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Does Parenthood Affect Mortality? A Study of Norwegian Men and Women Aged 20-67 in the Years 1971-2002

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Abstract

This paper analyze the association between parenthood and mortality using very rich individual-level register data covering all people aged 20-67 years in Norway 1971-2002. A total of 67 014 male deaths and 33 714 female deaths are included in the analysis, while the number of male and female person-years of follow-up are respectively 30.2 and 28.9 million. For both sexes, the paper finds that parents have lower mortality than non-parents. Furthermore, for both sexes mortality is highest for the childless and for those with only one child, while the lowest mortality for men is found for those with two children and the lowest mortality for women for those with three or four children. Age of the youngest child also matters for both sexes: the younger the age of youngest child, the lower is mortality. However, interaction of age of youngest child and parity is important to take into account: relative mortality risks for one-child parents, in particular for mothers, increases much faster by rising age of youngest child compared to higher parities. One explanation for this might be that individuals with poor health have impaired fecundity or that they might have chosen to limit the number of children voluntarily because of their poor health status (the stronger effect for women might be associated with a complicated pregnancy and/or delivery). The paper also finds that parenthood plays a more important role in protecting females than males from premature mortality, while marriage seems to reduce mortality more for males than for females.

1. Introduction[1]

The association between marital status and mortality is well established (for two reviews, see Livi-Bacci 1985 and Hu and Goldman 1990). Generally, the greatest differences are found between the married and the never-married, but the mortality of the married is also markedly lower than that of the previously married. A particularly high mortality is seen for divorced men compared with married men (Prinz 1995; Kravdal 2001). There are two competing explanations for these differences (Wyke and Ford 1992). First, the selection theory suggests that people with good health and favorable socioeconomic characteristics are more likely to marry, stay married and to remarry. Second, social causation theory implies that the married are protected from premature mortality because the institution of marriage offers economy of scale, social support, and social control. The bulk of the evidence suggests more specifically that marriage is more beneficial to men's health and survival than to women (Gove 1973). One reason for this may be that efforts to control and monitor spouse's health behavior are stronger among women than among men (Gove 1973; Umberson 1992a).

A large majority of married people finally end up having children. Some of the protective effect of marriage may actually be due to factors related to parenthood. Children may offer social support to parents and also impose social control similar to what spouses is hypothesized to give one another in a marriage. Furthermore, there may also be selection into parenthood similar to the selection processes into marriage. The impact of parenthood on mortality has received some attention, although largely in studies of all-cause mortality. Some studies find weak or no effect of children controlling for marital status and other confounders, while others conclude that such effects on mortality are significant and equally strong for either parents or stronger for women than for men (or no effect for men). Opposite to the findings for marriage, however, most studies seem to conclude that parenthood protects women more than men with respect to premature mortality (Gove 1973; Umberson 1987; Weatherall et al. 1994; Hemström 1996; Mamelund 2006).

This paper tests the well-established theory of the protective effect of marriage on all-cause mortality, but the main focus is on testing the less widely supported theory of the protective effect of having children. More specifically, this paper test the hypothesis whether parenthood in Norway 1971-2002, using very rich individual-level register data, has effect on overall mortality above and beyond marital status (and socioeconomic factors). Moreover, the paper tests whether the number of children serves as important "buffers" after bereavement and divorce. This paper adds to the existing literature on parenthood and mortality in several ways. First, most of the previous research has mainly focused on married women. By doing this type of research for both sexes (and also for all marital status groups), one may be better able to distinguish between the pure biological processes related to pregnancy on the one hand, from the life style factors that were influenced by or influenced family size, on the other hand (Kravdal 1995; Lawlor et al. 2003; Weitoft et al. 2004). Furthermore, this study adds new insight to the relationship of parenthood and overall mortality because the analysis takes advantage of a large and very

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rich individual-level register data set: the high number of events (deaths) and person-years of follow-up included in the analysis makes it more likely, than for example in panel surveys, to reach statistical significance of important interactions. To my knowledge, previous mortality studies have not investigated the full range of interactions between marital status and parity on the one hand, and the full range of interactions between parity and age of youngest child on the other hand, as detailed as is done in the current paper.

2. Previous research on parenthood and mortality

All-cause mortality

With or without children

Previous studies generally show that individuals with children have lower mortality than the childless controlling for marital status, socioeconomic and other relevant confounders (see for example Kobrin and Hendershot 1977, Lund et al. 1990, and Kvåle, Heuch and Nilsen 1994).

Number of children

Lund et al. (1990) found that among married Norwegian women older than 25 years followed from 1970 to 1985, nulliparous had higher mortality than the parous, while lowest mortality was found for parous women with 2-4 children. Parity also showed a weak relationship with increasing mortality among grand multiparous women (5 or more children). Kvåle, Heuch and Nilsen (1994) found an inverse association between parity and all-cause mortality for Norwegian women 1961-1980, but only for women younger than 50 years at start of follow up in 1961. Women older than 50 years at start of follow up had a moderate positive association between total mortality and parity. The lowest mortality was nevertheless found in women with 2-4 children, while the highest mortality figured in nulliparous women as well as in grand multiparous women. The same mortality pattern by parity has also been documented for women aged 50-70 years from England and Wales 1991-2000 (Grundy and Tomassini 2005). Hinkula et al. (2005), however, found lower overall mortality for grand multiparous women (5 or more children) and no difference for grand grand multiparous women (10 or more children) when compared to the average female Finish population.

Dependent children and mortality of their parents by sex and working ages

Studies on the role of dependent children in explaining the mortality of their mothers and fathers are numerous. Kobrin and Hendershot (1977) found that married persons aged 35-44 (in 1966-68) who did not live with children under 18 years had 2.1 (men) to 2.4 (women) times as high mortality as those living with children under 18 years. For higher ages (45-54 and 55-64 years), the effect was weaker, but still stronger for women than for men. Gove (1973) and Weatherall et al. (1994) similarly concluded that the protective effect of young children (< 10 years in the Weatherall et al. 1994-study) is stronger for women than for men. In a study of Swedish individuals aged 31-65 years in 1981-1986 (Hemström, 1996), it was found that the mortality of women with one child below the age of 16 at home was 24 per cent lower than that of childless women – for two or more children the reduction was 47 per cent. For men, the child effects were 19 per cent and 33 per cent, respectively. Martikainen (1995) observed that having children under the age of 16 in Finland lowered mortality for the married and unmarried as well as for the employed and non-employed women aged 35-64 years. Zick and Smith (1991) observed that children reduced mortality and affected men and women in the same way. Tucker et al. (1996) finds that having children only impose a negative effect on female mortality. Weitoft et al. (2004) finds, in the case of Swedish men, support not only for the well-established protective effect of marriage on all-cause mortality, but also for the less widely supported theory of the protective effect of having children. Lillard (1995) have analyzed whether the marriage premium is partly explained by economies of scale and children: household income explained a substantial part of the marriage premium for women, while having dependent children in the household did not affect this relationship. However, those who lived with children had a quite modest mortality advantage. Except for a recent paper by Mamelund (2006), there seems to be no current study on the effect of the number and age of children on all-cause mortality of Norwegian men.

Adult children and old-age mortality

Yi and Vaupel (2004) found that the oldest-old (80-105 years) of both men and women in China who had two or more surviving children born after age 35 or 40 and where at least one such late-born daughter living nearby had higher rates of healthy survival compared to those who also had two or more surviving children born after age 35 or 40 but did not have a nearby living late-born daughter. This supports not only the role of sex in caregiving but also the role of geographic proximity to children for adult health. Kravdal (2003) finds no effect of having at least one adult child on cancer survival of somewhat younger adult Norwegian women (aged 30-63 in the period 1960-1999). When discussing the possible effects of proximity of adult children on parents' health and mortality one should of course take into account possible endogeneity problems. One may for instance speculate that some adult children do not move to other parts of the country because they rather want to live close to their sick (and dying) parents. Future research on this topic should also consider the possibility that effects of step-children are different from that of biological children. One may for instance assume that step-children feel less obliged to care for an old step-parent than biological children for their old biological parents.

Employment and parenthood

A substantial part of the literature has been analyzing whether the double role of being a mother and at the same time being fully employed is burdensome and therefore affects mortality. Kotler and Wingard (1989) found virtually no effect of parity on the mortality of employed women (and rejected their multiple burden theory for this group). Housewives, however, had elevated mortality when a child was present in the home. Neither the number of children nor the presence of a child in the home affected the mortality risk of men. Hibbard and Pope (1991, 1992, and 1993) also found no association between the number of children (aged 19 and below) at home and mortality for employed or non-employed women (and men). Martikainen (1995) observed that having children under the age of 16 lowered mortality for the married and unmarried as well as for the employed and non-employed women. Elstad (1996) found that the health of married women with children working full-time was significantly better compared to other combinations of parenthood and marital status. The overall conclusion from the current literature suggests that there is no or little support for the multiple role theory and increasing mortality risks. On the contrary, it seems as if having multiple roles instead "enhances" opportunities in life which in turn may increase general satisfaction and health, and lowers mortality.

Interactions between marital status and parity

Rogers (1996) has concluded that having children under the age of 25 years reduce mortality in both married couples and in previously married persons. Hemström (1996) also finds interactions between marital status and children: divorced men and women, for example, had significantly higher mortality compared to the married, but the differences were smaller for the divorced with than without children vs. the married (but was larger for those with two than for those with one child). In a recent study of neighboring Norway 1990-2002 (Mamelund 2006), controlling for marital/cohabitation status and education, it was found that both the married and previously married with at least one child had significantly lower mortality compared to their childless counterparts, but also that the effects were stronger for women than for men. Mamelund (2006) also showed that among the separated/divorced, those with at least one child who had not remarried or cohabit had significantly higher mortality than those who cohabit and had at least one common child. Further, the separated/divorced which did not cohabit and were childless had significantly higher mortality compared to the counterpart who had at least one child. Significantly lower mortality was also found for bereaved persons with at least one child compared to the childless. The effect was found to be stronger for widows than for widowers. These studies show that children may serve as important "buffers" after bereavement, but also after divorce.

Timing of parenthood: early and late motherhood

Lund et al. (1990) found that among Norwegian married women that late first and last birth was associated with low mortality. Grundy and Tomassini (2005) have studied England and Wales and found also elevated mortality for teenage mothers, while late childbearing (after age 39) was linked to lower mortality.

Birth spacing

Grundy and Tomassini (2005) have found that short birth interval, defined as less than 18 months, were associated with elevated mortality.

Cause-specific mortality

There are also studies on the impact of parenthood on cause-specific mortality. Some show a negative and others a positive relationship of parity. The association between parity and mortality from coronary heart disease, for example, has been shown to be "J" shaped with the lowest mortality for those with two children, and has been explained by life-style risk factors related to child-rearing which lead to obesity for both sexes, but also biological pathways for women (Lawlor et al. 2003). A negative relationship between parity and mortality has been found from deaths from different types of cancer, in particular cancer of breast, corpus uteri and ovaries, but also for deaths from stroke dementia, accidents, violence and suicide (Høyer and Lund 1993; Kvåle, Heuch and

Nilsen 1994; Martikainen 1995; Gaist et al 2003; Weitoft et al. 2004; Koski-Rahikkala et al. 2006; Hinkula et al. 2005; several early studies on suicide are reviewed by Mastekaasa 2000).

Sickness and health

Several studies also show that the sickness and self reported health is lower among parents (in particular the married) than among the childless (Arber 1991; Elstad 1996; Mastekaasa 2000; Hughes and Waite 2002). Helbig et al. (2006) shows that parenthood, in particular for men, is associated with lower rates of psychiatric morbidity in general, and depressive and substance use disorders in particular.

2. The mechanisms

Why should parenthood have effects on health and mortality? The underlying mechanisms are complex, but three main pathways are identified in the literature. These are respectively physiological, social and selection effects related to parenthood.

Physiological effects

In a rich welfare state such as Norway, maternal mortality is very low, but pregnancy, delivery and lactation can leave physical imprints on a woman that have a long-lasting influence on her health. One example is the effect of age at first birth on breast cancer incidence, which has received much attention in cancer epidemiology (Kravdal 1995, 2003). Such direct physiological effects are restricted to the mothers, of course, and are much more relevant for some causes of death than for others. Further, several studies have shown that late motherhood, the ability to conceive and give birth after age 40, might be a marker of “slower” aging, better health and longevity (see review of literature and analysis in Yi and Vaupel 2004).

Social effects

There are at least four types of social factors mentioned in the literature – relevant for both the mother and the father – that may influence the incidence of and survival from a large number of diseases, as well as on violent deaths (Umberson 1987, 1989, 1992a, 1992b; Ross et al. 1990; Grundy and Shelton 2001; Kravdal 2003). The first two are the positive effect that respectively – giving care to (dependent) children and receiving care from adult children – may have on parents health (direct effects), while the last two – increased social control (of health behavior and lifestyle) and social integration associated with having and raising children – may also improve health and lower mortality of parents (indirect effects). The level of social support is probably a function of the number of children, although it does not necessarily increase monotonically by parity.

Direct social effects

Young and dependent children may be a source of emotional and physical support, provide a sense of meaning and order to life, and even a source of self-esteem and prestige. However, given the traditional sex-differentials in responsibilities for children, one would perhaps expect that this aspect of the protective role of children in marriage to be stronger for the mother than for the father. Because of rising popularity of consensual unions in the last 20-30 years, at least in Norway and the Scandinavian countries, the effect of children on the mortality in the never married group with and without children may be difficult to interpret. Because a large majority of children lives with the mother after divorce, the sex-specific differences of having biological children might be even greater for the divorced. The father (and the mother) may of course benefit from the possible protective role of step-children as well as from the births of new children if remarrying (or re-cohabiting). Whether step-children have the same effect on step-parents mortality as biological children have on their biological parents seems to be an unattended question in previous research. After death of a spouse, of course, the bereaved spouse has daily care alone for possible dependent children, and will also benefit exclusively from possible caregiving from adult children.

The role of adult daughters as caregivers has received widespread attention (see Walker, Pratt and Eddy (1995) for a review), but their effect (or those of adult sons) on all-cause (and cause-specific) mortality of the parents seems to be neglected in the current literature. Specifically, one might assume that the mortality risks of parents with adult daughters living nearby are lower than those of parents with adult daughters living far away or of parents with only adult sons living at any distance away from their parents' home. This hypothesis was supported by the study of Yi and Vaupel (2004) cited above.

Indirect social effects

Children may be a source of social control. Young and dependent children may for example affect their parent's life style (less risk taking) and health behaviors (reduced alcohol intake and smoking, increased physical activity and better nutrition). Kravdal (1995) has found that consumption of alcohol and tobacco is strongly and negatively associated with parity for both sexes in Norway. Not only current, but also anticipated parenthood seems to matter. Hyssala et al. (1992) has for example found that future fathers report a reduction of alcohol consumption and smoking at the onset of their wives' pregnancies. This type of indirect social control may be the result of traditional norms as well comments on lifestyle and health behavior from friend and relatives. Furthermore, parents may of course also be encouraged to take care of their own health in order to live long enough to see their see children and grand-children grow up.

There seems to be important interactions of marital status and the likelihood that children are agents of social control: Umberson (1992a) has shown that for married it is the spouse, but more often the husband than the wife, who is the primary agent of social control, while for the separated/divorced and the bereaved, children are those who most often reminds women to take care of their health, but unrelated persons are those who most often are agents of social control for men. For divorced women, it is not surprising that children are the most important source of social control given the fact that most children lives with the mother after divorce.

Children may also increase parent's external support (help in child care from family, friends, and neighbors) and social relations (contacts with children's friends and their parents in neighborhood, day-care center, school, and after-school activities). Such increase in social integration has been reported to positively affect well-being and negatively affect mortality (Umberson 1987, 1989, 1992a, 1992b). However, it has also been argued that children may reduce opportunities for fulfillment of other roles than being a mother (or a father), and there are certain stresses associated with child rearing, as well as substantial economic costs (Joshi 2002). However, as concluded above the results from previous studies do not find a strong association between multiple role burdens and mortality.

Selection

The third and final explanation in which children may affect parents' mortality is through selection. The idea is that there is selection into parenthood in terms of socio-economic resources, health, values and life-style preferences. Individuals with poor health (e.g. emotionally unstable and/or physically handicapped) may for example become involuntary childless (certain chronic diseases impair fertility) or voluntary choose childlessness or at least limit the number of children, but such individuals, including those of poor socio-economic status, have also lower chances of getting married, staying married and remarry. Young children may induce a healthy life-style in their parents, but may also be a proxy for selection of healthy people into parenthood.

3. The hypotheses in the current paper

Q1. How does the total number (and age) of children that a person has fathered/mothered influence the parents' mortality, given marital status, and does it explain, mediate or confound the effects of marital status? Given the traditional sex-differentials in responsibilities for children, I expect that children "protect" the mother more than the father with respect to premature mortality. By contrasting the findings for women with men I expected to be better able than most previous research reports to distinguish between the pure biological processes related to pregnancy on the one hand, from the life style factors that were influenced by or influenced family size, on the other hand. I further believe to find that marriage, given parenthood, is more important to lower men's than women's mortality.

I include in the analysis age of youngest child as covariate to capture the assumed healthy lifestyle of parents with young children as well as the possible selection of healthy people into parenthood. Age of youngest child may also reflect time since the parent(s) considered himself/herself to be in good enough health to have, care and rare a child. The favorable position married with children have with respect to mortality may actually work trough the negative effect (young) children have on divorce risks (and strains to health associated with divorce). I believe that it is important to differentiate age of youngest child by parity. One may for instance expect that the health of one-child parents is poorer than that of multiparous parents. For one-child mothers, health problems may also be associated with a complicated first-pregnancy and/or delivery that may have prevented or discouraged her from having more children (Grundy and Tomasini 2005). Although Wetherall et al. (1994) and Martikainen (1995) included age of youngest child as covariate in their studies of female mortality, they did not differentiate by parity.

The health-behavior differences (smoking and alcohol consumption) by parity reported by Kravdal (1995), which in turn is known to affect health and mortality, are assumed captured by education in the analysis. However, Kravdal (1995) found that education and two other socioeconomic indices (place of residence and occupation) of women were not good proxies for these life-style differences because the three variables had no impact on the relationship between parity and cancer incidence. Nevertheless, education might be a good proxy for such life-style differences that affects all-cause mortality of not only women, but also men. Education is also important to control for because this variable is generally found to reduce total fertility, but at the same time education also increase propensities to marry, stay married and to remarry.

Q2. Do the children serve as important “buffers” after bereavement and divorce? Because more than 8 out of 10 children lives with the mother after divorce in Norway (Jensen and Clausen 1999), the protective effect of children is supposed to be larger for divorced mothers than divorced fathers. This would be true also after adult children leave the “broken home”, because literature shows that the parent that have had daily care, usually the mother, is the one who also have the most contact with the child in later life (Tomassini et al. 2004); thus, the mother would also be more likely to receive most care in later life which can improve health and prolong life.

4. Data

Dependent variable

The outcome variable is all-cause deaths in the period 1971-2002. The data is from the Norwegian cause of death registry, which is made up of individual death certificates. A national 11-digit personal identification number, used both in the cause of death register and the Norwegian Central Population Register, makes it possible to link the two data sources. The linkage has been carried out by Statistics Norway. The analysis includes 67.014 male deaths and 33.714 female deaths. The distribution of deaths by the relevant covariates is found in results tables 1-3.

Independent variables

The individual-level information used to construct the independent variables in this study is from the Norwegian Central Population Register for the period 1971-2002. The total number of male and female person-years of follow up is respectively 30.181.061 and 28.934.355.

Age of parents. Complete parental histories from the register data could only be constructed for all individuals born in about 1935 or later, covering biological children born (and their dates of birth) in about 1953 or later. For this reason, ages of parents considered in this study is confined to ages from 20 to 67. In the final models, the age-effects were modeled by a linear and quadratic term (age+age^2). In preliminary models five-year age groups were also tried, but this did not affect either the size or the statistical significance of the variables of interest.

Parity. This study analyze the total number of live-born children an individual have ever fathered or mothered, but do not take into account whether a child, dependent or not, lives at home, have died, have left the home or with which parent a child lives (for example after a divorce), nor does the analysis consider effects of possible step-children on mortality. For a very small number of biological children (approximately two per cent), the father’s identity is unknown. Parity is categorized into six categories, childless, 1, 2, 3, 4 and 5+ children.

Age of youngest child is categorized as follows: 0-1 years (41.80%), 2-3 years (9.48% 51.28%), 4-6 years (10.02%), 7-12 years (14.2%), 13-17 years (8.8%), and 18 years and over (15.70%) (ca. 10% in the open ended age-group is in their 20s, and 2.5% is 30 years and older). The age groups were chosen after first inspecting the odds ratios for one-year age groups. Social realties of children were also kept in mind when lumping ages together (infants, day-care age, school-children, teenagers, and finally, adult children).
Marital status is categorized into four distinctive groups: the never married, married, separated/divorced, and widow(er).

Education is categorized in four levels, respectively 9, 10-12, 13-16 and 17+ years of schooling.

5. Methods
The all-cause mortality risks are estimated separately for men and women using discrete-time logistic regression models estimated in SAS. The men and women 20-67 years are followed up in one-year observation intervals starting 1. January 1971. The life courses are censored at the time of emigration or the last date that the data cover (31.12. 2002). The results are presented as odds ratios with 95% confidence intervals. In order to simplify the presentation odds ratios for the main effects of period, age and education is not shown in the tables, but is available from the author on request.

6. Results
With or without children
Non-parents of both sexes have significantly higher mortality than parents in the unadjusted models (M1, table 1; Male OR=2.06; CI 2.03-2.10; Female OR=1.95; CI 1.90-2.00). However, a substantial part of these differences is accounted for after controlling for marital status (and education) (M3, table 1; Male OR=1.32; CI 1.29-1.35; Female OR=1.66; CI 1.66-1.71). This is not surprising given the fact that a majority of the parents are married, while a majority of the non-parents are never married. In the fully adjusted models, it may be seen that parenthood seems to be more beneficial to women than to men. The usual effects of marital status remained in all relevant models (results not shown). In other words, parenthood and marriage affects mortality above and beyond the other.

Number of children
When it comes to parity, for both sexes mortality is highest for the childless and for those with only one child, while the lowest mortality for men is found for those with two children and the lowest mortality for women for those with three or four children (see fully adjusted model in figure 1 and table 1). For childless women and one-child mothers, a substantial part of the differences from the unadjusted model (M1, table 1; Female OR=2.28; CI 2.23-2.33 and OR=1.42; CI 1.38-1.45) are accounted for when marital status (and education) is included (M3, table 1; OR=1.42; CI 1.38-1.45 and OR=1.42; CI 1.38-1.45). The same is also the case for childless men and one-child fathers (see table 1). Childless women seem to have much higher relative mortality than childless men (see figure 1). The usual effects of marital status remained in all relevant models (results not

shown). In other words, parenthood and marriage affects mortality independently of the other.[2]

Marital status and parity

The mortality, given parity 0-4+ for both sexes, are ranked, from the lowest to the highest, in the following order: married, widowers/widows, separated/divorced, while the very heterogeneous never married group falls between the widows/widowers and the separated/divorced (see table 2 and figure 3). As hypothesized, the number of children works as important buffers for the separated/divorced (but also the bereaved) with respect to premature mortality, in particular for women.

When women have children, in particular two or more, the differences between the marital statuses groups seem to be much less compared to when men have children. The differences between the marital statuses groups of men, however, are much larger for the childless and those with only one child compared with men with two or more children (figure 3). To express this finding another way: when men are married, whether he has 1, 2, 3 or 4+ children do matter when it comes to relative mortality, in particular when he is childless, but compared to married women, the number of children matters relatively little. This finding confirm other mortality studies that have found that marriage matters more for men than women, while having children matters more for women than for men. A married woman without children seems to have much higher mortality than a married man without children. This may possible be explained by the failure to live up to the expectations of having children in marriage would be more burdensome for women than for men?

Age of youngest child and parity

Age of the youngest child matters for both sexes: the younger the age of youngest child, the lower is mortality (see table 3 and figure 2). However, interaction of age of youngest child, parity and sex of parents, is important to take into account: relative mortality risks for one-child parents, in particular for mothers, increases much faster by rising age of youngest child compared to higher parities (see table 3, figures 4a-c).

7. Discussion

This paper support previous studies which have found that parents have lower mortality than non-parents (see for example Kobrin and Hendershot 1977, Lund et al. 1990, and Kvåle, Heuch and Nilsen 1994).

Furthermore, the classic U-shape effect of parity on women's mortality reported in previous studies (Lund et al. 1990; Kvåle, Heuch and Nilsen 1994; Grundy and Tomassini 2005; Koski-Rahikkala et al. 2006) is repeated for men, but not for women in the present paper. Like Lund et al. (1990), however, the present study also shows a weak but not significant relationship with increasing mortality among grand multiparous women (5 or more children).

This paper also supports previous findings on the effects of age of youngest child on mortality of females; the higher the age of the youngest child the higher the mortality. To my knowledge, this is the first paper which also demonstrates this mortality pattern

[2] Parity 4 and 5+ was lumped together because the main effects in models M1-M3, see table 1, did not significantly differ from one another.

for males. However, interaction of age of youngest child, parity and sex of parents, is important to take into account: relative mortality risks for one-child parents, in particular for mothers, increases much faster by rising age of youngest child compared to higher parities (see table 3, figures 4a-c). One explanation for this might be that individuals with poor health have impaired fecundity or that they might have chosen to limit the number of children voluntarily because of their poor health status. The reason why this effect was stronger for women than for men may be associated with a complicated first pregnancy and/or delivery (which may or may not be independent of pre-pregnancy health) which can have long-lasting effects on health and mortality – and also prevent or discourage these women from having more children. These effects may not be equal for the different marital groups. Later version of this paper should therefore look into possible interaction effects.

The paper also finds that parenthood plays a more important role in protecting females than males from premature mortality, while marriage seems to protect men more than women with respect to mortality levels. This is also in accordance with previous research (see for example Gove, 1973; Umberson 1987, 1992a; Weatherall et al. 1994; Hemström, 1996; Mamelund 2006). Like Rogers (1996) and Hemström (1996), this paper also demonstrates that the previously married with children is higher compared to the married with children, but also that increasing number of children, in particular for the bereaved, but also for the separated/divorced, works as important buffers with respect to premature mortality. The results for the interactions between parity and the never married group, but also the interactions between parity and the divorced/separated, should be interpreted with special caution because many in these groups may in fact be cohabitants (see Mamelund 2006).

Some of the effects of children on mortality documented in this paper may be a social effect of having adult children. However, perhaps effects of adult children as caregivers (on mortality) are more important at ages beyond age 67, which is also the formal age of pension in Norway.

8. Limitations

There are several possible weaknesses of this study. One is that the register data utilized in the analysis do not include information to control for baseline biological characteristics (e.g. birthweight), self-reported health, pregnancy health, lifestyle (risk taking), and health behavior variables (e.g. alcohol intake, smoking, physical activity, nutrition), religious affiliation, or, for that sake, a rating of satisfaction with life given marital status.

Furthermore, we do not have information on possible sex-differentials in the time spent on child-rearing, nor do we have data on children's visits to older parents or data on the level of external support and social relations that might be associated with parenthood (or marriage). Another possible weakness of this study may be that it does not take into account whether a child has died or not, and with which parent a (dependent) child lives (for example after a divorce). If a child dies, it may increase parent's mortality risks. However, in the study period, 1971-2002, only 1-2% dies before age 20 and only 2-3% before reaching the age of 30 (mortality for children born before start of follow-up 1. January 1971 can of course not be captured, that is mortality for the 1953-cohort from age 0-18 years, mortality for the 1954-cohort from age 0-17 years, mortality for the 1955-cohort from age 0-16 years, and so on). Furthermore, only adult children alive can give care which may affect health and mortality of their parents. When a married woman has dependent children she usually lives with her children, whether they are from first or later marriages. After a divorce more than eight out of ten of women have daily care of her biological children (Jensen and Clausen 1999). In a revision of this paper, a control can be made for whether a married father is married with the mother of any of his dependent biological child(ren) and therefore probably also live with his (first or later) wife and dependent child(ren). This is important because parents living with children may have less negative health behaviors, which in turn may affect mortality, than when they live separately (Umberson 1987).

9. Conclusion

This paper has analyzed the association between parenthood and mortality using very rich individual-level register data covering all people in the ages 20-67 that have ever lived in Norway in the years 1971-2002. For both sexes, the paper finds that parents have lower mortality than non-parents. Furthermore, for both sexes mortality is highest for the childless and for those with only one child, while the lowest mortality for men is found for those with two children and the lowest mortality for women for those with three or four children. Age of the youngest child also matters for both sexes: the younger the age of youngest child, the lower is mortality. However, interaction of age of youngest child and parity is important to take into account: relative mortality risks for one-child parents, in particular for mothers, increases much faster by rising age of youngest child compared to higher parities. One explanation for this might be that individuals with poor health have impaired fecundity or that they might have chosen to limit the number of children voluntarily because of their poor health status. The reason why this effect was stronger for women than for men may be associated with a complicated pregnancy and/or delivery (which may or may not be independent of pre-pregnancy health) which can have long-lasting effects on health and mortality. The paper also finds that parenthood plays a more important role in protecting females than males from premature mortality, while marriage seems to protect men more than women with respect to mortality levels.

10. Future work

A logical follow-up of this paper is to repeat the analysis for few broad groups of causes of death, for example those related to health behavior (cancer, cardiovascular diseases, cirrhosis of the liver), lifestyle (e.g. risk taking; motor vehicle accidents, other accidents) and all other causes of death combined. Furthermore, one may also speculate whether effects of step-children are different from those of biological children. It would also be interesting to analyze whether the protective effect of children is different in later compared to first marriage.

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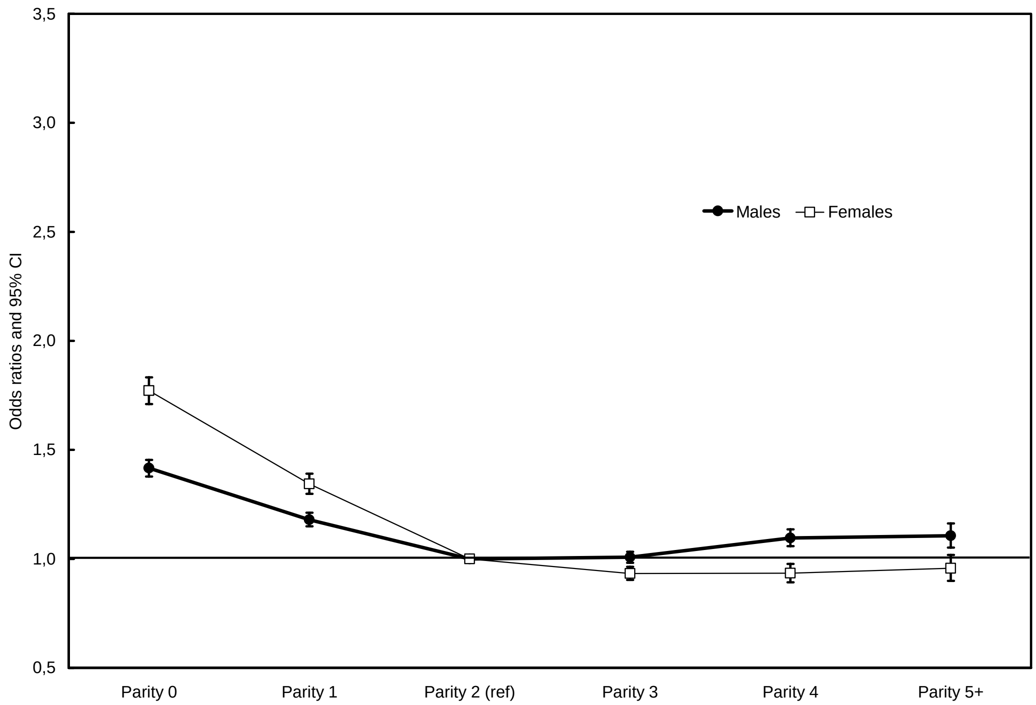


Figure 1. Odds ratios (with 95% CI) for both sexes by parity 1971-2002. Controlling for age, period, marital status and education.

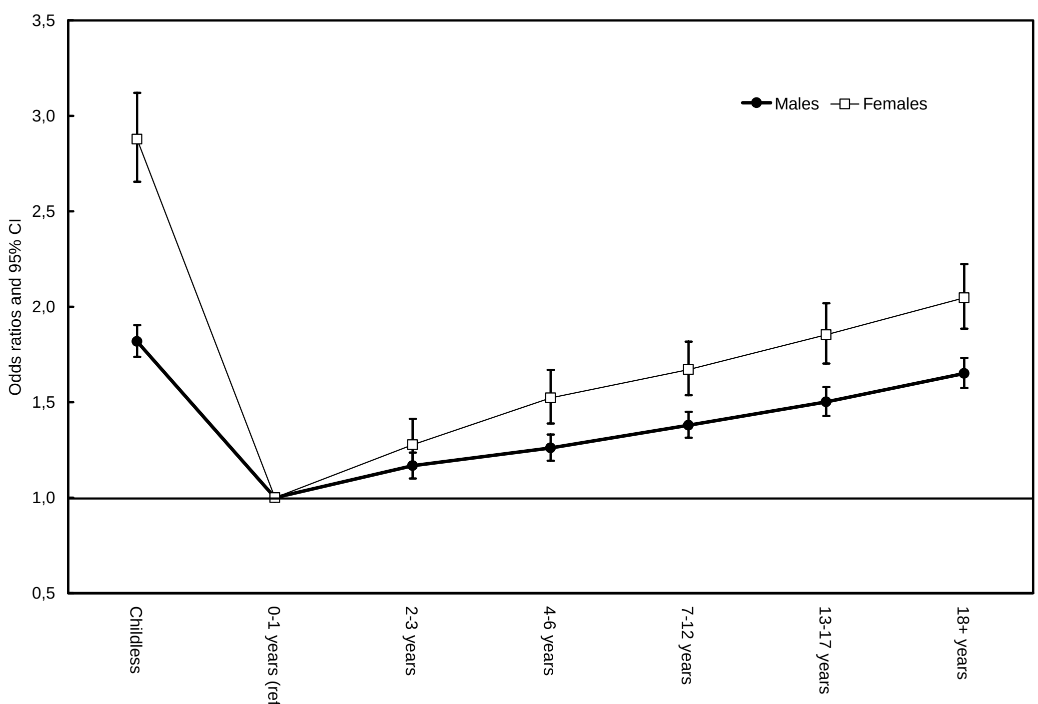
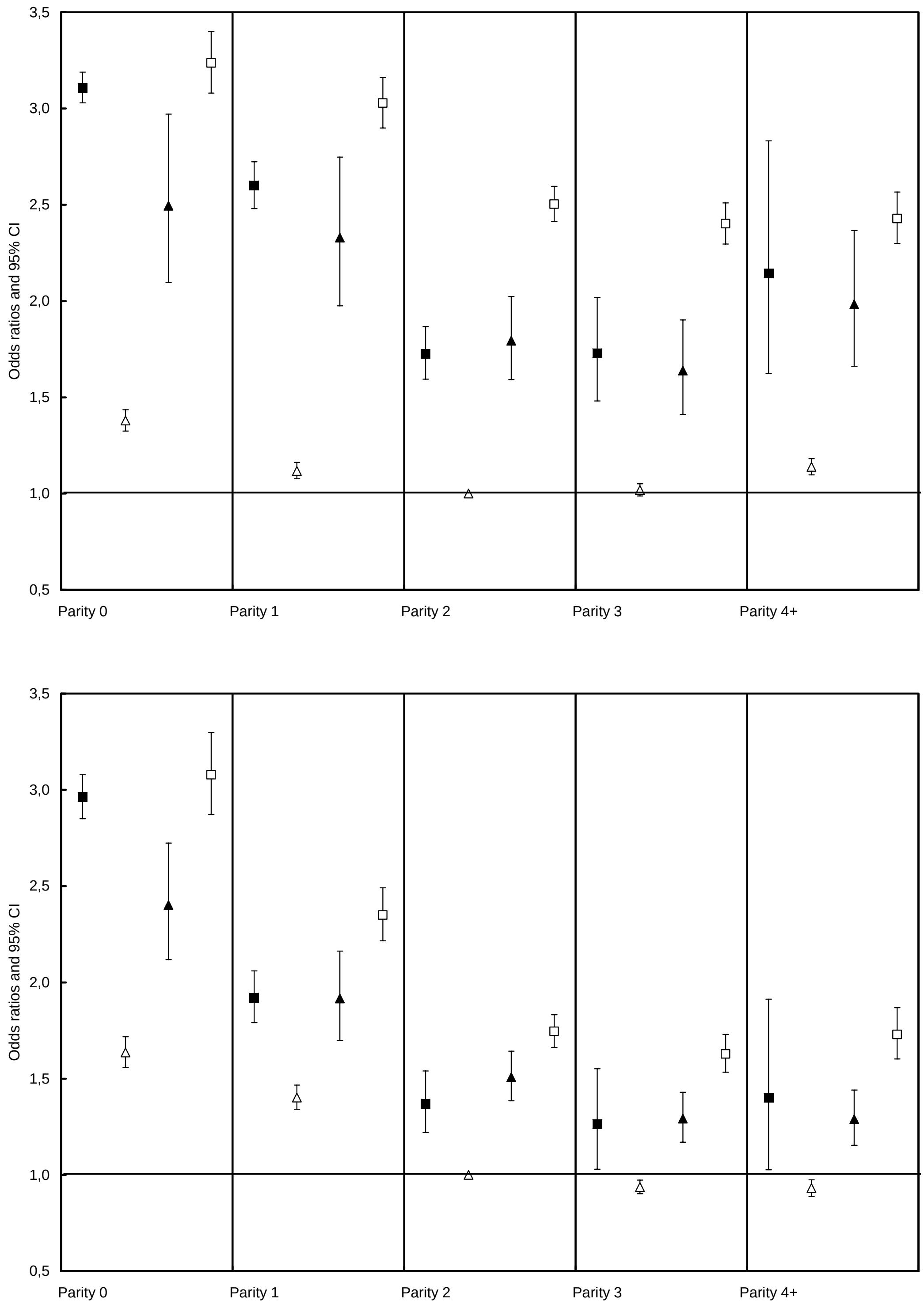


Figure 2. Odds ratios (with 95% CI) for both sexes by age of youngest child 1971-2002. Controlling for age, period, marital status and education



Legends: white triangles = married; black triangle = widower; black boxes = never married; white boxes = separated/divorced

Figure 3. Odds ratios (with 95% CI) for males (upper panel) and females (lower panel) by parity and different marital status groups 1971-2002. Controlling for age, period and education.

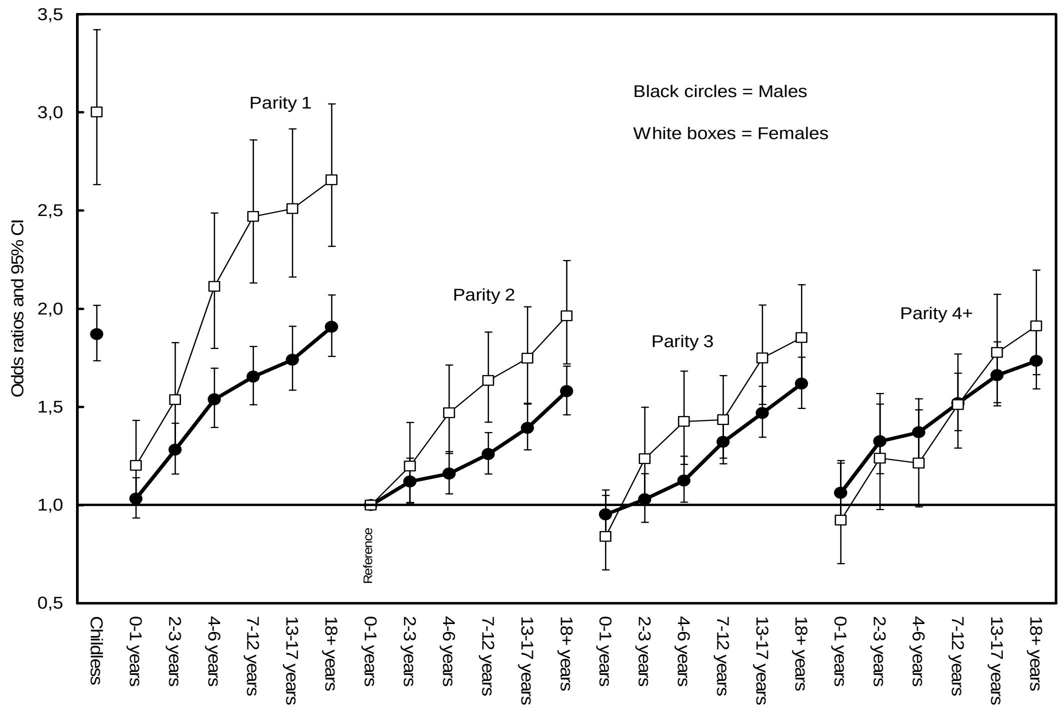


Figure 4a. Odds ratios (with 95% CI) by sex, parity and age of youngest child 1971-2002. Controlling for age, period, marital status and education.

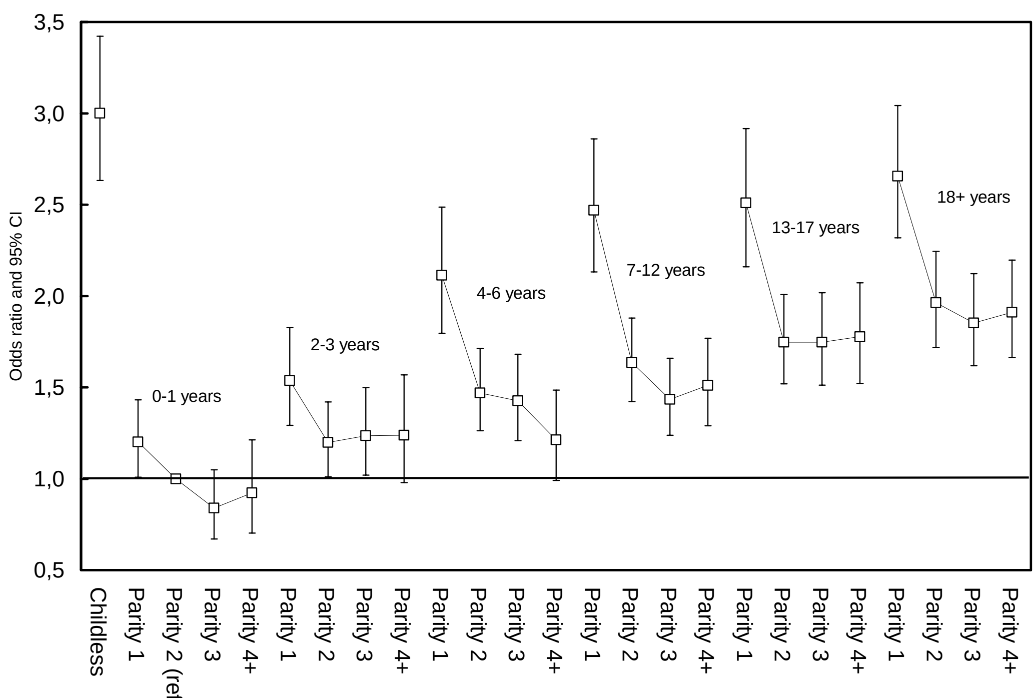


Figure 4b. Odds ratios (with 95% CI) for females by parity and age of youngest child 1971-2002. Controlling for age, period, marital status and education.

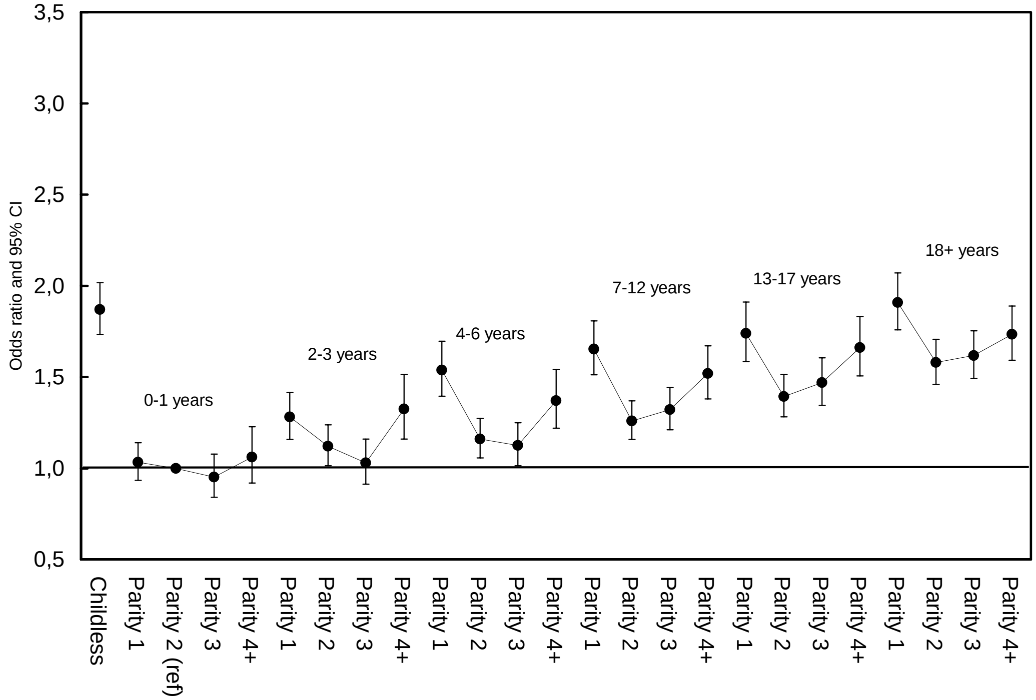


Figure 4b. Odds ratios (with 95% CI) for males by parity and age of youngest child 1971-2002. Controlling for age, period and education.

Table 1. Odds ratios (with 95% CI) by sex, parenthood status, parity, and age of youngest child 1971-2002

		Model 1		Model 2		Model 3	
		Age + period		M1 + marital status		M2 + education	
	Deaths	OR	95% Wald CI	OR	95% Wald CI	OR	95% Wald CI
Parenthood status							
Males							
Non-parent	27 455	2.06*	2.03-2.10	1.33*	1.30-1.36	1.32*	1.29-1.35
Parent (ref)	39 559	1.00	/	1.00	/	1.00	/
Females							
Non-parent	8 888	1.95*	1.90-2.00	1.61*	1.56-1.66	1.66*	1.61-1.71
Parent (ref)	24 826	1.00	/	1.00	/	1.00	/
Parity							
Males							
0	27 455	2.28*	2.23-2.33	1.45*	1.41-1.49	1.42*	1.38-1.45
1	8 767	1.42*	1.38-1.45	1.21*	1.18-1.25	1.18*	1.15-1.21
2 (ref)	15 458	1.00	/	1.00	/	1.00	/
3	9 746	1.00	0.97-1.02	1.04	1.02-0.99	1.01	0.98-1.03
4	3 868	1.15*	1.11-1.19	1.14*	1.10-1.18	1.10*	1.06-1.14
5+	1 720	1.23*	1.17-1.30	1.20*	1.14-1.26	1.11*	1.05-1.16
Females							
0	8 888	2.01*	2.03-2.16	1.75*	1.69-1.81	1.77*	1.71-1.83
1	5 292	1.48*	1.43-1.53	1.36*	1.31-1.40	1.34*	1.30-1.39
2 (ref)	9 754	1.00	/	1.00	/	1.00	/
3	6 229	0.94*	0.91-0.97	0.95*	0.92-0.98	0.93*	0.90-0.96
4	2 414	0.99	0.95-1.03	0.99	0.95-1.04	0.93*	0.89-0.98
5+	1 137	1.07*	1.00-1.14	1.06*	1.00-1.13	0.96	0.90-1.02
Age of youngest child							
Males							
Childless	27 455	2.99*	2.87-3.13	1.84*	1.76-1.93	1.82*	1.74-1.90
0-1 (ref)	2 216	1.00	/	1.00	/	1.00	/
2-3	2 347	1.16*	1.09-1.23	1.17*	1.11-1.24	1.17*	1.10-1.24
4-6	3 225	1.29*	1.22-1.36	1.27*	1.20-1.34	1.26*	1.19-1.33
7-12	6 579	1.43*	1.36-1.50	1.39*	1.32-1.46	1.38*	1.31-1.45
13-17	6 073	1.57*	1.49-1.65	1.51*	1.43-1.58	1.50*	1.43-1.58
18+	19 119	1.78*	1.70-1.87	1.68*	1.60-1.76	1.65*	1.57-1.73
Females							
Childless	8 888	3.77*	3.48-4.07	2.93*	2.70-3.17	2.88*	2.66-3.12
0-1 (ref)	685	1.00	/	1.00	/	1.00	/
2-3	867	1.30*	1.17-1.44	1.29*	1.17-1.43	1.28*	1.16-1.41
4-6	1 441	1.60*	1.46-1.76	1.56*	1.43-1.71	1.52*	1.39-1.67
7-12	3 359	1.81*	1.67-1.97	1.73*	1.59-1.88	1.67*	1.54-1.82
13-17	3 593	2.07*	1.91-2.26	1.93*	1.77-2.10	1.85*	1.70-2.02
18+	14 881	2.45*	2.26-2.66	2.20*	2.03-2.39	2.05*	1.89-2.22

Models controlling for period, age, and education
*P<0.05
Source: Norwegian Central Population Register

Table 2. Odds ratios (with 95% CI) by sex, marital status and parity 1971-2002

		Model 4		Model 5	
Marital status and parity		Age + period		M4 + education	
	Deaths	OR	95% Wald CI	OR	95% Wald CI
Males					
Never married, childless	22 190	3.41*	3.32-3.50	3.11*	3.03-3.19
Never married, 1 child	2 259	2.91*	2.78-3.05	2.60*	2.48-2.72
Never married, 2 children	669	1.92*	1.78-2.08	1.73*	1.59-1.87
Never married, 3+ children	164	1.95*	1.67-2.27	1.73*	1.48-2.02
Never married, 4+ children	50	2.53*	1.92-3.35	2.14*	1.62-2.83
Married, childless	3242	1.44*	1.38-1.50	1.38*	1.33-1.44
Married, 1 child	3 774	1.15*	1.11-1.19	1.12*	1.08-1.16
Married, 2 children (ref)	10 375	1.00	/	1.00	/
Married, 3 children	6 956	1.03*	1.00-1.06	1.02	0.99-1.05
Married, 4+ children	3 941	1.20*	1.16-1.25	1.14*	1.10-1.18
Separated/divorced, childless	1 893	3.51*	3.34-3.69	3.24*	3.08-3.40
Separated/divorced, 1 child	2 589	3.25*	3.11-3.39	3.03*	2.90-3.16
Separated/divorced, 2 children	4 135	2.63*	2.54-2.73	2.50*	2.41-2.60
Separated/divorced, 3 children	2 448	2.57*	2.46-2.69	2.40*	2.30-2.51
Separated/divorced, 4+ children	1 471	2.70*	2.56-2.85	2.43*	2.30-2.57
Widower, childless	130	2.74*	2.31-3.27	2.50*	2.10-2.97
Widower, 1 child	145	2.49*	2.11-2.94	2.33*	1.98-2.75
Widower, 2 children	279	1.88*	1.67-2.12	1.79*	1.59-2.02
Widower, 3 children	178	1.72*	1.48-2.00	1.64*	1.41-1.90
Widower, 4+ children	126	2.19*	1.83-2.61	1.98*	1.66-2.37
Females					
Never married, childless	5 551	2.85*	2.74-2.96	2.96*	2.85-3.08
Never married, 1 child	932	1.97*	1.84-2.11	1.92*	1.79-2.06
Never married, 2 children	303	1.44*	1.28-1.62	1.37*	1.22-1.54
Never married, 3+ children	93	1.37*	1.12-1.68	1.26*	1.03-1.55
Never married, 4+ children	40	1.64*	1.20-2.23	1.40*	1.03-1.91
Married, childless	2 158	1.65*	1.58-1.74	1.64*	1.56-1.72
Married, 1 child	2 730	1.42*	1.35-1.48	1.40*	1.34-1.47
Married, 2 children (ref)	6 712	1.00	/	1.00	/
Married, 3 children	4 456	0.95*	0.92-0.99	0.94*	0.90-0.97
Married, 4+ children	2 433	1.00	0.95-1.04	0.93*	0.89-0.98
Separated/divorced, childless	922	3.12*	2.92-3.35	3.08*	2.87-3.30
Separated/divorced, 1 child	1 352	2.36*	2.23-2.50	2.35*	2.22-2.49
Separated/divorced, 2 children	2 156	1.77*	1.68-1.86	1.75*	1.66-1.83
Separated/divorced, 3 children	1 265	1.70*	1.60-1.81	1.63*	1.53-1.73
Separated/divorced, 4+ children	742	1.92*	1.78-2.08	1.73*	1.60-1.87
Widow, childless	257	2.53*	2.23-2.87	2.40*	2.12-2.72
Widow, 1 child	278	2.03*	1.80-2.29	1.92*	1.70-2.16
Widow, 2 children	583	1.58*	1.45-1.72	1.51*	1.38-1.64
Widow, 3 children	415	1.38*	1.25-1.53	1.29*	1.17-1.43
Widow, 4+ children	336	1.44*	1.29-1.61	1.29*	1.15-1.44

Models controlling for period, age, and education
*P<0.05
Source: Norwegian Central Population Register

Table 3. Odds ratios (with 95% CI) by sex, parity and age of youngest child 1971-2002

		Model 6		Model 7		Model 8	
Parity and age of youngest child		Age + period		M6 + marital status		M7 + education	
	Deaths	OR	95% Wald CI	OR	95% Wald CI	OR	95% Wald CI
Males							
Childless	27 455	3.20*	2.97-3.44	1.91*	1.78-2.06	1.87*	1.74-2.02
1 child aged 0-1	852	1.18*	1.07-1.30	1.04	0.94-1.14	1.03	0.93-1.14
1 child aged 2-3	809	1.48*	1.34-1.64	1.30*	1.18-1.44	1.28*	1.16-1.42
1 child aged 4-6	917	1.98*	1.80-2.18	1.58*	1.43-1.74	1.54*	1.40-1.70
1 child aged 7-12	1 473	2.22*	2.03-2.43	1.70*	1.55-1.86	1.65*	1.51-1.81
1 child aged 13-17	1 154	2.30*	2.10-2.53	1.79*	1.63-1.97	1.74*	1.59-1.91
1 child aged 18+	3 562	2.48*	2.29-2.70	1.99*	1.84-2.16	1.91*	1.76-2.07
2 children, youngest child aged 0-1 (ref)	728	1.00	/	1.00	/	1.00	/
2 children, youngest child aged 2-3	802	1.11*	1.01-1.23	1.12*	1.01-1.24	1.12*	1.01-1.24
2 children, youngest child aged 4-6	1 147	1.18*	1.08-1.29	1.16*	1.06-1.28	1.16*	1.06-1.27
2 children, youngest child aged 7-12	2 409	1.30*	1.20-1.42	1.26*	1.16-1.37	1.26*	1.16-1.37
2 children, youngest child aged 13-17	2 353	1.47*	1.35-1.60	1.39*	1.27-1.51	1.39*	1.28-1.52
2 children, youngest child aged 18+	8 019	1.73*	1.60-1.87	1.59*	1.47-1.72	1.58*	1.46-1.71
3 children, youngest child aged 0-1	386	0.95	0.84-1.07	0.96	0.85- 1.08	0.95	0.84-1.08
3 children, youngest child aged 2-3	426	1.02	0.90-1.15	1.04	0.92-1.17	1.03	0.91-1.16
3 children, youngest child aged 4-6	691	1.13*	1.02-1.25	1.13*	1.02-1.26	1.13*	1.01-1.25
3 children, youngest child aged 7-12	1 654	1.35*	1.24-1.47	1.33*	1.22-1.45	1.32*	1.21-1.44
3 children, youngest child aged 13-17	1 606	1.54*	1.41-1.68	1.48*	1.35-1.61	1.47*	1.35-1.61
3 children, youngest child aged 18+	4 983	1.77*	1.63-1.92	1.65*	1.53-1.79	1.62*	1.49-1.75
4+ children, youngest child aged 0-1	250	1.16*	1.00-1.34	1.11	0.96-1.28	1.06	0.92-1.23
4+ children, youngest child aged 2-3	310	1.44*	1.26-1.65	1.39*	1.22-1.59	1.33*	1.16-1.51
4+ children, youngest child aged 4-6	470	1.51*	1.34-1.69	1.44*	1.28-1.62	1.37*	1.22-1.54
4+ children, youngest child aged 7-12	1 043	1.70*	1.54-1.87	1.60*	1.45-1.76	1.52*	1.38-1.67
4+ children, youngest child aged 13-17	960	1.88*	1.70-2.07	1.75*	1.58-1.93	1.66*	1.51-1.83
4+ children, youngest child aged 18+	2 555	2.03*	1.86-2.21	1.86*	1.71-2.03	1.73*	1.59-1.89
Females							
Childless	8 888	3.93*	3.45-4.48	3.11*	2.73-3.54	3.00*	2.63-3.42
1 child aged 0-1	269	1.26*	1.06-1.50	1.19*	1.00-1.42	1.20*	1.01-1.43
1 child aged 2-3	284	1.66*	1.40-1.97	1.55*	1.31-1.85	1.54*	1.29-1.83
1 child aged 4-6	384	2.48*	2.11-2.92	2.18*	1.85-2.56	2.11*	1.80-2.49
1 child aged 7-12	750	3.02*	2.61-3.49	2.56*	2.21-2.97	2.47*	2.13-2.86
1 child aged 13-17	672	3.12*	2.68-3.62	2.64*	2.27-3.07	2.51*	2.16-2.92
1 child aged 18+	2 933	3.48*	3.04-3.98	2.92*	2.55-3.35	2.66*	2.32-3.04
2 children, youngest child aged 0-1 (ref)	236	1.00	/	1.00	/	1.00	/
2 children, youngest child aged 2-3	298	1.21*	1.02-1.44	1.21*	1.02-1.43	1.20*	1.01-1.42
2 children, youngest child aged 4-6	546	1.53*	1.31-1.79	1.50*	1.29-1.75	1.47*	1.26-1.71
2 children, youngest child aged 7-12	1 324	1.76*	1.53-2.02	1.68*	1.46-1.93	1.64*	1.42-1.88
2 children, youngest child aged 13-17	1 390	1.94*	1.69-2.23	1.82*	1.58-2.09	1.75*	1.52-2.01
2 children, youngest child aged 18+	5 960	2.34*	2.05-2.68	2.12*	1.86-2.42	1.96*	1.72-2.25
3 children, youngest child aged 0-1	114	0.85	0.68-1.07	0.86	0.69-1.08	0.84	0.67-1.05
3 children, youngest child aged 2-3	187	1.27*	1.05-1.54	1.28*	1.06-1.55	1.24*	1.02-1.50
3 children, youngest child aged 4-6	352	1.51*	1.28-1.78	1.49*	1.27-1.76	1.43*	1.21-1.68
3 children, youngest child aged 7-12	815	1.57*	1.36-1.81	1.51*	1.31-1.75	1.43*	1.24-1.66
3 children, youngest child aged 13-17	970	1.98*	1.71-2.28	1.86*	1.61-2.15	1.75*	1.51-2.02
3 children, youngest child aged 18+	3791	2.24*	1.96-2.57	2.04*	1.78-2.334	1.85*	1.62-2.12
4+ children, youngest child aged 0-1	66	1.02	0.78-1.35	1.02	0.77-1.34	0.92	0.70-1.21
4+ children, youngest child aged 2-3	98	1.39*	1.10-1.76	1.37*	1.08-1.74	1.24	0.98-1.57
4+ children, youngest child aged 4-6	159	1.39*	1.14-1.70	1.35*	1.11-1.66	1.21	0.99-1.49
4+ children, youngest child aged 7-12	470	1.78*	1.52-2.09	1.69*	1.44-1.98	1.51*	1.29-1.77
4+ children, youngest child aged 13-17	561	2.15*	1.85-2.51	2.00*	1.71-2.33	1.78*	1.52-2.07
4+ children, youngest child aged 18+	2 197	2.46*	2.14-2.82	2.21*	1.93-2.54	1.91*	1.66-2.20

Models controlling for period, age, and education

*P<0.05

Source: Norwegian Central Population Register