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Population Economics

Childbearing History and Mortality in Later Life

*Comparing Men and Women in Southern Sweden,
1766–1895*

Martin Dribe

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Abstract

This paper analyzes the impact of childbearing history on later-life mortality for ever-married men and women using high-quality historical longitudinal microlevel data for southern Sweden. The main advantage of using historical data is that it makes it possible to investigate the experience of many birth cohorts with medium to high fertility, thereby facilitating estimation of the effects of the number of births as well as the timing of first and last births. The dataset also allows a comparison of the effects on men with the effects on women, which is of vital importance when assessing the likely mechanisms underlying the relationship between childbearing history and health in later life. The analysis is made using a Cox proportional hazards model on mortality in ages 50 and older, including covariates on number of births, age at first birth, and age at last birth and also controlling for the socio-economic conditions of the individuals. The results show that number of children ever born negatively affected the survival of women after age 50, while there was no corresponding effect on men, which seems to indicate that women paid most of the price of parenthood, at least in terms of health and longevity.

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Comparing Men and Women in Southern Sweden, 1766–1895

Martin Dribe

Introduction

In recent years the health and mortality of old people has been the subject of much attention. As the proportion of the elderly in the population increases, so does concern about the costs to society of that increase. Many studies focus on prevailing living conditions such as social status or income (e.g. Black et al. 1988; van Doorslaer et al. 1997; Kunst et al. 1998; Mackenbach et al. 1997; Marmot & Wilkinson 1999), marital status (e.g. Joung et al. 1996; Lillard et al. 1996), access to social networks (e.g. House, Landis, & Umberson 1988; Lindström 2000), and behaviors or conditions during adulthood that affect health, such as smoking, diet, exercise, and work conditions (see, e.g., Lindström 2000).

There has also been growing interest in the impact of factors early in life and during the life course on later-life health and longevity. In a highly influential study, Barker (1994) summarized the medical evidence regarding the connection between nutrition during the fetal stage and infancy and health outcomes later in life. Both temporary disturbances in nutritional intake and chronic malnutrition during early life

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can affect health and mortality in adulthood. Similar suggestions were also made in early cohort studies of mortality (Derrick 1927; Kermack et al. 1934). There is now a vast literature in both epidemiology and the social sciences devoted to studying these relationships, stressing the effects of conditions very early in life on health and mortality in adulthood and old age (see, e.g., Barker 1994; Elo & Preston 1992; Fogel 1994, 1999).

In addition to prevailing living conditions and conditions during the fetal stage and in infancy, various events and circumstances during the life course of an individual may have an impact on health (see, e.g., Kuh & Ben-Shlomo 1997). One such life-course factor with potential effects on longevity is childbearing. Within evolutionary theories of aging, for example, it has been argued that there exists a trade-off between reproduction and longevity, for animals as well as humans, because longevity requires investments in body maintenance and repair. Reproduction makes use of resources that could be used for such somatic maintenance and thus competes for resources, with faster aging as a result (Kirkwood 1977; Kirkwood & Holliday 1979). Pregnancy and childbirth also affect hormonal production in women, with potential effects on morbidity and, ultimately, mortality. There have been a great many epidemiological studies, mainly of women in contemporary Western populations, on the connections between reproductive history and later-life health, morbidity, and mortality. The results from these studies clearly show that there are indeed effects from childbearing on later-life health and mortality, although the exact relationship seems to differ with different diseases, different patterns of reproductive history, and different age groups.

This paper investigates the relationship between childbearing history (number of children ever born, age at first birth, and age at last birth) and overall mortality later in life (50–90 years) for a historical population in southern Sweden (1766–1895). The main advantage of using historical data is that it makes it possible to investigate the experience of many birth cohorts with medium to high fertility, thereby facilitating estimation of the effects of the number of births as well as those of the timings of first and last births. It also makes it possible to compare the effects on men with the effects on women. That is of vital importance when assessing the likely mechanisms underlying the relationship between childbearing history and health. Studying the long-term effects of childbearing on the longevity of males as well as the longevity of females can give us new insights into issues of reproductive health and the costs, in terms of health and mortality, of having children. In the empirical analysis a Cox proportional hazards model is estimated for mortality of men and women aged 50–90, including covariates on num-

ber of births, age at first birth, and age at last birth, controlling for the socioeconomic status and the marital status of the individuals.

As already mentioned, there are many epidemiological studies on the relationship between reproductive history and later-life health, morbidity, and mortality, dating back at least to the 1950s (see Kington, Lillard & Rogowski 1997). In a study of self-reported health status of women in the United States (1985–1990), Kington, Lillard, and Rogowski (1997) found a relationship between childbearing history and later-life health. Controlling for socioeconomic status, high parity (6+) had a negative impact on health and physical abilities. Christensen et al. (1998) showed that among Danish female twins aged 73 and older, high parity was associated with a lower tooth count. Although the effect was more pronounced in lower social strata, it was present also in higher social groups.

Studies of overall mortality have found conflicting results of the number of children ever born. Beral (1985) and Friedlander (1996) found higher mortality for parous women than for nulliparous, while in Israel Manor et al. (2000) instead found higher mortality for nulliparous women compared to parous women. Some other studies have found a U-shaped pattern for overall mortality, with the higher mortality for nulliparous women and women of high parity (Green et al. 1988; Doblhammer 2000). Differences in the effects of the number of children on overall mortality can to some extent be accounted for by differences in time periods, samples, study design, and choice of variables, but also by disease-specific differences (see Green et al. 1988; Kvåle et al. 1994). The direction of effects frequently differs not only between different diseases but also between risks of getting the disease and survival after diagnosis.

The risk of breast cancer, for example, seems to be lower for parous women (Magnusson et al. 1999; Lambe et al. 1998), while the survival after diagnosis appears to be lower for parous women than nulliparous (Korzienowski & Dyba 1995). For some other forms of cancer, a higher number of children appears to have a protective effect (Egan et al. 1999; Lochen & Lund 1997; Salvesen et al. 1998), while the effect of number of children on the risk of cardiovascular disease varies between studies (de Kleijn, van der Schouw & van der Graaf 1999).

The effect of age at first birth is also different with different diseases. There is considerable evidence indicating that a low age at first birth (below 20) is associated with worse health status (Kington, Lillard & Rogowski 1997) and higher mortality (Doblhammer 2000). Lower ages at first birth appear to be related to higher risks of pancreatic cancer (Karlson et al. 1998), cancer in the *corpus uteri* (Lochen & Lund 1997),

mortality from hip fractures (Jacobsen et al. 1998), and poorer survival from breast cancer after diagnosis (Kroman et al. 1998), but to lower risks of ischemic heart disease (Cooper et al. 1999) and breast cancer (Kroman et al. 1998) and to lower mortality in cervical cancer (Bjorge & Kravdal 1996).

The effect of age at last birth has not received as much attention as number of children and age at first birth, but Doblhammer (2000) found higher ages at last birth to be associated with lower overall mortality risks, while Cooper et al. (1999) found higher risks of ischemic heart disease for women with higher ages at last birth. Several studies find no relationship between age at last birth and the risk and survival of various forms of cancer (Lochen & Lund 1997; Heuch & Kvåle 2000; Jacobsen, Vollset & Kvåle 1995).

Historical demography has not shown as much interest in these issues. There are a couple of studies investigating the evolutionary trade-off between reproduction and longevity following the “disposable soma theory” (Kirkwood & Holliday 1979), which use historical data. As already mentioned, this theory, derived from evolutionary theories of aging, implies that there exists a kind of evolutionary trade-off between reproduction and longevity, because reproduction demands resources that otherwise could be used for maintenance and repair of cells, with faster aging as a result (see Le Bourg 2001; Gavrilov & Gavrilova 2002 for reviews). Experimental studies have also tried to show that this kind of trade-off exists in nonhuman species (see Kirkwood & Austad 2000; Kirkwood & Rose 1991; Kirkwood 2002). This theory has also been tested on human populations using historical data in different settings and with mixed results. Westendorp & Kirkwood (1998), using a genealogical database of the English aristocracy spanning a period of 1200 years (from 740 to 1875), found that higher numbers of children and lower ages at first birth were associated with lower ages at death for both males and females. However, this study has been quite heavily criticized; its methods and its data, as well as the interpretations of the results, have all been questioned (Gavrilov & Gavrilova 1999; Gavrilova & Gavrilov 2003; see also Le Bourg 2001; Doblhammer & Oeppen 2003). Doblhammer and Oeppen, in their 2003 study using the English peerage data, simultaneously modeled fertility and mortality in order to control for unobserved health differences that might affect the observed link between parity and survival. They found more children to be associated with higher mortality of females aged 50 and older but no statistically significant effect for males.

Lycett, Dunbar, and Volland (2000) used German historical data (eighteenth and nineteenth centuries) to test the same hypothesis. Only

when controlling for duration of marriage did they find a negative relationship between number of children and longevity. The relationship was stronger in lower social strata. In a study mixing data from European aristocratic families and rural Finnish families of the eighteenth to nineteenth centuries, Korpelainen (2000) found that women surviving more than 80 years had borne fewer children than had those who died between ages 50 and 79, but there was no corresponding difference among males. This result is interpreted as supporting the existence of a trade-off between reproduction and longevity. The mixing of families living in highly different contexts may, however, have biased the results. In a re-analysis of the data, Le Bourg (2001) showed that while there was no statistically significant difference in the number of children by age at death among the sample of European aristocrats, there was such an effect among rural Finnish females. What is interesting, however, is that this difference only pertains to the number of children ever born, not to surviving children; regarding the latter, there was no effect on age at death (Le Bourg 2001). Thus, while women surviving beyond age 80 had had fewer children than women dying between 50 and 79, they apparently were better able to rear these children since they did not have fewer surviving children.

Le Bourg et al. (1993) found no link between previous childbearing and longevity in a historical population in Quebec (seventeenth and eighteenth centuries), while Muller et al. (2002) found increasing number of children to actually increase longevity in a French-Canadian cohort of women from the seventeenth and eighteenth centuries. Later ages at last birth also increased longevity. In a historical setting, with no parity-specific fertility control, higher age at last birth is probably related to higher age at menopause, which may indicate the individual is aging more slowly or is positively selected in terms of health in one way or another (see Doblhammer 2000). These results suggest that a higher than average reproductive potential may be related to better health and thus a longer life.

Moreover, recent findings for a Sami population in Finland (seventeenth to nineteenth centuries) showed that it was only the number of sons ever born that had had a negative effect on female longevity, while the number of daughters appeared to have been positively associated with maternal survival (Helle, Lummaa & Jokela 2002). This difference, according to the authors, could result from any or all of several factors: the higher physiological costs of giving birth to sons (faster intrauterine growth, higher birth weight, and longer time to reproduction), the higher levels of testosterone in mothers giving birth to sons (which may adversely affect the immune system and ultimately lead to earlier death),

and the role of daughters in the family economy (helping their mothers both with child care and with household production). Replicating the analysis for German and Canadian historical populations, Beise and Voland (2002), however, found conflicting results in the two populations; they also found that social status affected the results, which led them to question the conclusions of Helle, Lummaa, and Jokela.

From a different point of departure, Alter et al. (2002) also studied the relationship between childbearing history and later-life mortality among women in nineteenth-century rural Belgium, without finding any relationship between number of births and mortality risks after age 50. Similar findings were also made by Knodel in his impressive study of 14 German villages in the eighteenth and nineteenth centuries, where there was no association between children ever born and age at death for women over 45 (Knodel 1988: 114). In the Belgian case, however, early age at first birth and late age at last birth, were both related to lower mortality in old age, which was interpreted as a selection effect in terms of health (Alter et al. 2002).

Thus, there is mounting evidence that previous childbearing may affect women's health status in old age. Considerably less attention, however, has been paid to whether the later-life health of men is also affected by their childbearing history. This question is interesting for several reasons. One is simply that knowing the answer may tell us something about the likely mechanisms underlying the connection between childbearing history and longevity. If women and men are affected similarly by their reproductive experience, then the strictly biological/physiological effects of childbearing on women seems less convincing as an explanation of the effects of childbearing on health, and more attention should probably be given to psychosocial and economic factors.

Especially in preindustrial societies, having children can be of vital importance for security in old age (see, e.g., Cain 1981; Lee 2000; Stecklov 1999), and children are also highly valued assets in family production in many agricultural societies (e.g. Cain 1977; Mueller 1976). In fact, the economic and social benefits of having children are often viewed as the underlying cause of high fertility in preindustrial populations (e.g. Caldwell 1982; Easterlin & Crimmins 1985). Studying the relationship between childbearing and longevity for men as well as women may tell us something about who bears the main costs of having these highly valuable assets.

Studies of the relationship between childbearing and longevity for males have come up with somewhat mixed results, although in most cases childbearing affects women more often and more strongly than it

does men. For example, Friedlander (1996) in her study of Californians from the 1970s to the 1990s found clear effects of previous childbearing on women's survival but not on men's. Christensen et al. (1998) found that for women but not for men many children tended to mean fewer teeth. Ptok, Barkow, and Heun (2002) found an increased risk of Alzheimer's disease among women who had experienced childbirth, but no corresponding effects for males. On the contrary, Westendorp and Kirkwood (1998), in their study of the English peerage, found similar patterns for males and females, indicating a negative effect of childbearing on longevity for both men and women, while Doblhammer and Oeppen (2003), using similar data but a different methodology, found statistically significant effects only for females.

Area and data

The dataset is based on family reconstitutions carried out within the Scanian Demographic Database¹ for nine parishes in western Scania in southern Sweden. The sample used here is four of these nine parishes: Hög, Kävlinge, Halmstad, and Sireköpinge. They are located about 10 kilometers from the coast in the western part of Scania, the southernmost province of Sweden. The social structure of the parishes varied somewhat. Hög and Kävlinge were dominated by freeholders and by tenants on crown land, a group rather similar to the freeholders in its social characteristics, while Halmstad and Sireköpinge were totally dominated by tenants on noble land (see Dribe 2000). Besides the peasant group, the parishes also hosted various landless and semi-landless groups, dependent on working for others to cover the subsistence needs of the family. In 1766 the four parishes had 1310 inhabitants. By 1894 that figure had increased to 3866: an average annual increase of 0.8 percent during this 128-year period, which is a somewhat faster rate of growth than for Sweden as a whole during the same period, 0.7 percent per year (Statistics Sweden 1999: 10).

From the final decades of the eighteenth century onward, mortality in Scania, like that in Sweden as a whole, was falling among infants and children. Life expectancy in 1750 was about 35 years; in 1850 it was 45 years; in 1900, 55 years (Statistics Sweden 1999). Old-age mortality (50–80) was also declining in the area between the eighteenth and nineteenth centuries, but the decline was not secular due to an increase in the

¹ The Scanian Demographic Database is a collaborative project between the Regional Archives in Lund and the Research Group in Population Economics at the Department of Economic History, Lund University. The source material is described in Reuterswärd and Olsson (1993), and the quality of data is analyzed in Bengtsson and Lundh 1991.

1830s and 1840s (Bengtsson & Lindström 2000). Sweden as a whole appears to have witnessed a somewhat faster mortality decline in old age than western Scania, although most of this decline took place after 1850 (see Statistics Sweden 1999: 116).

The family reconstitutions were carried out using data on births, marriages, and deaths, for the period from the late seventeenth century until 1894. The material is of high quality, with only a few years missing. The reconstitutions were carried out automatically using a computer program. They have also been checked manually and compared with other sources, mainly the poll-tax registers and the catechetical examination registers. The method used has been described and evaluated in considerable detail in previously published work and need not be reproduced here. Suffice it to say that the performance of the method seems satisfactory overall (Bengtsson & Lundh 1991). The database contains all individuals born in, or migrating into, the parishes. Instead of sampling a certain stock of individuals, for example a birth cohort, each individual chosen for the sample is followed from birth, or time of immigration, to death, or out-migration.

The male-to-female sex ratio at birth for the period 1766–1865 is 1.09 (Bengtsson & Dribe 2002), which indicates that some births of daughters may have gone unrecorded. Four percent of all births are stillbirths (Bengtsson & Dribe 2002), which can be considered normal. The quality of the death records seems very high.

To learn where the families lived and whether they had access to land, the poll-tax registers (*mantalslängder*) were used (see Dribe 2000: ch. 2). They were compiled yearly and show the size of each landholding, the type of ownership (i.e., manorial, crown, church or freehold), and the number of servants and lodgers. Land registers (*jordeböcker*) have been utilized to clarify the ownership of land. Data from these two kinds of registers have been linked to the reconstituted families. Thus the history obtained for each family includes demographic events and economic realities. For the years before 1766, some registers are missing. That is why we began our investigation with the year 1766.

Scania was characterized by a rather typical (Western) European marriage pattern (Hajnal 1965; see Lundh 1999). Age at marriage was quite high; around 30 years for males and 28 for women. Mean ages at marriage seem to have declined from the eighteenth to the nineteenth century, which may reflect an increasing demand for labor that made it easier for young people to marry. A fairly high proportion of people (10 to 15 percent) never married. That proportion declined, at least for males, in the mid-nineteenth century (Dribe 2000: 68), which is yet another indication of easier access to marriage (Lundh 1999).

The total fertility rate (TFR) was slightly above 5 during most of the period under study, which is somewhat higher than for Sweden as a whole. Total marital fertility (TMFR) in Scania was above 9, while the rates for women over 20 were around 7 (Bengtsson & Dribe 2002). The level of marital fertility for Sweden as a whole was somewhat higher, although the differences are not very large, which implies that the higher total fertility rates for Scania compared to Sweden as a whole stem from differences in the proportion of married individuals rather than differences in marital fertility.

Swedish fertility did not start its secular decline until about 1880 (e.g. Carlsson 1966). Therefore, most of the women aged 50 and above in this study, which covers the period 1766–1895, were never affected by the decline.

A previous analysis of the fertility patterns in the area could not find any indications of parity-specific fertility control (Bengtsson & Dribe 2002), which is also in line with many other studies of pretransitional populations in Europe (see, e.g., Coale and Watkins 1986; Knodel 1977; Wrigley et al. 1997). However, when it comes to the impact of short-term economic stress (as measured by grain price variations) the seasonal pattern of the fertility response suggests that it mainly resulted from a deliberate postponement of childbirth, rather than a passive response to malnutrition or spousal separation following migration (Bengtsson & Dribe 2002).

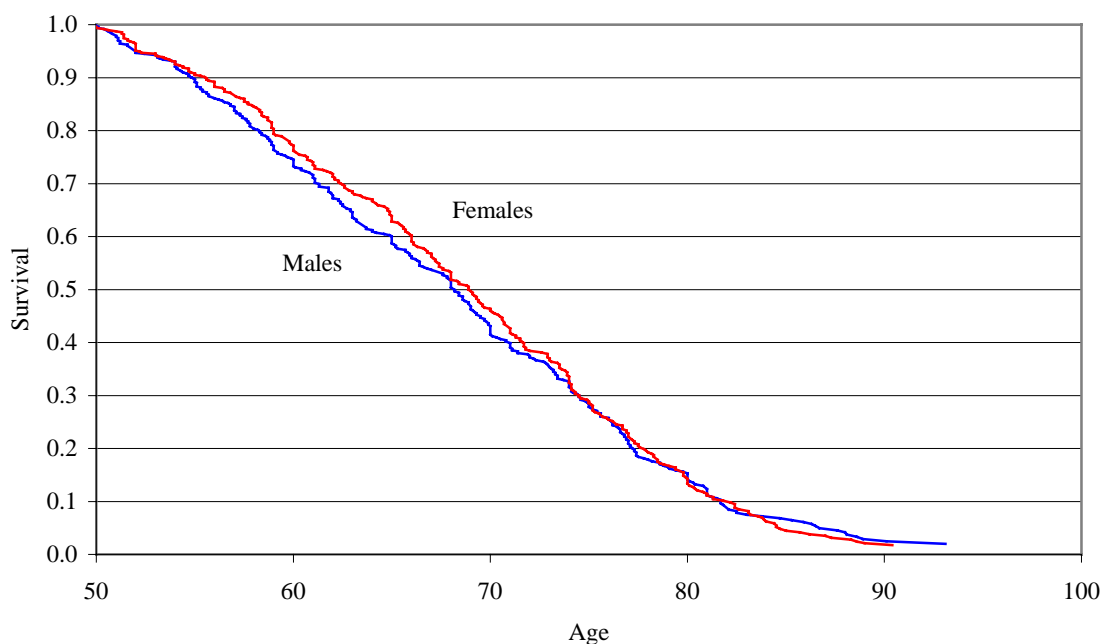
Statistical method and model

The risk of death in the age group 50–90 is modeled as a Cox proportional hazards model with number of children ever born, age at first birth, age at last birth, social status at age 50, marital status, and parish of residence as the explanatory covariates. Separate models are estimated for males and females. The model can be written as:

$$h_i(t) = h_0(t)e^{\beta X_i}$$

where $h_i(t)$ is the individual hazard of death at age t , $h_0(t)$ is the baseline hazard, i.e. the hazard function for an individual with the value zero on all covariates, and β is the vector of parameters for the covariates (X_i) in the model (see, e.g., Therneau & Grambsch 2000). The distinguishing feature of the Cox model is that it does not require a specification of the

Figure 1. Kaplan-Meier estimates of the survival function in ages 50 and older in the four parishes 1766–1895.



Source: The Scanian Demographic Database.

baseline hazard function. We are only estimating the differences between groups in the risk of death, assuming that hazards between groups are proportional in the age span under consideration.²

The sample consists of men and women aged 50 to 90 living in the four parishes described above. In order to study the entire reproductive history of men and women, it is important to have them under observation during their entire reproductive span. However, given the nature of the data, if we include only those individuals of whose histories we can be certain from their fifteenth birthday onward, that will create a selection bias, because we could only include people born in the parish and remaining there for the rest of their life or at least beyond age 50. There would also be difficulties in following up on all never-married

² In order to test the validity of this assumption the test proposed by Therneau & Grambsch (2000: 130-135) was used (using the 'cox.zph' function with 'coxph' in R/S-Plus). By and large the test showed that hazards for females were reasonably proportional (the null-hypothesis of proportionality could not be rejected at the 5 percent level), although the individual p-values for two subcategories (8+ children ever born and age at last birth over 45) were below 0.1 (0.07 and 0.06 respectively). For males, age at first birth: 30–35 and marital status: previously married were non-proportional.

Table 1. Descriptive statistics of survival functions for the sample (50–90 years).

	Events	Mean	se(mean)	Median	95 % C.I. Low	95 % C.I. High
Males	381	68.3	0.501	68.2	66.4	69.5
Females	367	68.8	0.488	68.9	67.4	70.6

Source: Scanian Demographic Database.

adults in the data. Taken together, these considerations led us to narrow our focus to the ever-married population. Thus, instead of studying the reproductive history of all men and women during their entire reproductive span, the sample is limited to the ever married. To make sure that we can capture the entire reproductive history of these men and women, we have included in the sample only those whose first marriage took place in the parish. Fortunately, the marriage records tell if either party is a widow or widower.

Figure 1 shows the survivor function for males and females in the sample. Although males have slightly higher mortality in younger ages, the differences are by no means large. The median survival age is 68.1 for males and 68.9 for females according to table 1.

Table 2 displays the covariates included in the estimated model and the percentage distribution among the individuals (of time at risk). Social status at age 50 is measured at the family level implying, for example, that spouses to landholding peasants are also seen as belonging to the same social group. In most cases this covariate reflects access to economic resources in old age in a better way than current social status, because it is difficult to account for the different retirement arrangements used in preindustrial society. Because people normally became landless as they grew older, using current social status would distort matters, making it difficult to distinguish former peasants with retirement contracts from people who had been landless for a long time.

The different peasant groups faced quite different conditions. Freeholders owned their land and paid tax to the crown, while crown tenants rented land from the crown. In several respects they faced similar conditions; for instance, both were quite dependent on the

Table 2. Percentage distribution of covariates.

	Males	Females
Social Status at age 50		
Freeholder/Crown tenant	12	12
Noble tenant	24	15
Semi-landless	33	39
Landless	31	35
Total	100	100
Children ever born		
0	0.2	0.3
1	8	8
2	10	10
3	10	14
4	12	9
5	15	11
6	11	14
7	12	13
8	10	9
9	5	5
10+	9	7
Total	100	100
Age at first birth		
<25	11	32
25-30	36	38
30-35	29	20
35+	23	10
Total	100	100
Age at last birth		
<35	13	16
35-40	19	33
40-45	25	43
45+	43	8
Total	100	100
Marital status		
Currently married	76	55
Previously married	24	45
Total	100	100
Parish of residence		
Hög	21	24
Kävlinge	17	17
Halmstad	31	28
Sireköpinge	31	32
Total	100	100
Total time (years)	7733.7	7749.9

market. Noble tenants farmed land belonging to a noble estate owner and were thus part of a manorial system. At least up until the mid-nineteenth century they paid most of their rent as labor rent, working on the demesne (the land farmed by the noble landowner himself). During the second half of the nineteenth century, a gradual replacement of labor rent by rents in money took place, which equalized the conditions faced by all the peasant groups to a certain extent (see, e.g., Olsson 2002).

It is, however, by no means clear that these differences between the various peasant groups also led to marked differences in their standards of living. Previous studies on the demographic characteristics of the groups have indicated that they appear to have had much in common, especially when they are compared with the landless (Dribe 2000; Bengtsson & Dribe 2000, 2002).

Besides the landholding peasants, there were also groups of landless and semi-landless people. The latter group in particular is quite difficult to classify, partly due to lack of information in the registers on, for instance, the sizes of their landholdings. Here peasants with land below subsistence level (see Dribe 2000: 27) have been grouped together with crofters (*torpare, gatehusmän*), who, at least in some cases, also had a plot of land, into one group of semi-landless. The landless group consists of landless laborers in agriculture as well as artisans and soldiers without land. According to table 2, around 60 to 70 percent of the sample belonged to the landless and semi-landless groups.

The childbearing history is measured by three separate covariates: children ever born, age at first birth, and age at last birth. Few individuals had no children at all, which is not surprising, since only ever-married individuals are included in the sample. Mean number of children ever born in the sample is about 5 (table 3), which corresponds fairly well with the total fertility rate (TFR) in the area under study, while it is somewhat lower than the period total marital fertility rates in ages 20–50 (TMFR20), which was around 7 (Bengtsson & Dribe 2002). It should probably be somewhat higher than TFR, since only ever-married women are included in the analysis, but also somewhat lower than TMFR20, because mean age at marriage was between 25 and 30, and fertility rates for women marrying early were usually quite high, thereby inflating TMFR. For example, in the area of concern in this paper, TMFR for women marrying after age 25 was 5.7, while the corresponding figure for women marrying before age 20 was 8.6 (Bengtsson & Dribe 2002: 18). One reason behind the somewhat low number of children ever born for women included in the sample could be a certain

Table 3. Descriptive statistics of childbearing history for males and females in the sample.

	Males		Females	
	Mean	St. Dev.	Mean	St. Dev.
Children ever born	5.0	2.8	5.3	2.8
Age at first birth	31.3	6.4	27.5	5.4
Age at last birth	41.9	6.3	39.0	4.8
N	525		498	

Source: The Scanian Demographic Database

under-recording of previously married in the marriage records, implying that a small number of previously married have been wrongly registered as marrying for the first time. Another reason could be a selection bias in the sample stemming from an over-representation of more sedentary families, due to the necessity of limiting the sample to individuals for whom we have information for their entire reproductive history. There are some indications that women migrating into the parishes had somewhat higher fertility than women born in the parishes, which seems to lend some support to the idea of there being this kind of selection effect (Bengtsson & Dribe 2002: 24). Mean age at first birth is 31.3 for males and 27.5 for females, which corresponds fairly well with the mean ages at marriage in the area (Lundh 1999). Mean age at last birth is 41.9 for males and 39.0 for females, which also seems reasonable.

The model also controls for marital status, which could be an important factor behind mortality in old age (see, e.g., Nystedt 2002). Twenty-four percent of male exposure and 45 percent of female exposure was spent as widower or widow. Finally, parish of residence is included in the model in order to control for potential differences between the parishes not captured by the other covariates in the model.

Results

Table 4 displays the results of estimating the Cox proportional hazards model. There is a positive effect of number of children ever born on female mortality, but no corresponding effects for males. Only the effect for 4–5 children is statistically significant, but judging from the size of the coefficients, the big increase in mortality from previous childbearing comes between parity 2–3 and 4–5. In parities over 5 the effects are again smaller and not statistically significant. Thus, it appears as if having more children increased mortality among women later in life and

Table 4. Cox proportional hazards estimates of mortality (ages 50–90) in the four parishes 1766–1895.

	Males		Females	
	Relative risk	p-value	Relative risk	p-value
Children ever born				
0-1	1.00	reference	1.00	reference
2-3	0.99	0.99	1.07	0.77
4-5	0.92	0.76	1.99	0.0077
6-7	0.88	0.66	1.37	0.26
8+	0.82	0.51	1.42	0.24
Age at first birth				
<25	1.00	reference	1.00	reference
25-30	0.91	0.61	0.94	0.69
30-35	0.93	0.70	1.18	0.32
>35	0.91	0.67	1.12	0.68
Age at last birth				
<35	1.00	reference	1.00	reference
35-40	1.01	0.95	0.91	0.60
40-45	1.05	0.83	0.96	0.84
>45	1.45	0.13	1.16	0.58
Social status at age 50				
Freeholder/Crown ten.	1.00	reference	1.00	reference
Noble tenant	0.62	0.022	1.12	0.62
Semi-landless	0.95	0.78	0.84	0.37
Landless	0.84	0.33	0.87	0.47
Marital status				
Currently married	1.00	reference	1.00	reference
Previously married	1.52	0.0004	1.14	0.26
Parish				
Hög	1.00	reference	1.00	reference
Kävlinge	1.13	0.47	1.26	0.19
Halmstad	1.18	0.31	1.39	0.048
Sireköpinge	1.18	0.30	1.13	0.45
Events	381		367	
Likelihood ratio test	29.4		28.1	
df	17		17	
Overall p-value	0.031		0.043	

that the strongest effect is found in parity 4 and 5. It is impossible to show a similar effect for males, indicating that, at least in this respect, women were paying most of the price of having children. This also seems to indicate that the mechanisms behind the negative effect of childbearing might well be connected to female-specific physiological/biological effects of pregnancy and childbirth, although it might

also be connected to social factors as long as they have a stronger impact on women. In other words, it may well be the case that women paid a higher price for having children because of the physical hardships of childbearing and childrearing conjoined with their work in the household or in the market. But it could also be the case that women suffered from different kinds of physiological degradation, hormonal changes, or other factors leading to increased mortality in various diseases, as indicated by the contemporary epidemiological literature discussed above.

There are no statistically significant effects of age at first birth neither for males nor for females. For age at last birth there might be a positive effect on mortality of having children after 45, but it is not statistically significant. What is interesting, however, is that the effect is stronger for men than for women.

Turning to the control variables, male noble tenants show lower mortality than other social groups, while no similar effect can be discerned for women. Marital status also affects the risk of mortality, especially for males. Being a widow increases mortality after 50 by over 50 percent. Similar gender differences have also been found in several other studies of marital status and mortality (see Nystedt 2002).

Discussion

As we have seen, childbearing is a life-course experience that may have important effects on health and mortality, not only immediately following childbirth but also in the longer term. There have been a large number of studies demonstrating that such long-term effects of childbearing on health and mortality actually exist in both contemporary and historical populations.

The results presented here also show that people in historical Sweden were affected by their childbearing history. Number of children ever born affected old-age mortality for women but not for men, while no effect of age at first birth or age at last birth could be shown, neither for men nor for women.

There can be several explanations behind these results. First, number of children ever born may affect women's health through hormonal changes following childbearing (e.g. estrogen levels), which in turn may affect morbidity and mortality of different diseases. However, such effects often seem to be protective, lowering rather than increasing female mortality, and they frequently also seem hard to prove empirically (e.g. de Kleijn, van der Schouw & van der Graaf 1999; Korzeniewski & Dyba 1994; Ness et al. 2000). The observed negative effect of parity on women's longevity could perhaps also be seen as

support for the idea of an evolutionary trade-off between reproduction and longevity, as was discussed above. However, the fact that we could demonstrate an effect only for females appears to make it less likely that natural selection of genes favoring either reproduction or longevity, as envisaged by the evolutionary theories, could be a main explanation. It may, however, be possible that the same kind of trade-off between reproduction and longevity is present at the individual level, if childbearing uses up resources that otherwise would have been available for body maintenance and repair (Kirkwood & Rose 1991). Such an individual-level trade-off could be expected to affect women more than men and would thus be in accordance with our findings, but there appears to be some skepticism in the literature regarding this kind of trade-off at the individual level (Le Bourg 2001).

The higher mortality of women with more children could also result from the physical depletion arising from repeated pregnancies and childbirths combined with hard physical labor. The comparatively high rate of maternal mortality in preindustrial society is another indication of the negative effects for women of childbearing. While contemporary Western countries typically have maternal mortality ratios (deaths of mothers per 100,000 live births due to complications of pregnancy and delivery) below 10, many developing countries in sub-Saharan Africa and some places in Southeast Asia show figures between 500 and 1000 (UNFPA 1999: 67-69). Equally high levels of maternal mortality characterized preindustrial Western Europe between 1750 and 1850 (Wrigley et al. 1997: 314).

Finally, it is conceivable that various social and economic factors related to childbirth could lay behind the negative effects of childbearing/childrearing on health. For example, to the extent that having more children implies a financial burden on the family, higher parities could be connected to poorer health and higher mortality. In a preindustrial context, however, this is not likely to be the case. Quite the contrary, having more children should in most cases probably be seen as a marker of higher economic status (e.g. Bengtsson & Dribe 2002). Moreover, the fact that it is only the mortality of women that is affected by the number of children ever born, makes it less likely that the underlying mechanisms are to be found in these kinds of social and economic factors.

Thus, the fact that we found an effect of previous childbearing for women only seems to indicate that we should turn our attention primarily to female-specific conditions when looking for an explanation. With the data available in this study, it is impossible to distinguish the purely physiological/biological mechanisms from the depletion mechanisms discussed above. We do not have cause-specific data in sufficient

detail for a large enough population to determine which diseases were most affected by previous childbearing. There are, however, some possibilities for doing future analyses on a cause-specific level (see Bengtsson & Lindström 2000), and such studies may shed light on this issue.

It may also seem quite surprising that we cannot find any effects of the timing of first and last births on long-term mortality. It is easy to imagine that, particularly for women, starting early and stopping late would impose higher levels of stress and hardship, with corresponding effects on health and mortality later in life. It should also be noted that the results do not depend on other control variables in the model estimated; almost exactly the same effects are produced when children ever born are not controlled for. As was mentioned previously, some studies have found negative effects on mortality of higher ages at last birth for women, which they have attributed to selection effects (e.g., Doblhammer 2000; Alter et al. 2002). Higher ages at last birth in a population not practicing contraception should indicate higher ages at menopause, which in turn could be seen as a marker of better health. However, this study shows no such effects for women in preindustrial Sweden.

Conclusion

Children were precious assets in the preindustrial household-based economy. They contributed to production by starting to work at an early age, although there are some diverging views in the literature as to just how much that contribution actually offset the costs of rearing children (see, e.g., Cain 1977; Caldwell 1981; Kaplan 1994; Lee 2000). In preindustrial society the household was also the most fundamental welfare-producing institution, and children were very important in this respect, providing security for their parents in times of sickness and in old age. Among landholding peasants, parents frequently retired well before they died, handing over the farm to the younger generation in return for some kind of retirement benefits (e.g. Gaunt 1983). Among the landless groups, too, children doubtless played an important role in looking after their parents in old age, although we know much less about the retirement arrangements among the landless than we do about those among the landholding peasants.

This high demand for children is also evident in the rather high fertility rates in this society. It was clearly advantageous to have many children, and families did not limit their fertility deliberately after producing a certain number of children. It may even have been the case that

the supply of children (given the level of natural fertility and infant and child mortality) was lower than the desired number of children (i.e., the demand) (cf. Easterlin & Crimmins 1985).

However, children are expensive as well as valuable. The economic literature on fertility has been largely devoted to modern societies where the costs of rearing children are comparatively high and are often argued to be the main reason for low fertility. There are both direct costs of rearing children (food, clothing, education, etc) and indirect costs, such as the value of women's time rearing children (see, e.g., Becker 1991). In preindustrial society the latter costs were often not as important, since most of the production occurred at the household level, and child care did not interfere with that production to the same extent as it does today. Similarly, the costs of education were very low or nonexistent.

There is, however, a physical cost of having and rearing children. One aspect of this health cost of childbearing is maternal mortality, which was more than a hundred times higher in preindustrial Europe (and in some of today's developing countries) than it is in the contemporary Western world. In addition, as has been shown in this paper, a number of studies in both contemporary and historical settings have also pointed to negative long-term effects of childbearing on health and longevity, especially for women, but sometimes also for males. The analysis in this paper shows that number of children ever born had a negative impact on female longevity after age 50 for ever-married women but could not show a corresponding effect for males. The exact mechanisms behind this long-term effect of childbearing on health and longevity are difficult to pinpoint with any accuracy given the data at hand. But it seems less likely that the results could be interpreted as confirming the existence of an evolutionary trade-off between fecundity and longevity, since we are only able to show an effect for females and not for males. This does not, of course, imply that there is no such evolutionary trade-off between reproduction and survival; it may simply be that such an effect is concealed by other confounding factors.

Instead, the higher mortality of women with more children may have to do with the physiological effects of childbearing, more or less independent of socioeconomic context, or with a physical depletion and exhaustion in mothers arising from repeated pregnancies and deliveries in combination with hard physical labor that shortened survival in old age.

Regardless of the exact mechanisms in operation, this paper shows that there clearly was a price of childbearing in terms of health and longevity in preindustrial society, and that women paid most of that price. In terms of reproductive health, the results also highlight the importance

of focusing not just on the short-term effects of childbearing, but that there might also be long term-effects on health and mortality of having children.

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