



## Reproductive history and post-reproductive mortality: A sibling comparison analysis using Swedish register data



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### ABSTRACT

A growing body of evidence suggests that reproductive history influences post-reproductive mortality. A potential explanation for this association is confounding by socioeconomic status in the family of origin, as socioeconomic status is related to both fertility behaviours and to long-term health. We examine the relationship between age at first birth, completed parity, and post-reproductive mortality and address the potential confounding role of family of origin. We use Swedish population register data for men and women born 1932–1960, and examine both all-cause and cause-specific mortality. The contributions of our study are the use of a sibling comparison design that minimizes residual confounding from shared family background characteristics and assessment of cause-specific mortality that can shed light on the mechanisms linking reproductive history to mortality. Our results were entirely consistent with previous research on this topic, with teenage first time parents having higher mortality, and the relationship between parity and mortality following a U-shaped pattern where childless men and women and those with five or more children had the highest mortality. These results indicate that selection into specific fertility behaviours based upon socioeconomic status and experiences within the family of origin does not explain the relationship between reproductive history and post-reproductive mortality. Additional analyses where we adjust for other lifecourse factors such as educational attainment, attained socioeconomic status, and post-reproductive marital history do not change the results. Our results add an important new level of robustness to the findings on reproductive history and mortality by showing that the association is robust to confounding by factors shared by siblings. However it is still uncertain whether reproductive history causally influences health, or whether other confounding factors such as childhood health or risk-taking propensity could explain the association.

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## 1. Introduction

In contemporary developed populations a growing body of evidence points to the influence of individual reproductive history on post-reproductive health and mortality. Previous studies have shown that an early age at first childbearing, childlessness, and having many children are associated with higher mortality (Grundy and Tomassini, 2005; Grundy and Kravdal, 2010). The association

between reproductive history and mortality is likely to be the result of multiple biological and social pathways, some of which may operate in opposing directions on health status, and may differ for men and women (Grundy and Read, 2015).

A potentially important dimension of the association may be confounding by early life socio-economic and health factors that increase both the chance of selection into specific reproductive patterns and later mortality. For example, those who become teenage parents are more likely to have grown up in socioeconomically disadvantaged households or non-intact families compared with non-teenage parents (Kiernan, 1997), and education is typically inversely related to both completed fertility (Nisen et al., 2014a), and mortality in adulthood (Torsander and Erikson,

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2010).

Most previous studies on fertility and mortality have attempted to adjust for selection processes by controlling for parental education (Henretta, 2007), or the educational attainment of the index person (Doblhammer, 2000; Grundy and Kravdal, 2008; 2010). However, because detailed data on early life characteristics are often limited, and this is particularly true of the older cohorts that are used in mortality studies, there remains a risk of omitting important selection factors such as early life socio-economic status or family disruption that could produce biased estimates for the relationship between reproductive history and post-reproductive mortality.

We use Swedish population register data to examine the relationship between age at first birth, completed parity, and post-reproductive mortality for Swedish men and women, our index persons, born 1932–1960 over ages 40 to 80. We apply a sibling comparison design to compare mortality amongst siblings who grew up in the same family. Sibling comparisons have been used to investigate the socioeconomic consequences of fertility patterns (Geronimus and Korenman, 1993; Hoffman et al., 1993), but so far only one study has examined the relationship between reproductive history and health outcomes (Einiö et al., 2015). This recent study using Finnish register data found that early fatherhood is associated with increased mortality. However, the study focused only on men, who do not go through the physiological process of childbearing, and mortality at ages 45–54.

### 1.1. Early parenthood and mortality

Previous research has consistently found that women who experience early motherhood, usually defined as giving birth before the age of 20, have excess morbidity and mortality in mid- and later-life (Doblhammer, 2000; Grundy and Tomassini, 2005; Henretta, 2007; Grundy and Kravdal, 2008, 2010; Spence and Eberstein, 2009; Grundy and Kravdal, 2010; Read et al., 2011). The associations are similar for men (Grundy and Kravdal, 2010; Read et al., 2011; Einiö et al., 2015).

There are a number of potential explanations for the association between early age at first childbearing and post-reproductive mortality. Social mechanisms include the interruption of educational and labour market trajectories (Hobcraft and Kiernan, 2001; Kane et al., 2013), and a higher risk of single parenthood and partnership disruption (Hobcraft and Kiernan, 2001), which are associated with worse health (Berkman et al., 2015; Huisman et al., 2003). Socioeconomic selection may also explain part of the association. Teenage parents are more likely to come from deprived backgrounds, disrupted families, and have a lower education level (Kiernan, 1992; Imamura et al., 2007; Raymo et al., 2015), and these factors are associated with worse health in later life (Ploubidis et al., 2014). Men who become young fathers are also more likely to have adolescent educational or behavioural problems (Sigle-Rushton, 2005; Lehti et al., 2012).

It appears that these social mechanisms are particularly harmful to health, as physiological mechanisms actually suggest a protective effect against some health risks. Early pregnancy, childbirth, and breastfeeding are linked to lower risk of breast cancer (Grundy and Kravdal, 2010). The mechanism linking reproductive behaviours to breast cancer in women concerns exposure to estrogen and progesterone, which are produced by a woman's ovaries. These ovarian hormones stimulate cell growth, including the growth of cancerous tissues (Kelsey et al., 1993). Pregnancy and breastfeeding both reduce a woman's lifetime number of menstrual cycles, and thus her cumulative exposure to these ovarian hormones. Pregnancy and breastfeeding also have a direct effect on breast cells, causing them to differentiate, or mature so as to produce milk,

which may reduce the risk of those cells transforming into cancer cells (Russo et al., 2005). Although the same hormonal mechanism also influences the risk of uterine and ovarian cancer, the empirical evidence for the relationship between age at first birth and these cancers is mixed (Merrill et al., 2005; Grundy and Kravdal, 2010). A younger age at first birth has also been associated with cervical cancer (Grundy and Kravdal, 2010), with the mechanism thought to be related to sexual behaviour, a higher number of partners, and increased risk of exposure to human papillomavirus (Merrill et al., 2005).

### 1.2. Parity and mortality

Most studies on the relationship between completed parity and post-reproductive mortality in contemporary populations find a J-shaped or U-shaped relationship, where childlessness, having only one child, and high parities are associated with higher mortality (Doblhammer, 2000; Hurt et al., 2006; Read et al., 2011). However the association for high parity parents varies somewhat between studies, possibly due to contextual or methodological differences (Hurt et al., 2006; Grundy, 2009; Spence and Eberstein, 2009; Hank, 2010). For example, a study using Swedish register data found a small increase in mortality hazard for parents of 6 or 7 children compared to 2 children (Barclay and Kolk, 2015a), while similar studies using Norwegian register data found no evidence for such association (Grundy and Kravdal, 2008; 2010).

Explanations for the parity–mortality association include both physiological and social mechanisms. The disposable soma theory suggests a trade-off between reproduction and longevity (Westendorp and Kirkwood, 1998). The maternal depletion hypothesis also argues for a trade-off between reproduction and longevity primarily through nutritional deficiencies (Winkvist et al., 1992). Repeat childbearing may also have protective physiological effects due to decreased exposure to progesterone and estrogen, which lowers the risk of breast, uterine and ovarian cancer (Merrill et al., 2005) though this could be offset by permanent deficiencies in glucose metabolism, the cardiovascular system, and fat distribution (Lawlor et al., 2003; Lassek and Gaulin, 2006).

Since the relationship between parity and mortality is similar for women and men (Grundy and Kravdal, 2008), social mechanisms are likely to play a substantial role in this relationship. Short birth intervals are associated with higher mortality for both men and women (Grundy and Kravdal, 2014), suggesting that the emotional, psychological and social strains of raising multiple children plays a role in that association. On the other hand children could benefit parents by providing social and emotional support throughout the life course (Grundy and Read, 2012). Nulliparity, low parity (and in men, high parity) are associated with a higher risk of death from diseases stemming from poor health behaviours, including alcohol-related disease, circulatory disease and accidents and death, which could reflect both selection and an absence of social control of health related behaviours from close family members (Grundy and Kravdal, 2010). Childlessness may also be a consequence of an underlying health problem, or social or psychological factors that reduce the likelihood of finding a partner (Kiernan, 1989).

As with the relationship between age at first birth and mortality, the relationship between parity and mortality could be driven by selection mechanisms related to socioeconomic status in the family of origin. For example, childlessness in Sweden, as well as other European countries, is more common amongst women with higher educational attainment (Hoem et al., 2006; Neyer and Hoem, 2009), though the opposite is true for men (Nisen et al., 2014b).

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