Family life history and mortality: associations between combined marriage and childbearing histories and late mid life mortality in Norway

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Abstract

Using data on all Norwegians born 1935-1968 , we analyse the combined effects of fertility history and marital or partnership status and history on mortality. The focus is on age 40-73 and the years 1980-2008 (30 million person-years of observations and 117000 deaths). Among men in first marriage, the childless have 36% higher mortality than those with two or more children. The corresponding figure for women is 61%. The never-married have higher mortality and are differentiated even more by parenthood status. Thus, the combined effect is large: childless never-married men and women have three times as high mortality as those who are married and have two or more children. The advantage associated with having at least two children is smallest among men who divorced before their oldest child's tenth birthday. Having step-children has no association with mortality for those without natural children but is associated with higher mortality among the parous.

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Introduction

The increasing complexity of family life courses in Western populations is recognized to have important implications across a number of public policy domains including implications for individual health and well-being. Associations between aspects of family life experiences and mortality have been investigated in many studies, as summarized below, but most of these have had a primary focus on either marriage or parenthood. In this paper we use a combined marriage-fertility indicator that reflects some of the complexity of family life courses and analyse how it is associated with mortality in the whole Norwegian population at ages 40-73.

Background

A large number of studies from many countries have shown that, at any given age, a person's marital status is related to his or her chance of dying within a specified subsequent period (Manzoli, Villari, Pirone, and Boccia 2007; Waite and Lehrer 2003). Being married is always associated with lower mortality, often more clearly among men than among women, while there is a less clear pattern of mortality differences between the never-married, divorced and widowed. These effects of current marital status are hypothesized to reflect, for example, the health related benefits of social control, emotional and practical support, and economic contributions from a partner. However, selection is obviously also important as a number of individual and community factors affect an individual's family behaviour as well as later health and mortality, and many of these are very difficult to control for (Brockmann and Klein 2004). Life course approaches which consider past as well as present circumstances provide one means of partially addressing the selection issue and additionally may allow investigation of long-term effects of advantages associated with marriage, and of disadvantages associated with marital disruptions. These possibilities have led to increased interest in studying associations between mortality or health and marital history as well as current marital status. Some authors have made a distinction between first and second marriages, while others have assessed the effects of time since divorce or widowhood or total time spent within a marriage (Dupre, Beck, and Meadows 2009; Hughes and Waite 2009; Grundy and Tomassini 2010).

Parenthood as well as partnership may have implications for health and there is a growing literature on associations between childbearing (and -rearing) and later health and mortality. Most of this literature deals with women, but some recent contributions discussed below have also considered men. Typically, childless women are found to have higher mortality rates than mothers, even allowing for the fact that childlessness is associated with being unmarried (Grundy and Kravdal 2008; Grundy and Tomassini 2005). Childbearing before the age of 20, on the other hand, is associated with increased mortality among women (Henretta 2007). In addition, excess mortality among high parity women (typically more than 4 or 5) has been reported in many populations (Doblhammer 2000; Grundy and Tomassini 2005; Hurt, Ronsmans, and Thomas 2006), although this effect is seen to a much lesser extent in Nordic countries (Hinkula, Kauppila, Näyhä, and Pukkala 2006; Grundy and Kravdal 2008) and in some studies has been found not to persist once early life circumstances are controlled (Henretta 2007; Spence 2008).

Associations between parity and women's health may partly reflect the fact that pregnancies may trigger certain physiological processes that raise or reduce the risk of developing cancer, or have implications for some other diseases, such as type 2 diabetes (Fletcher, Gulanick, and Lamendola 2002; Rieck and Fiander 2006; Britt 2007). Parenthood also affects individuals' life styles, which is probably an important reason why a similar relationship between number of children and health or mortality is observed among men as for women (Grundy and Kravdal 2008, 2010). Parents may, for example, be less inclined to take extreme risks (Wang 2009), they may have a more home-oriented lifestyle with lower alcohol consumption, and they may be better socially integrated into the community (Knoster and Eggebeen 2006; Bühler 2008). Additionally, children above a certain age may exert social control and be a potential resource as informal caregivers for parents with assistance needs (Barefoot, Grønbæk, Jensen, Schnohr, and Prescott 2005; Kendig 2007; Umberson, Pudrovska, and Recznek 2010). On the other hand, responsibility for (many) children may also be stressful and a source of economic strain, particularly when children are young (Evenson and Simon 2005; Margolis and Myrskylä 2011). Further, as for marital status, there are selection effects relevant to both women and men: socioeconomic resources, lifestyle preferences, and health are among the determinants of fertility (through the availability of a partner, fecundity, the couple's fertility desires, and whether contraception is used adequately), and are clearly also important for later health and mortality.

Studies of associations between family life courses and health and mortality are potentially valuable for a variety of reasons. In particular, identifying groups with more health problems than others – even if differences are partly due to selection – is useful to guide allocation of preventive and treatment resources and for the planning of future health care needs and services. Furthermore, analyses of the family-life-health relationship may provide some insights into possible causal effects of family-related behaviours on health, although realistically we will never be able to fully disentangle these from various selective influences. In principle, such knowledge might help individuals and governments with decisions and policy making relevant to family building strategies (Kravdal 2010).

Knowledge about health and mortality differentials by number of children or marital status and history is particularly important given the large changes that are expected to take place over the coming decades. In many European countries the proportions now entering later life include lower proportions never-married and childless than in preceding cohorts (Murphy, Martikainen and Pennec 2006; Grundy 2008). However, this situation will reverse once cohorts born in the second half of the twentieth century, whose family patterns have been characterised by changes associated with 'The second demographic transition', reach this stage of life (see for example projections for Norway by Keilman and Christiansen 2010). These changes include lower marriage rates, increases in cohabitation and non-marital childbearing (Kiernan 2004), high rates of divorce and even higher disruption rates for non-marital unions (Lyngstad and Jalovaara 2010), and frequent remarriage or re-partnership (Wu and Schimmele 2005; Poortman 2007), for which particularly high dissolution rates have been reported (Steele, Kallis, and Joshi 2006; Poortman and Lyngstad 2007). Such changes in family behaviour have been particularly marked in Norway. In the 1960s, about 10 percent of marriages were estimated to end in divorce. The comparable figure peaked in 2005 at 50 percent (Statistics Norway, 2011a). Over the same period, there has been a steady increase in

non-marital cohabitation and currently 25 percent of all co-residential partnerships are informal unions. Also, since the latter half of the 1990s more than 50 percent of first births have been outside marriage compared with 20 percent in the first half of the 1980s, and in 2010 16 percent of firstborn children were born to mothers who were neither married nor cohabiting (Statistics Norway 2011b).

Aims of this analysis

Our main aim is to investigate the extent to which associations between fertility histories and mortality vary according to marital and partnership status and history. Although there are many reasons why one would expect such variation (see below) and its exploration could be seen a natural ingredient of an effort to learn generally more about the importance of people's family situation for their health, it has attracted little attention in the literature. In one of the few studies that considered interactions of this type, only variations in parity effects between currently married (in first or later marriage), never-married, divorced and widowed were shown, and with limited discussion (Grundy and Kravdal 2008). We go beyond this by constructing a combined marriage-fertility indicator that reflects current marital status, whether an individual is remarried, the broader partnership history (as judged from the identity of the children's co-parents), number of own children, how the births of these children are placed in the partnership history, and step-parenthood (also indicative of spouse's relationship history).

One example of an interactive effect is that the social influences of parenthood may vary according to history of co-residence with children. More specifically, if living with young children influences a person's lifestyle in a positive way, with possible long term health consequences, one would not expect to see the same outcome for non-custodial parents (generally men), particularly if they have had little contact with their children. One analysis of Swedish data, for example, found that among men aged 29-54 long-term non-custodial fathers had the highest mortality, including higher mortality from addiction related causes, suicide and other external causes, while fathers living with the mother of their children had the lowest risks. Lone custodial fathers and men who were partnered but childless had similar intermediate levels of risk (Weitoft, Burström, and Rosen 2004). Fathers who have lived apart from their children may also have lower levels of contact and support from children in later life, as suggested by studies which have found much lower rates of contact between divorced (or remarried) older fathers and their adult children compared with married or widowed fathers, or divorced mothers (Furstenberg, Hoffman, and Shrestha 1995; Dykstra 1997; Grundy and Shelton 2001; Tomassini, Kalogirou, Grundy, Fokkema, Martikainen, Van Groenou, and Karisto 2004; Grundy and Murphy 2006).

To summarize, it seems likely that especially divorced men, and perhaps also the never-married (who have usually lived with the mother of any children they might have, but in informal relationships, which tend to be less stable than marriages), may benefit less from children than others because of a shorter period of co-residence. In addition, it is possible that the negative effects of stress from parenting are greater for single parents than for those who

have a partner (Harrison, Barrow, Gask, and Creed 1999; Muhammad and Gagnon 2010), an effect that would apply predominantly to women. On the other hand, marriage and parenthood may substitute for each other, in the sense that the benefits from having children may be *larger* for a single parent than for one who has a partner who can provide much of the same support and exert social control. Given these opposing mechanisms, it is far from obvious how the relationship between childbearing and mortality might be expected to vary by marital status and history, let alone the broader partnership history.

The second and related goal of our study is to analyse the association between mortality and being a step-parent (in different family situations), which has also received little attention. Just as the social effects of children may depend on whether and for how long the parent has lived with them, they may also vary by whether the children are own or step-children. For example, feelings of responsibility and levels of involvement may be lower for some step-parents than for other parents, which may have implications for lifestyle when children are young, and also for the child's feeling of obligation later. The step-parenthood relationship may also be a source of stress (Wilkes and Fromme 2002) and couples with step-children have been found to have poorer quality relationships than other parents (Wiik, Bernhardt, and Noack 2009), a factor that is itself related to health (Umberson, Williams, Powers, Liu, and Needham 2006). The selection into step-parenthood is also different from that into parenthood. In particular, step-parents have not been involved in the process of deciding to have the child. Instead, certain factors behind the choice of partner who has a child, and who may therefore have lived in an earlier and disrupted relationship, may also have a bearing on mortality – as may the characteristics of such a partner.

The study is based on register data for the entire Norwegian population born 1935-1968. This 1935 limit is set because birth histories are not complete for men and women born earlier. The marriage histories only go back to 1970, but this still leaves us with a lot of relevant information. Regrettably, we are not able to identify cohabitants as they were identified in the official registers for the first time in 1987, and then only if they lived with children of their current union. Neither can we identify those who do not live together in spite of being married, but according to the fourth round of the European Social Survey (2008) only 1 percent of married Norwegians were not currently living with their spouse. While our main intention is to analyse the relationship between all-cause mortality and family situation, as measured by the combined marriage-fertility indicator, we also show the proportions of the population in the different family types considered. This should itself be a valuable contribution to the literature, since family complexity has not been described in such detail for an entire national population or a nationally representative sample in any earlier study.

Data and Methods

The Norwegian Population Register includes all individuals who have ever lived in Norway since 1960, each of whom is assigned a unique identification number. For almost all those born after 1953, parents are identified. Since few have children before they are 18, the consequence is that birth histories are almost complete for women and men born after 1935.

The present study encompasses only these cohorts. We extracted the following information from the Population Register: dates of birth of all children for whom the individual is registered as a parent, the individual's own dates of birth and (if any) death, dates of migration to and from Norway (after 1965), and marital status at the beginning of each calendar year from 1970 onwards. Information about the highest educational level achieved as of 1970 and for each year 1980-2008 was added from the 1970 census and the educational data base operated by Statistics Norway.

Children are linked to their social rather than biological parents in case of adoption. For example, a child born to a woman in an earlier marriage may be adopted by her current spouse and thus be registered with him as the father. However, there are very few of these step-father adoptions (e.g., 223 in 2008), and not many other adoptions either, so we ignore this issue below.

We estimated discrete-time hazard models of mortality separately for men and women. For each individual, a series of one-year observations was created, starting in January 1980 (if born 1935-39, i.e. age 41-45 in 1980) or in January the year he or she turned 40 (if born 1940 or later) and ending with the year of death, emigration, or in 2008, whichever came first. The last cohort included were born in 1968 (age 40 in 2008). Each observation included a marriage-fertility indicator that referred to the situation at the beginning of the year (see details below), educational level achieved as of October the previous year, age at the end of the year, and calendar year. The outcome variable was whether the person died within this year or not. Observations were excluded if the person did not live in Norway at the beginning of the year, and logistic models were estimated from the remaining ones. There were a total of 73,506 deaths within 15,334042 person-years of observation among men and 43,863 deaths within 14,923945 person-years among women.

The marriage-fertility indicator was a cross-classification of number of children and marriage histories, the latter in a broad sense, since the classification also reflects earlier non-marital partnerships of the study subject and the spouse, and how the children are placed in this history. Number of children (for whom the person is registered as a parent) was defined as 0,1, or 2 or more, because earlier Norwegian research has shown rather small differences in mortality across higher parities (Grundy and Kravdal 2008, 2010) and because we thought adding more categories to the parity dimension would make the variable too complex.

We defined a total of 19 marital status and history groups comprising seven main groups listed below and further subdivision of some of them.

A: *currently married and most likely to live in a first marriage*, i.e. married continuously since 1970, which is the first year for which marital status is known, since the year of immigration (only 7% of the selected cohorts immigrated as married), or since what is definitely a first marriage. This group includes people who had remarried before 1970 or immigration. (Remarriage is particularly likely for the approximately ¼ of the individuals who entered the observation period as married in 1970 or as immigrants and were older than 25 years at these points in time.)
B: *currently divorced or separated*.

C: *currently widowed*.
D: *currently re-married, previously divorced or separated*, i.e. recorded as divorced or separated in 1970 or year of immigration or with a divorce or separation later. Those who also experienced widowhood (after separation) are included in group E.
E: *currently re-married, previously widowed*, i.e. recorded as widowed in 1970 or year of immigration or with subsequent experience of widowhood.
F: *never married*.
G: *currently married, but missing information on the spouse.*

Among the married with information available for their spouse (groups A, D and E) four subgroups were defined:
1) neither spouse has had children with another person;
2) the study subject has had at least one child with another person but the spouse has not;
3) the spouse has had at least one child with another person but the study subject has not; and
4) both spouses have had at least one child with another person.
With very few exceptions these children with a co-parent other than the current spouse were born before any children of the current union, and usually within an earlier marriage or partnership. The groups are already rather small, so we have not split them up further according to the number of children born to the couple or to either spouse separately. Men and women in groups 2 and 4 are by definition parents (i.e. they have had one or more children, though not all of them with their current spouse) and those in groups 3 and 4 are defined as step-parents (i.e. their current spouse has had a least one child with someone other than them). In addition, those in groups 3 and 4 may or may not have their own biological children.).

Additionally, we grouped the previously married (groups B and C) into two subgroups indicative of probable differential level of contact with the child(ren): 1) the time of the disruption was found in the data (i.e. occurred after 1970 or time of immigration) and the oldest child (if any) was born and aged less than 10 years old at that time, and 2) all others. The latter group thus includes people widowed, divorced or separated before 1970 or immigration; childless individuals; those whose oldest child was at least 10 at the time of a disruption after 1970 or immigration; and those (few) whose oldest child was not born yet at the time of divorce, but typically in a subsequent informal relationship. Most commonly, men in the first group will have lived with their oldest child for less than 10 years and even fewer years with any younger child.

Age and year were included as continuous variables (which gave the same main results as if they were specified as categorical variables, with 5-year categories), while four categories were defined for educational level: compulsory school (currently 10 years), some or full secondary school (11-13 years), tertiary education up to and including Bachelor level (14-17 years), and higher education (18+ years).

Results

Tables 1 and 2 show for men and women respectively the proportion of exposure time for the family status categories described above, while estimates of relative mortality (odds ratios

along with their 95% confidence intervals) for men and women respectively are shown in Tables 3 and 4. To make it easier to follow the description, we use character codes A-G or combined character and numeric codes such as A1-A4 to denote the various marital-history categories, in accordance with the definitions above. All discussion of results is left to the subsequent section.

(Tables 1-4 here)

The majority of men live in what is probably a first marriage (marital-history group A), although this group also includes some men who remarried prior to 1970 or the year of immigration. Within this marital-history group, the most common situation (contributing 56% to the total exposure time) is that neither spouse has any children from another union (subgroup A1). A large majority of these men have at least two children from their current marriage and these men contribute 49% of the exposure time (person-years of observation until death or censoring). This category was chosen as the reference group. In terms of proportion of exposure time, the only other groups which account for 5% or more are childless never-married men (10%); divorced or separated men with two children, the oldest of whom is not known to be under 10 at the time of disruption (8%); and those in marital-history subgroup A1 (men, in what probably are their first marriages with no step children or children outside the union) with one child (5%). The remaining smaller groups in total account for about ¼ of the exposure time. These include, for example, those who are definitely remarried and have at least one child with the current spouse while both partners also have children with earlier partners (2%), never-married men with two or more children (2%), and men in a probable first marriage with no own or step-children (2%).

Among women, those in probable first marriages with two or more children with no step-children or children from other unions account for half the exposure time (Table 2). The second largest category comprises divorced or separated mothers of two or more children not known to have had a young child at the time of disruption (10%) followed by the childless never-married (5%).

Mortality estimates for men

For married men without step-children or children outside the current partnership and no identified previous marriage (marital-history subgroup A1), the childless (contributing 2% of the exposure time) have a mortality 36% higher than that of men with two or more children; mortality for men with one child was lower than for the childless but higher than for fathers of two or more children (Table 3).

Men in (probable) first marriages who have at least one child with a woman other than their current spouse, but who have no step-children (subgroup A2) have higher mortality than

equivalent men with the same number of own children but no children outside the current partnership or step-children (subgroup A1). For example, among those with one child (meaning that they have no child with their current wife, only a child with another woman), relative mortality is 1.61, as compared to 1.12 among one-child fathers in the largest subgroup (A1). Similarly, mortality is raised from 1 to 1.18 among men who have two or more children when at least one of these is with another woman.

Men who have step-children, but no children of their own outside their current marriage (A3; accounting for 3% of exposure time) have higher mortality than equivalent men with no step-children: having at least one step-child in addition to two or more own children raises relative mortality from 1 to 1.26, while having step-children in addition to having one own child raises it from 1.12 to 1.23 (compare A3 with A1). However, the latter difference was not statistically significant as judged from the overlapping confidence intervals. For the childless, having a step-child has no impact in either direction (relative mortality is 1.38 as opposed to 1.36). The fourth marital-history subgroup, A4, consists of men who have at least one step-child and who have also themselves had at least one child with another partner. Among those with two or more children, a higher mortality is seen than in any other group of men in a first marriage with two children. However, confidence intervals for these high-parity men in the three smallest marital-history subgroups A2-A4 are overlapping.

Turning now to the divorced or separated men (B), who contribute 15% to the total exposure time, mortality is more than doubled compared to that among men in first marriage without step-children and children outside the current partnership. In fact, the relative mortality among the childless is as high as 3.02. Among the divorced fathers with one child, relative mortality is 3.12 if the disruption was known to have occurred when the oldest child was younger than 10 (subgroup B1), and otherwise 2.59 (subgroup B2). Similarly, among the divorced fathers of two or more children, relative mortality is 2.73 if the disruption occurred when the oldest child was younger than 10 and otherwise 2.22. These differences according to age at the time of disruption are significant as judged from the non-overlapping confidence intervals (and significance was confirmed in additional models where other reference categories were chosen). Mortality is generally lower among widowers, but there are too few of them to allow a detailed comparison across subgroups.

About 9% of the exposure time is among men who definitely live in their second or higher-order marriage (main marital-history groups D and E). Those who have experienced a divorce or separation are clearly the largest group, and we focus entirely on them (group D), ignoring those remarried after widowerhood (group E). Generally, mortality among the remarried is higher than that of men in their first marriage, but lower than that of men who are divorced (B) or widowed (C), as seen also in a number of other studies (e.g. Grundy and Tomassini 2010). Further, the same general pattern of increasing mortality with decreasing parity appears in this marital-status group as elsewhere. For example, in subgroup D1 (those without step-children or children outside the current partnership), relative mortality falls significantly from 1.97 among the childless to 1.41 among the fathers of two or more children. Among the childless, having at least one step-child (which may indicate that the wife has been married earlier) reduces mortality from 1.97 to 1.72 (compare subgroups D1

and D3), but this difference is not significant. Similarly, being a step-father or having had a child outside the current partnership is not significantly associated with mortality among men with one or more children.

Among the quite large number of men who are never-married (group F, contributing 15% to the exposure time), there is much variation in mortality. The childless (who constitute 2/3 of the never-married) have a relative mortality of 2.93, which is higher than in any other group except the divorced with low parity, while those with two or more children have only half as high mortality (relative mortality 1.67). The latter group may include many cohabitants.

One-fifth of the never-married men with two or more children have had these children with two or more different mothers, and these men have a particularly high mortality (2.06, CI 1.81-2.24; not shown in tables). The remainder, whose children have the same mother and who are therefore particularly likely to live or have lived in a long-lasting informal union, have a relative mortality of 1.56 (CI 1.44-1.69; not shown in tables).

The difference between childless men and men with two or more children, measured in terms of a relative-mortality ratio, varies moderately across marital status. If we consider the largest subgroups within the main marital-history categories, the ratio is 1.36 among the men in their first marriage (A1), 1.36 (3.02/2.22=1.36) among the divorced or separated (B2), 1.45 among the widowed (C2), 1.40 among those remarried after divorce or separation (D1), and 1.75 among the never-married (F). The ratio is generally lower in some of the smaller marital-history subgroups. It is, for example, 1.10 among the married men with step-children (A3), because of the already mentioned increase in mortality associated with step-children for two-child fathers (but not for the childless).

Mortality estimates for women

The relationship between mortality and number of children within a given marital-history group is generally stronger among women than among men (Table 4). This finding accords well with earlier studies (Grundy and Kravdal 2008). For example, among women in first marriage with no step-children and no children outside the current partnership (marital-history subgroup A1), the mortality of the childless is 1.61 times the mortality of those with two or more children, while the corresponding relative mortality among men is 1.36. It should be noted, however, that there is– according to the point estimates –a smaller difference between the sexes in the association between parity and mortality for the never-married (F) than for other marital-history groups: never-married childless women have 1.89 times higher mortality than never-married women with two or more children (2.80/1.48=1.89), while the corresponding ratio among men is, as mentioned earlier, 1.75 (2.93/1.67=1.75). This also means that, while there is a rather small difference in the parity-mortality association between never-married women (1.89) and other women (e.g. 1.61 in marital-history subgroup A1), there is a somewhat larger difference for men (1.75 versus e.g. 1.36 in A1). Stated differently,

the particular disadvantage of being childless for the never-married is somewhat more pronounced among men than among women.

Another interesting finding is that, for divorced women, having experienced disruption while the children were relatively young (B1) does not reduce the ratio between the childless and those with two or more children as much as it does among men. Two-child mothers with a disruption at this stage have a relative mortality of 1.93, compared to 1.73 among other divorced women. Among men, the corresponding numbers are 2.73 and 2.22 and thus differ more (confidence intervals almost overlap for women, while they are more sharply separated among men). It might also be noted that, while childlessness is associated with a particularly strong mortality disadvantage for women, the associations between marital status and mortality are generally weaker, which is consistent with many previous studies of marital status differentials in mortality. As a result gender differences in the *combined* effect of being not married and childless are trivial: the relative mortality for the never-married (F) and childless and for the divorced (B2) and childless is almost the same for men (2.93 and 3.02) as for women (2.80 and 2.93).

Having step-children does not affect the mortality of childless women, which parallels the result for men. Among the first-time married with two or more children, both step-children and children outside the current relationship (subgroups A2-A4) are associated with higher mortality for both sexes, though the point estimates suggest that step-children add less to mortality for women than men. This is also weakly indicated for the remarried.

Discussion

In this paper we used information on the partnership and parenthood characteristics of the Norwegian population to derive an indicator of family life status and history and to investigate how this was related to mortality in late mid life. We were particularly interested in how associations between mortality and parenting histories varied with marital and partnership histories, which has received little attention in the literature. The direction of these interactive effects was far from obvious at the outset. On the one hand, the protective effects of having children might be reduced among men who had divorced when their children were relatively young, and so perhaps had lower levels of contact with them. There might also be lower benefits of children among some groups of non-married because of stresses caused by lone parenthood. On the other hand, children might be particularly important if there is no partner who can provide much of the same support and exert social control. Our second and related goal was to see whether benefits of step children might be lower than those of own children.

Results showed great diversity in the family lives of those in the study population. Those in a probable first marriage with two or more children of the union and no other children of either spouse accounted for half the observed exposure time. The representation of currently or previously widowed people was very small, as would be expected given the relatively young age of the population. A larger proportion of exposure time was accounted

for by the currently or previously divorced or separated, most of whom had had two or more children. 15% of men and 9% of women were never-married, some of whom may have been in cohabiting relationships. About one-third of the never-married had children. Proportions in the subgroups with more complex histories were small. For example, those with children with a current spouse, own children from another union and step-children accounted for only 2% of exposure time, although current trends indicate that this proportion will be higher in more recently born cohorts.

Our results were consistent with other studies in showing mortality disadvantages for non-married groups and higher mortality for the childless and those with only one child than for parents of two or more children. For example, among the large group who are married and for whom no earlier disruption has been registered, the relationship between parity and mortality is of the same size as reported elsewhere for the general population: mortality is raised by about 50% among the childless compared to those with two or more children, more precisely 36% among men and 61% among women. This larger effect of children among married women than married men may have at least three explanations: physiological effects that are not relevant for men, women have more responsibility for children and are therefore also more socially influenced by them, and the effect of health selection may be greater as mother's fecundity and health is likely to play a large role in fertility (decisions) than the father's health.

In the discussion below, we first consider the differences across marital history in the effects of parity and the very high mortality of the childless non-married. Subsequently, we elaborate on the conditional effects of contact with children, as indicated by the timing of disruption, and address the implications of having step-children.

Differential effects of parity across marital history and the high mortality among the childless non-married

We found a somewhat stronger relationship between mortality and parity among the never-married than the married (especially for men), but there is no difference in this association between the previously-married and the married. This pattern suggests that the various interaction mechanisms suggested above are rather weak or cancel each other out. Having never had a spouse to rely on, who might provide the same types of support and control as a child, may be the most important conditioning factor. However, there is an alternative interpretation of the relatively sharp effect of parity among the never-married: some of the non-married may be cohabiting, who may benefit from many of the same health advantages as the married (Murphy, Glaser, and Grundy 1997; Koskinen, Joutsenniemi, Martelin, and Martikainen 2007), and cohabitation is probably especially likely among the never-married with two or more children (most of whom have also had these children with the same partner).

Because the never-married and previously married have generally higher mortality than the married, and the effects of the number of children is at least as large in these groups, the combination of being childless and never-married or previously married is associated with

very high mortality: for both sexes, it is about *three* times as high as that among the first-time married with two or more children and neither step-children nor children outside the current relationship. This very high mortality among the childless and non-married probably reflects the absence of social control of health related behaviours and emotional and practical support from a partner or child, lack of economic contribution from a partner, and possibly weaker integration into the wider community.

In addition, there is obviously negative selection into this high-mortality group. We have controlled for the individual's educational level, which especially for men is negatively related to childlessness and divorce and positively related to marriage (Lyngstad 2006; Kravdal and Rindfuss 2008). This had some impact on the estimates (for example, the relative mortality among childless never-married men would have been about 30 percentage points higher without education included), but it cannot be regarded as a sufficient control. In particular, lifestyle preferences and earlier life health are important confounders on which we have no information.

The conditional effect of contact with children, as indicated by disruption

Comparisons among the divorced indicate differentials according to age of the youngest child at the time of the divorce, which we consider a proxy for likely duration of co-residence. The difference is larger among men than among women, probably reflecting the fact that children more often live with their mothers after disruption. Our results are consistent with the hypothesis that fathers who divorced when their children were young received less 'health benefit' from these children. It would seem likely that this reflects both different exposure to living with children (and associated impacts on health related behaviours) and quality of the relationship later in life, but we are not able to explore these issues further with our data.

Another finding of relevance for the idea about contact with children is that, among the married, those who have had at least one child outside the current partnership, typically in an earlier relationship, have higher mortality than those who have had all their children with the spouse. However, this effect is not particularly sharp among men, and it also has an alternative explanation: the earlier disruption may be an indication of individual socioeconomic or other characteristics that also increase mortality.

Possible benefits of step-children

It is somewhat surprising that there is no clear benefit of having a step-child for those who are childless (though an effect is very weakly indicated for women and men in a second marriage). Such a child should provide many of the same advantages as an own child, though perhaps not to quite the same extent. However, step-parenthood may be associated with poorer family relationships, with implications for later health, and there may also be selection mechanisms involved. Having a step-child most likely implies that the spouse has been in a relationship earlier. The dissolution of this relationship may have had adverse effects on his or

her earlier health and health behaviour, with implications also for the new spouse. Characteristics associated with higher risks of partnership breakdown may also impact negatively on the quality of subsequent relationships and on health. A related mechanism is that these new partners who have chosen this 'divorce-prone' person may have certain characteristics themselves that tend to raise mortality. The fact that an adverse effect of step-children appears at higher parities may suggest that these selection arguments are generally relevant, but that they are outweighed by a protective effect of having contact with more children only for those who would otherwise be childless. Such an idea would accord with the fact that the association between mortality and own parity is strongest at the lowest parity levels.

Limitations of the study

This study has four main methodological limitations. One is that the data only include those born 1935 or later, who were younger than 73 during the period of observation. If we could have followed the men and women up to higher ages, there would have been more deaths which would have increased the power of the analysis. Additionally, the deaths we observe in this study are all 'premature' in the sense of occurring at much younger ages than the modal age of death in the Norwegian population and the cause of death distribution for these deaths differs from that of the whole population. This could be investigated in future cause specific analysis.

More importantly, we have not been able to identify cohabitants, who are hidden among the non-married. Cohabitants probably have lower mortality than the single but higher than the married, as found in Finland (Koskinen et. al. 2007). Thus, those who are truly single and childless may have an even higher relative mortality than 3, while those who are in first marriage and have never experienced disruption of a consensual union may have even lower mortality than that appearing in the group we denote as (probably) first-time married.

The third limitation is that the marriage histories only cover the years after 1970 and that some have immigrated as married. Thus, some individuals who are categorized as living in a first marriage may actually live in a second or higher-order marriage. Furthermore, we do not have information for everyone about how old their children were at the time of divorce, which is an important determinant of the number of years lived with these children. However, we are not aware of any large data set from any country that includes complete cohabitation, marriage and fertility biographies up to the ages when deaths typically occur.

Fourth, we lack information on important hypothesised mediating variables, such as health related behaviours, stress, and social support. There are of course also a number of joint determinants of family behaviour and mortality that we have not been able to control for, but this is a general limitation in this research area. Some authors have dealt with the selection problem by using data (often collected retrospectively in surveys) that allow control for particularly important confounders such as earlier health (e.g. Horwitz et a. 1996), while

others have used various types of fixed-effects (e.g. Lee at al. 2004) or multilevel-multiprocess models (e.g. Lillard and Panis 1996) that capture constant unobserved family and health determinants. The latter approaches require multiple measurements of the outcomes, and are therefore not relevant in mortality studies. Even with the most advanced statistical techniques and measurements, one can realistically never completely get rid of selection in observational studies.

Conclusion

There is great diversity in people's family lives. While it is still very common to have two or more children and live in a stable marriage, there are, for example, also many who never marry or who divorce and perhaps subsequently enter a new partnership. A substantial proportion of the latter have not lived many years with all their children, and many have step-children (because their new partner has also been in another relationship earlier). According to the Norwegian register data we have used, there is huge variation in mortality across these groups. Presumably, this reflects long-term physiological effects of pregnancies, social effects of parenthood and earlier living arrangements (partnership and contact with children), and that factors that sort people into different family trajectories also affect health. Although there is uncertainty about the causal mechanisms, such large differences in mortality by family situation have a number of implications both for further research and for policy, including the targeting of health care interventions.

The most novel aspect of our analysis is that we have described the relationship between mortality and family situation – for men as well as women – in more detail than in earlier studies, where the focus has usually been on differentials across *either* marital status (history) *or* reproductive patterns, typically without consideration of step-children and largely restricted to women. Our results suggest that the relationship between childbearing and mortality is quite strongly conditioned on the broader family situation, such as whether or how long the person has lived with the other parent (and hence child), and whether the child is a step-child. This complexity should to a larger extent be taken into account in future research about the role the family plays on people's health.

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Table 1. Proportion of exposure time (%)– by family status among men aged 40-73 and born 1935 or later, observed 1980-2008.

	Number of children		
	0	*1*	*2+*
A. Married. Not divorced, separated or widowed earlier			
1. Neither he nor she has a child with another person	*2.20*	*5.03*	*49.02*
2. He has at least one child with another person		*0.09*	*1.26*
3. She has at least one child with another person	*0.77*	*1.03*	*1.22*
4. Both have at least one child with another person		*0.08*	*0.25*
B. Divorced or separated			
1. Oldest child born and <10 at time of disruption		*1.24*	*2.33*
2. All others	*1.36*	*1.37*	*8.48*
C. Widowed			
1. Oldest child born and <10 at time of disruption		*0.03*	*0.05*
2. All others	*0.11*	*0.14*	*0.81*
D. Married. Divorced or separated earlier (but not widowed)			
1. Neither he nor she has a child with another person	*0.18*	*0.28*	*1.32*
2. He has at least one child with another person		*0.19*	*2.39*
3. She has at least one child with another person	*0.21*	*0.15*	*0.11*
4. Both have at least one child with another person		*0.32*	*1.93*
E. Married. Widowed earlier			
1. Neither he nor she has a child with another person	*0.01*	*0.01*	*0.07*
2. He has at least one child with another person		*0.01*	*0.10*

3. She has at least one child with another person	*0.01*	*0.00*	*0.00*
4. Both have at least one child with another person		*0.02*	*0.10*
F. Never married	*10.38*	*2.04*	*2.36*
G. Married, but identification of spouse not known	*0.36*	*0.12*	*0.41*

Table 2. Proportion of exposure time (%)– by family status among women aged 40-73 and born 1935 or later, observed 1980-2008.

	Number of children		
	0	*1*	*2+*
A. Married. Not divorced, separated or widowed earlier			
1. Neither he nor she has a child with another person	*2.23*	*5.04*	*50.38*
2. She has at least one child with another person		*0.17*	*1.42*
3. He has at least one child with another person	*0.59*	*0.54*	*1.64*
4. Both have at least one child with another person		*0.14*	*0.31*
B. Divorced or separated			
1. Oldest child born and <10 at time of disruption		*1.20*	*2.26*
2. All others	*1.10*	*1.67*	*10.43*
C. Widowed			
1. Oldest child born and <10 at time of disruption		*0.10*	*0.23*
2. All others	*0.33*	*0.48*	*3.40*
D. Married. Divorced or separated earlier (but not widowed)			
1. Neither he nor she has a child with another person	*0.17*	*0.24*	*1.15*
2. She has at least one child with another person		*0.23*	*1.78*
3. He has at least one child with another person	*0.19*	*0.10*	*0.15*
4. Both have at least one child with another person		*0.35*	*1.77*
E. Married. Widowed earlier			
1. Neither he nor she has a child with another person	*0.02*	*0.01*	*0.09*
2. She has at least one child with another person		*0.01*	*0.15*
3. He has at least one child with another person	*0.02*	*0.01*	*0.01*

4. Both have at least one child with another person		*0.02*	*0.12*
F. Never married	5*.21*	*1.98*	*1.95*
G. Married, but identification of spouse not known	*0.12*	*0.11*	*0.39*

Table 3. Associations (odds ratios with 95% CI) between family status and mortality, among men aged 40-73 and born 1935 or later, observed 1980-2008.*

	Number of children		
	0	1	2+
A. Married. Not divorced, separated or widowed earlier			
1. Neither has a child with another person	1.36 (1.29-1.43)	1.12 (1.08-1.17)	1.00 (REF)
2. He has at least one child with another person		1.61 (1.25-2.08)	1.18 (1.09-1.27)
3. She has at least one child with another person	1.38 (1.27-1.51)	1.23 (1.13-1.34)	1.26 (1.17-1.35)
4. Both have at least one child with another person		1.35 (1.00-1.81)	1.39 (1.18-1.64)
B. Divorced or separated			
1. Oldest child born and <10 at time of disruption		3.12 (2.96-3.29)	2.73 (2.62-2.86)
2. All others	3.02 (2.89-3.17)	2.59 (2.47-2.71)	2.22 (2.17-2.27)
C. Widowed			
1. Oldest child born and <10 at time of disruption		2.82 (2.09-3.80)	1.64 (1.20-2.25)
2. All others	2.62 (2.32-2.96)	2.14 (1.90-2.41)	1.81 (1.71-1.91)
D. Married. Divorced or separated earlier (but not widowed)			
1. Neither he nor she has a child with another person	1.97 (1.69-2.28)	1.54 (1.33-1.78)	1.41 (1.32-1.52)
2. He has at least one child with another person		1.81 (1.55-2.11)	1.29 (1.23-1.36)
3. She has at least one child with another person	1.72 (1.50-1.98)	1.51 (1.23-1.86)	1.52 (1.20-1.93)
4. Both have at least one child with another person		1.38 (1.22-1.58)	1.40 (1.33-1.47)
E. Married. Widowed earlier			
1. Neither he nor she has a child with another person	2.34 (1.35-4.05)	1.79 (0.99-3.24)	0.98 (0.71-1.33)

2. He has at least one child with another person		2.15 (1.27-3.64)	1.04 (0.83-1.31)
3. She has at least one child with another person	1.85 (1.14-2.98)	1.47 (0.55-3.92)	1.75 (0.43-7.03)
4. Both have at least one child with another person		1.40 (0.88-2.23)	1.47 (1.24-1.76)
F. Never married	2.93 (2.85-2.98)	2.56 (2.42-2.70)	1.67 (1.56-1.78)
G. Married, but identification of spouse not known	1.55 (1.37-1.76)	2.22 (1.86-2.64)	2.63 (2.42-2.86)

* Controlled for age, period, education. – means no deaths in this group.

Table 4. Associations (odds ratios with 95% CI) between family status and mortality, among women aged 40-73 and born 1935 or later, observed 1980-2008.*

	Number of children		
	0	1	2+
A. Married. Not divorced, separated or widowed earlier			
1. Neither has a child with another person	1.61 (1.52-1.71)	1.37 (1.31-1.44)	1.00 (REF)
2. She has at least one child with another person		1.62 (1.30-2.01)	1.32 (1.22-1.44)
3. He has at least one child with another person	1.58 (1.40-1.79)	1.45 (1.25-1.67)	1.19 (1.08-1.30)
4. Both have at least one child with another person		1.52 (1.16-2.00)	1.23 (1.01-1.50)
B. Divorced or separated			
1. Oldest child born and <10 at time of disruption		2.40 (2.20-2.58)	1.93 (1.81-2.06)
2. All others	2.93 (2.74-3.13)	2.26 (2.13-2.40)	1.73 (1.68-1.78)
C. Widowed			
1. Oldest child born and <10 at time of disruption		1.93 (1.50-2.49)	1.43 (1.16-1.75)
2. All others	2.27 (2.07-2.50)	1.96 (1.81-2.13)	1.48 (1.42-1.54)
D. Married. Divorced or separated earlier (but not widowed)			
1. Neither he nor she has a child with another person	2.12 (1.76-2.55)	1.70 (1.40-2.06)	1.47 (1.34-1.62)
2. She has at least one child with another person		2.04 (1.73-2.41)	1.28 (1.19-1.39)
3. He has at least one child with another person	1.84 (1.52-2.23	1.46 (1.04-2.05)	1.32 (0.98-1.77)
4. Both have at least one child with another person		1.49 (1.27-1.75)	1.28 (1.19-1.38)
E. Married. Widowed earlier			
1. Neither he nor she has a child with another person	1.70 (0.91-3.16)	1.47 (0.73-2.94)	1.05 (0.76-1.45)
2. She has at least one child with another person		1.17 (0.52-2.61)	1.31 (1.05-1.63)

3. He has at least one child with another person	2.21 (1.35-3.62)	-	1.92 (0.71-5.14)
4. Both have at least one child with another person		0.73 (0.32-1.63)	1.38 (1.10-1.73)
F. Never married	2.80 (2.70-2.90)	2.05 (1.91-2.19)	1.48 (1.35-1.63)
G. Married, but identification of spouse not known	2.57 (2.11-3.14)	2.69 (2.19-3.31)	2.26 (2.01-2.53)

* Controlled for age, period, education. – means no deaths in this group.