***	(0.66–0.88)
Chinese							0.69	*	(0.5–0.95)	0.73	*	(0.53–1.)
Other							0.53	**	(0.33–0.84)	0.55	*	(0.35–0.88)
<i>SES</i>												
Higher managerial							1			1		
Lower managerial							1.15	***	(1.07–1.23)	1.15	***	(1.07–1.23)
Intermediate							1.18	**	(1.07–1.31)	1.18	**	(1.07–1.31)

Table 4 continued

	Model 1 (MS)			Model 1 (PS)			Model 2 (PS)			Model 3 (PS)		
	RR	Sign	CI	RR	Sign	CI	RR	Sign	CI	RR	Sign	CI
Small employers							1.19	***	(1.1–1.28)	1.19	***	(1.11–1.28)
Lower supervisory							1.37	***	(1.27–1.47)	1.37	***	(1.27–1.47)
Semi-routine							1.46	***	(1.35–1.58)	1.46	***	(1.36–1.58)
Routine occupations							1.54	***	(1.43–1.65)	1.54	***	(1.43–1.66)
Other							2.01	***	(1.86–2.17)	1.84	***	(1.7–1.99)
Missing							1.97	*	(1.11–3.5)	1.18		(0.74–1.91)
<i>Education</i>												
No qualifications							1.21	***	(1.16–1.26)	1.20	***	(1.15–1.25)
Low qualification							1			1		
Medium qualification							1.11	*	(1.01–1.21)	1.11	*	(1.01–1.21)
High qualification							0.88	***	(0.83–0.93)	0.88	***	(0.83–0.94)
NA/missing							0.82		(0.46–1.46)	1.30		(0.81–2.09)
<i>Hhsize</i>												
2 persons										1		
1 person										1.03		(0.98–1.09)
3 persons										0.99		(0.92–1.06)
4 persons										0.97		(0.89–1.06)
5+ persons										1.08		(0.97–1.2)
Unknown										2.86	***	(2.63–3.1)
<i>Children</i>												

Table 4 continued

	Model 1 (MS)			Model 1 (PS)			Model 2 (PS)			Model 3 (PS)		
	RR	Sign	CI	RR	Sign	CI	RR	Sign	CI	RR	Sign	CI
No children										1		
Dependent										0.93		(0.84–1.03)
No dependent										1.15	**	(1.06–1.25)
Not applicable										1.13	***	(1.08–1.2)

Source: Authors' calculations based on the ONS LS

*** p value <0.001 , ** p value <0.01 , * p value <0.05

Table 5 Relative risk of mortality by marital and partnership status in England and Wales for women aged 30–85

	Model 1 (MS)			Model 1 (PS)			Model 2 (PS)			Model 3 (PS)		
	RR	Sign	CI	RR	Sign	CI	RR	Sign	CI	RR	Sign	CI
<i>Marital status</i>												
Married	1			1			1			1		
Single	1.43	***	(1.35–1.5)	1.45	***	(1.38–1.53)	1.47	***	(1.39–1.55)	1.34	***	(1.25–1.42)
Divorced/separated	1.37	***	(1.3–1.43)	1.38	***	(1.31–1.45)	1.35	***	(1.29–1.42)	1.37	***	(1.29–1.46)
Widowed	1.26	***	(1.22–1.3)	1.27	***	(1.23–1.31)	1.24	***	(1.2–1.28)	1.25	***	(1.18–1.31)
Premarital cohob				0.94		(0.72–1.23)	0.98		(0.75–1.28)	0.98		(0.75–1.28)
Post-marital cohob				1.23	**	(1.07–1.42)	1.22	**	(1.06–1.4)	1.24	**	(1.08–1.43)
<i>Country of birth</i>												
England and Wales	1			1			1			1		
Scotland and N. Ireland	1.17	***	(1.08–1.27)	1.17	***	(1.08–1.27)	1.19	***	(1.1–1.29)	1.20	***	(1.1–1.29)
Other	0.95	*	(0.9–0.99)	0.95	*	(0.9–0.99)	0.96		(0.91–1.02)	0.95		(0.9–1.01)
Missing	1.17		(0.29–4.7)	1.17		(0.29–4.68)	3.45		(0.75–15.9)	1.24		(0.28–5.43)
<i>Ethnicity</i>												
White							1			1		
White mixed							1.01		(0.78–1.31)	1.02		(0.79–1.32)
Asian							0.83	**	(0.74–0.93)	0.85	**	(0.76–0.96)
Black							0.83	*	(0.71–0.97)	0.85	*	(0.73–0.99)
Chinese							0.73		(0.51–1.05)	0.76		(0.53–1.09)
Other							0.61	*	(0.39–0.96)	0.63	*	(0.4–0.99)
<i>SES</i>												
Higher managerial							1			1		
Lower managerial							1.16	*	(1.01–1.34)	1.16	*	(1.01–1.33)
Intermediate							1.13		(0.98–1.3)	1.12		(0.97–1.29)

Table 5 continued

	Model 1 (MS)			Model 1 (PS)			Model 2 (PS)			Model 3 (PS)		
	RR	Sign	CI	RR	Sign	CI	RR	Sign	CI	RR	Sign	CI
Small employers							1.18	*	(1.01–1.39)	1.17		(1.0–1.37)
Lower supervisory							1.39	***	(1.19–1.63)	1.38	***	(1.19–1.61)
Semi-routine							1.29	***	(1.12–1.49)	1.28	**	(1.11–1.48)
Routine occupations							1.54	***	(1.34–1.78)	1.52	***	(1.32–1.76)
Other							2.02	***	(1.75–2.32)	1.90	***	(1.65–2.19)
Missing							3.03	**	(1.59–5.75)	2.14	**	(1.29–3.53)
<i>Education</i>												
No qualifications							1.25	***	(1.19–1.31)	1.24	***	(1.18–1.3)
Low qualification							1			1		
Medium qualification							0.93		(0.81–1.05)	0.93		(0.82–1.06)
High qualification							0.88	**	(0.82–0.95)	0.89	**	(0.82–0.95)
NA/missing							0.51	*	(0.27–0.96)	0.68		(0.42–1.1)
<i>Hhsize</i>												
2 persons										1		
1 person										0.95	*	(0.9–1.)
3 persons										1.03		(0.96–1.09)
4 persons										1.01		(0.92–1.1)
5+ persons										1.11		(0.99–1.24)
Unknown										2.96	***	(2.76–3.18)
<i>Children</i>												
No children										1		
Dependent										0.90		(0.81–1.01)

Table 5 continued

	Model 1 (MS)			Model 1 (PS)			Model 2 (PS)			Model 3 (PS)		
	RR	Sign	CI	RR	Sign	CI	RR	Sign	CI	RR	Sign	CI
No dependent										1.08		(1.0–1.17)
Not applicable										1.04		(0.98–1.12)

Source: Authors' calculations based on the ONS LS
*** *p* value <0.001; ** *p* value <0.01, * *p* value <0.05

and non-cohabiting men and women have significantly higher mortality levels than married men and women (Tables 6, 7). Mortality levels among singles in the younger age group are much higher in the model where we control for cohabitation due to the exclusion of those who cohabit. By contrast, men and women aged 30–49 in a premarital cohabitation have even lower estimated mortality levels than married individuals. Those differences are significant because our married group also includes remarried individuals. For older ages, single cohabiting men and women exhibit higher mortality rates than married people.

All models have been checked for multi-collinearity, using the correlation matrix of the coefficients. Further, all age-stratified Model 3(PS) (Tables 6, 7) fulfil the proportional hazard assumption.

6.1 Sensitivity Analysis I: Observation Window

Information on partnership status was measured only at the time of the 2001 census. We conducted a series of analyses to determine how sensitive the results are to different observation windows used in the study. The analysis shows that the results do not change very much depending on whether we followed individuals for 10, 7.5, 5 or 2.5 years (Fig. 2). This could be explained by the fact that on average fewer than 15% of individuals (singles <10%, married/remarried 20%, divorced/separated <15% and widowed <5%) had a different partnership status at death than at the 2001 census, emphasising that marriage is an accumulation of good health, and therefore the married population of 2001 ‘started’ with a health advantage at the beginning of the analysis. The confidence intervals do not vary much across the length of the observation window. Most importantly, the main mortality differences by marital status are robust to different sample specifications. Further analysis by age group confirms this finding, showing larger confidence intervals for the younger age groups (results are available upon request).

6.2 Sensitivity Analysis II: Embarkation Date

We also studied sensitivity of the results to unregistered emigration. In our analysis, a person had emigrated without registration if he or she was not present at the 2011 census and had no recorded death prior to the 2011 census date. There were approximately 28,000 individuals with missing embarkation dates. We therefore fitted different scenarios using the mean emigration date as calculated by Wallace and Kulu (2014b) and by using the mean embarkation date based on the 2000 emigrants with known date. We used four different censoring scenarios for emigrants: (1) all emigrants leave the country at the calculated mean embarkation date; (2) migrants leave either after 3.9 years or at their known emigration date; (3) all emigrants leave after 3.9 years, which was the mean emigration date in previous decades (Wallace and Kulu 2014b); (4) emigrants are excluded from the analysis. Analysis showed that the emigration date did not affect the estimates much, unless we completely excluded the emigrants (Fig. 3). Again, the analysis by age group showed similar results, with the exception of small groups such as the widowed in the youngest age group (results are available upon request).

Table 6 Relative risk of male mortality by marital and partnership status in England and Wales by age group

Age group	30–49						50–64						65–85					
	Model 3 (MS)			Model 3 (PS)			Model 3 (MS)			Model 3 (PS)			Model 3 (MS)			Model 3 (PS)		
	RR	Sign	CI	RR	Sign	CI	RR	Sign	CI	RR	Sign	CI	RR	Sign	CI	RR	Sign	CI
<i>Marital status</i>																		
Married	1			1			1			1			1			1		
Single	1.38	***	(1.19–1.6)	2.07	***	(1.7–2.52)	1.57	***	(1.4–1.77)	1.62	***	(1.4–1.88)	1.19	***	(1.1–1.28)	1.19	***	(1.11–1.29)
Divorced/ separated	1.32	***	(1.13–1.54)	1.79	***	(1.46–2.2)	1.45	***	(1.31–1.6)	1.53	***	(1.32–1.77)	1.28	***	(1.18–1.38)	1.30	***	(1.2–1.41)
Widowed	1.14		(.62–2.08)	1.55		(.84–2.84)	1.56	***	(1.33–1.82)	1.67	***	(1.39–2.)	1.15	***	(1.08–1.23)	1.16	***	(1.08–1.24)
Premarital cohab				0.76	*	(.58–.99)				1.75	***	(1.34–2.29)				1.95	*	(1.07–3.53)
Post-marital cohab				1.26	*	(1–1.57)				1.35	***	(1.17–1.56)				0.99		(.75–1.3)

Source: Authors' calculations based on the ONS LS

*** p value <0.001; ** p value <0.01; * p value <0.05; other covariates omitted, available upon request

Table 7 Relative risk of female mortality by marital and partnership status in England and Wales by age group

Age group	30–49						50–64						65–85					
	Model 3 (MS)			Model 3 (PS)			Model 3 (MS)			Model 3 (PS)			Model 3 (MS)			Model 3 (PS)		
	RR	Sign	CI	RR	Sign	CI	RR	Sign	CI	RR	Sign	CI	RR	Sign	CI	RR	Sign	CI
<i>Marital status</i>																		
Married	1.00												1.00			1.00		
Single	1.23	*	(1.02–1.47)	1.42	**	(1.14–1.77)	1.56	***	(1.34–1.81)	1.66	***	(1.41–1.96)	1.15	***	(1.07–1.24)	1.15	***	(1.07–1.24)
Divorced/ separated	1.19	*	(1.02–1.4)	1.25	*	(1.03–1.52)	1.50	***	(1.34–1.67)	1.62	***	(1.42–1.85)	1.17	***	(1.08–1.27)	1.16	***	(1.07–1.27)
Widowed	1.08		(0.72–1.62)	1.29		(0.85–1.95)	1.44	***	(1.27–1.63)	1.54	***	(1.34–1.76)	1.14	***	(1.08–1.21)	1.14	***	(1.08–1.21)
Premarital cohab				0.90		(0.64–1.25)				1.26		(0.75–2.14)				1.25		(0.4–3.89)
Post-marital cohab				1.19		(0.93–1.53)				1.27	*	(1.05–1.54)				1.25		(0.86–1.8)

Source: Authors' calculations based on the ONS LS

*** p value <0.001; ** p value <0.01; * p value <0.05; other covariates omitted, available upon request

Fig. 2 Sensitivity to observation window: *I* 10 years, *II* 7.5 years, *III* 5 years, *IV* 2.5 years. *Source:* Authors' calculations based on the ONS LS

Fig. 3 Sensitivity to embarkation date: *first* all leave after 3.9 years; *second* all leave after 3.9 years or their known embarkation date; *third* all leave on average embarkation date; *fourth* no emigrants. *Source:* Authors' calculations based on the ONS LS

7 Conclusion

Our study shows that unmarried non-partnered people in England and Wales have significantly higher mortality levels than married individuals. The differences in mortality decrease after controlling for individuals' socio-economic and socio-demographic characteristics. Adjusting for household size and the presence of children further reduces mortality differences between married and unmarried non-partnered individuals, but significant differences persist. As in previous research, we found that mortality differences are greater for men than for women, although gender differences are significantly reduced after adjusting for socio-economic variables (e.g. Brockmann and Klein 2004; Koskinen et al. 2007; Murphy et al. 2007; Staehelin et al. 2012).

This is one of the first studies to include cohabitants in the analysis. We showed that cohabitation plays a significant role in estimating mortality differences by partnership status, especially for the youngest age groups. Similarly to previous

studies, we found higher mortality of cohabitants with respect to married and lower with respect to non-married individuals (see e.g. Drefahl 2012; Koskinen et al. 2007; Scafato et al. 2008). Complementary to previous research, our analysis showed that in ages 30–49 cohabitants have mortality levels similar to, or even lower than, married individuals, whereas the single population has much higher mortality than previous studies have shown. Albeit unsurprising, this is an important finding.

Although we do not know how long cohabitants stay in their (respective) groups (e.g. cohabitants either continue cohabiting or dissolve their union or get married), their lower mortality risk at younger ages in comparison with married individuals suggests that this group is not simply a mix of (soon-to-be) married and never-married but rather that, in the short run, young cohabiting couples have as good health as married couples. Therefore, some of the protective effects of marriage, as described for example by Goldman (2001), such as emotional support, are also provided in cohabitation. In the long run, however, it seems that the accumulation of these advantages might be a challenge for cohabiting people because cohabitations are less stable than marriages, and cohabitants therefore are more likely to experience stress. Further, the lower mortality of cohabiting men compared to married men supports the selection hypothesis, i.e. healthier men are more likely to find a partner and healthier men may also postpone first marriages (Lillard and Panis 1996). Dupre et al. (2009) showed that the increase in mortality risk with age slows down with years of marriage, which could be due to the accumulation of health and wealth. We believe that the accumulation of material wealth in particular is not as effective for cohabitants than for married people. Because cohabitation is seen as a ‘trial marriage’ (Kulu and Boyle 2010), with a possible dissolution already in mind, it may restrict long-term investments, such as a mortgage for a house, whereas married couples still often pay off the mortgage together. This might not be the case for cohabiting couples where only one party may be left with the house.

The second contribution of this paper was the inclusion of household structure and size in the analysis. Studies have shown that living with someone and combining resources leads to an obvious economic advantage (e.g. Arber 2004). Therefore, it was expected that the mortality differences would decline if we included variables such as household size and dependent children in the analysis. Including household characteristics in the models led to a pronounced decrease in the mortality differences across partnership status for men, but not for women. Research has shown that the mortality risk is lower for men living with someone than for men living alone; however, for women the differences are negligible (Staehelin et al. 2012). Interestingly, the study showed the importance of household structure and size in explaining mortality differences across partnership status for men, but mortality variation by household size and structure was too small to warrant discussion at length. Still, the presence of children seems to have a mortality reducing effect both for men and women.

The strength of this study is the use of a large sample (over 300,000 people with more than 45,000 deaths). There are also some challenges. As the ONS LS is census-based, we only have a full record of individuals at two censuses (2001 and 2011), and we can only use information on the marital and partnership status at the

beginning of our observation period, which is 2001. Although the marital status at death is available, we could not exploit this information because there is no information on marital status changes for individuals who survive our observation period (from 2001 to 2011). Further, we did not include in the analysis marital histories. Although an individual's marital status is also available at previous censuses (e.g. 1991), the histories would have been not detailed enough to improve the analysis. Most importantly, our sensitivity analyses showed that the main results of the study were robust to different specification of the length of observation window (to reduce the uncertainty related to unrecorded changes in partnership status) and expected duration of stay for prospective return migrants. These sensitivity tests were the third contribution of this study.

Using register-based longitudinal data, this study showed large mortality differences between married and unmarried individuals. The differences between groups declined after adjusting for the socio-demographic and socio-economic characteristics of individuals, but persisted. The study showed that when controlling for cohabitation, we should not just consider the 'state' of the cohabitation (pre- or post-marital), but also the age groups. If healthy individuals are more likely to find a partner, then cohabitants at younger ages should have good health similar to married individuals. We showed that cohabitants younger than 50 have similar if not lower mortality rates than married couples. This provides some support to the selection theory—those in good health are more likely to find a partner. However, it could also be evidence supporting the protection theory, i.e. among those with a partner, the 'worst of the best' marry and the 'best of the best' postpone entry into marriage.

The relatively low mortality among married individuals at older ages could be a sign of the protective effects of marriage as well as the accumulation of good health and wealth. Assuming the importance of accumulation, the differences could also be due to differences in partnership length between marriages and cohabitations. Further research should investigate the cause of death by partnership status. Such an analysis would further improve our understanding of the causes of mortality variation by partnership status. It is also important to explicitly investigate the effect of health on partnership changes; such research would require annual information on the health status of individuals and partnership histories. Several panel studies, including the British Household Panel Study, provide such information.

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