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The Long-Term Impact of Parental Death in Childhood on Mortality and the Role of Socioeconomic Status: Evidence from Sweden at the turn of the 20th century

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Abstract

The death of a parent during childhood is a major traumatic event. While there is a good understanding of the early-life effects of parental loss, the evidence regarding its impact on adult mortality is still scarce. Accordingly, the aim of this article is to study the long-term consequences of parental loss on mortality with particular focus on differences in the impact of parental death by socioeconomic status (SES) of the family. We use data from 1880, 1890, 1900, and 1910 Swedish censuses that have been linked to the Swedish Death Index which contain records for all deaths occurred in Sweden between 1860 and 2016. We run a series of OLS regressions to estimate the mean age at death of orphans controlling for a set of parental and household characteristics. We are also able to account for possible mediating effects of children's own socioeconomic position and marital status in adulthood. The findings suggest that the effect of parental death in childhood is still significant later in life even though it decreases substantially as individuals get older. Furthermore, we find a positive impact for the presence of stepparents. Adulthood characteristics slightly attenuate the impact of parental death, which, nonetheless, remains significant. We do not find support for an interaction effect between parental death and family SES suggesting no significant differences in the effect of parental death based on the background SES. We explain the decreasing effect with age as likely to be due to an increase selection with the more resilient individuals surviving to older ages.

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1. Introduction

Orphans are one of the most vulnerable groups within a society and losing a parent in childhood can therefore have serious implications on a variety of social and health outcomes across different geographical contexts and temporal settings (Derosas & Oris, 2002). In pre-industrial and industrializing societies, when mortality had not yet reached today's low levels, the chance of losing at least one parent before entering adulthood was relatively high. Among local populations in China, Italy, and the Netherlands between one fifth and one third of the children lost at least one parent by the age of 15 (Breschi & Manfredini, 2002; C. Campbell & Lee, 2002; Derosas, 2002; van Poppel, Schenk, & van Gaalen, 2013). Nowadays, in developed countries, the percentage of eighteen years old children who experienced parental death is around 4% (Lutzke, Ayers, Sandler, & Barr, 1997; Rostila & Saarela, 2011). Furthermore, it should be considered that in nineteenth century societies the short- and long-term effects of family characteristics on mortality might have been even stronger compared to contemporary societies. That is because before social support was institutionalized and before the appearance and growth of welfare policies, the family's human and material resources played a more influential role than the state (Cunningham, 2005; van Poppel & Liefbroer, 2005).

The survival of orphans and, more generally, the impact of family structure and parental death on child mortality has gained much attention among historical demographers (Tommy Bengtsson, Campbell, & Lee, 2004; Derosas & Oris, 2002). It has been shown that a multitude of factors moderate the impact of parental death on child survival. Among others, the sex of the deceased parent, parental remarriage, as well as the societal context have been identified as important variables affecting infant and child mortality rates (van Poppel & van Gaalen, 2009).

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A vast literature argues that early life exposure to adverse events might also have severe consequences on later life outcomes (Almond & Currie, 2011; David James Purslove Barker, 1992; Ben-Shlomo & Kuh, 2002). Of main interest have been questions about the effect of early life socioeconomic status and health on later life morbidity, mortality, as well as socioeconomic outcomes (Ben-Shlomo & Kuh, 2002; Blackwell, Hayward, & Crimmins, 2001; Elo & Preston, 1992; Galobardes, Lynch, & Davey Smith, 2004; Hayward & Gorman, 2004; D. Kuh & Shlomo, 2004; Preston, Hill, & Drevenstedt, 1998). Despite the growing interest in life course studies, however, the long-term effect of family structure in childhood on later life mortality is still under explored. Only a few studies have addressed this issue and it is still unclear whether parental bereavement in childhood has a long lasting impact on adulthood mortality (Campbell & Lee, 2009; Hayward & Gorman, 2004; Smith, Hanson, Norton, Hollingshaus, & Mineau, 2014; Smith, Mineau, Garibotti, & Kerber, 2009).

In addition, it is still an open question whether the effect of parental loss varied by the socioeconomic status (SES) of the family. While we could expect a different impact of parental death based on family SES with higher social classes might be better equipped to respond to a negative shock in early life, previous studies provide limited evidence and consequently it is unclear whether this is actually the case (Derosas, 2002; van Poppel & van Gaalen, 2009).

The objective of this paper is to extend the knowledge about the effects of parental loss in childhood on adult mortality and to understand the role played by socioeconomic status on the survival of exposed offspring. To these aims, we use individual level data from full count Swedish censuses from 1880, 1890, 1900, and 1910 combined with the Swedish Death Index, which includes all deaths occurred in the country between 1860 and 2016. These data sources enable us to analyze differences in life expectancy at different ages between

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children who experience parental loss in childhood with respect to those who did not, controlling for a variety of potential confounders.

This paper contributes to the current literature in several ways. Firstly, we use data that covers the entire country avoiding problems related to small samples that affected multiple previous studies (e.g. Derosas, 2002). Secondly, the link between the censuses and the death index allows us to take a long-term perspective and study the impact of parental death in childhood up until old age. Thirdly, we can study the impact of stepparents as well as other caring figures that were present in the household, a factor that has been often overlooked in earlier studies. Finally, we contribute by disentangling possible inequalities in the effect of parental death by the family socioeconomic status and by studying whether parental loss makes possible SES inequalities in mortality to converge. With this study we are able to provide a unique perspective on the consequences of early parental death combined with other childhood characteristics in the long-term using a large sample from full count population data covering an entire country.

2. Background and context

2.1. Parental death in the short-term

Parental death in pre-industrial and industrializing societies is generally associated with extreme levels of infant and child mortality. Earlier research studying the relationship between parental loss and child survival consistently shows that a mother's death in early childhood was more detrimental than a father's death (Andersson, Hogberg, & Åkerman, 1996; Derosas, 2002; Pavard, Gagnon, Desjardins, & Heyer, 2005; Reher & González-Quiñones, 2003; van Poppel & van Gaalen, 2009). Maternal care seems to be particularly

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crucial during the first two years of life because the adverse consequences of maternal death decrease significantly with children's age (Andersson et al., 1996; Reher & González-Quiñones, 2003; Willführ, 2009). These findings are typically attributed to the important role of the mother as the main provider of care, hygiene, and nutrition. The period under consideration was characterized by important structural differences in the allocation of tasks between the spouses with regard to labor market participation and domestic work. Husbands were mainly responsible for the financial well-being of the family, whereas wives were in charge of household tasks such as cleaning and the care for children (Stanfors & Goldscheider, 2017; van Poppel & van Gaalen, 2009; Vries, 2008, p. 186-237). Accordingly, maternal loss in the study period is mainly related to a decline in parental care and social support, whereas paternal loss is associated with financial strain and lower living standards (Rosenbaum-Feldbrügge, 2019). In order to respond to the decline in resources associated with the death of a partner, widowed parents remarried frequently (Dribe, Lundh, & Nystedt, 2007; Lundh, 2003; Rosenbaum-Feldbrügge, 2018). There is mixed evidence, however, whether the arrival of a stepparent actually had a positive or negative impact on child survival in the short run (Andersson et al., 1996; Beekink, van Poppel, & Liefbroer, 1999; Sear, Steele, McGregor, & Mace, 2002; Willführ, 2009).

2.2. Parental death in the long-term and hypotheses

Paternal and maternal death may also have negative mortality consequences over the entire life-course, and there are several mechanisms that might link a parent's death in childhood to lower survival chances in adulthood. First, parental death has been found to be associated with lower living standards (Oris & Ochiai, 2002), which possibly resulted in poor nutrition, bad housing conditions, and an unhealthy environment. Poor nutrition in early life,

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in turn, have been shown to have detrimental effects on health later in life which are mainly attributed to the hindered developmental process of young children (Barker & Osmond, 1986; Elo & Preston, 1992; Fogel, 1994; Huang, Soldo, & Elo, 2011; Kuh & Wadsworth, 1993). In a similar fashion, poor housing conditions in childhood, such as overcrowding and lack of hygiene, increase the exposure to risk factors that have an adverse impact on a variety of health outcomes later in life (Barker, Coggon, Osmond, & Wickham, 1990; Bengtsson & Lindström, 2003; Dedman, Gunnell, Smith, & Frankel, 2001; Elo & Preston, 1992).

Second, parental death in childhood might be related to an increase in early-life stress which is known to alter health (Todd, Valleron, & Bougnères, 2017). Störmer and Willführ (2010) propose, for instance, that parental death results in higher mortality risk in later life because a social crisis during childhood may harm the immune system to a large degree, which in turn has detrimental consequences on an individual's health and mortality risk. Moreover, the exposure to adverse childhood experiences such as parental death has been connected to changes of the brain structure that have a negative impact on health and well-being in later life (Anda et al., 2006; Kelly-Irving et al., 2013).

Third, parental death can operate through certain adulthood characteristics, which are related to higher mortality risks in later life. Previous research has shown that losing a parent may reduce the amount of social support that a child receives (Maier & Lachman, 2000). Parental loss also endangers an individual's ability to form long-lasting relationships (Ragan & McGlashan, 1986). At the same time, being married has been linked to health and survival chances and is commonly associated with better health and lower mortality when compared to unmarried individuals; this relationship is evident for men particularly when residing in urban areas (Sundin & Willner, 2007, p. 125). In the case of Sweden, Sundin and Willner (2007) describe this as the vulnerable single man phenomenon, arguing that at the turn of the

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nineteenth century, a period characterized by rapid industrialization and urbanization, it was relatively common for unmarried middle aged men living in an urban environment to have a high alcohol consumption and higher mortality risks. As a further key adulthood characteristic, parental death might also affect later-life mortality through lower socioeconomic attainment. It is generally assumed that the death of a parent thwarts children's plans for work and education (Bras & Kok, 2003). Research on the northern Swedish region of Sundsvall in the nineteenth century shows, for example, that the labor market outcomes of orphans were slightly worse in relation to their non-bereaved counterparts (Andersson et al., 1996). Similar observations have been made in a nineteenth century Dutch town (van Poppel, Jong, & Liefbroer, 1998). Therefore, there is some indication that parental loss is linked to a lower occupational status in adulthood, which might be in turn related to higher workload, psychological stress, and an unhealthy lifestyle. All these factors have been shown to increase mortality risks in adulthood (Costa, 2000; Kuh & Shlomo, 2004; Marmot, 2005).

A fourth mechanism that could explain why children's mortality is related to parental loss in early life refers to factors shared between parent and offspring, such as genetic characteristics and disease environment. These shared characteristics, mostly unobserved by the researcher, could be the underlying reason for a correlation between parental mortality and child mortality in adulthood (Campbell & Lee, 2009). One of the measures to account for the intergenerational transmission of longevity is the familial excess longevity developed by Kerber and colleagues (2001). It has been argued to be one of the earliest early life exposure able to predict outcomes at older ages with a strong positive association between all-cause and cause-specific mortality (Smith et al., 2014, 2009).

Eventually, some studies, particularly in contemporary contexts, have tried to evaluate the causal effect of early parental loss, or more generally of parental separation in childhood,

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on later life outcomes finding a negative effect that is smaller in size but robust to more rigorous estimation methodologies (for a review see McLanahan, Tach, & Schneider, 2013).

Given all these theoretical considerations, we expect that parental death below the age of 10 is associated with enhanced mortality risk not only in early ages, but also in later-life.

Hypothesis 1: Parental death in childhood is associated with increased adulthood mortality.

Previous research studying the link between parental loss early in life and adulthood mortality, however, provides mixed results. Occasionally, a negative relationship between paternal death during childhood and survival at later stages of the life course was detected. Having been exposed to several adverse childhood conditions such as parental death has been shown to decrease life expectancy below the age of 50 among a cohort of British men and women born in 1958 (Kelly-Irving et al., 2013). In a Chinese region between 1749 and 1909, maternal loss during childhood was associated with elevated mortality risks in later life (15-55 sui) but not in old age (56-75 sui) (Campbell & Lee, 2009). Interestingly they also find that the effect on later-life mortality remains significant after controlling for unobserved household characteristics by introducing fixed effects (Campbell & Lee, 2009). In a study based on the Utah Population Database, it has been found that losing a parent before the age of 17 had a "modest but significant" detrimental impact on mortality after the age of 65, which also persisted after the inclusion of several adulthood characteristics (Smith et al., 2014). Remarkably, however, there are also studies that found a positive effect of parental loss on survival in later life. A second study on the historical population in Utah examined mortality risks after age 50 from 1850 onwards and found that experiencing parental death below age 20 was associated with a slightly lower later-life mortality for males (Smith et al., 2009). In a similar way, (van Poppel & Liefbroer, 2005) found that men born in the

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Netherlands between 1850 and 1922 who had lived during childhood in the absence of their natural mother had increased survival chances in adulthood. However, the authors themselves call their results into question because of the small sample size in their study. Finally, in some cases no effect of paternal death on later life mortality was detected. Willführ (2009) analyzed the impact of parental loss on long-term survival for the Krummhörn region in Northern Germany in the eighteenth and nineteenth century. He concluded that there were hardly any long-term mortality consequences of losing a parent during childhood. The same applies to a study conducted on a pre-industrial population in French-Canada (Gagnon & Mazan, 2009), and on French children who had lost a father during World War First (Todd et al., 2017).

To sum up, there are several mechanism that possibly link parental death to higher mortality risks in later life, such as the exposure to lower living standards and to early-life stress, the operation through certain adulthood characteristics, and shared genetic and environmental factors. Earlier research on a diversity of regions and time periods, however, does not find consistent evidence for this proposed relationship. Accordingly, it is important to consider the role of moderating factors in the analysis, such as the presence of stepparents, the family's socioeconomic status in childhood, and the child's adulthood characteristics.

On the family level, the entry of a stepparent might introduce stability by providing important resources in terms of additional income, childcare, and domestic work. Paternal remarriage might therefore decrease the child's risk of growing up under poor and unhealthy circumstances, which are associated with higher mortality risks as noted above. The same reasoning can be applied to the presence of larger kin networks in the household. In his "nuclear hardship hypothesis", Laslett (1988) argued that the adverse effect of parental loss will be larger in nuclear family units than in extended ones because of the absence of an alternative caring person or household head. Indeed the child mortality risk following parental

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death has been found to be lower in households or in circumstances where other kin such as grandmothers were present, who could have taken care of the half-orphaned child (Sear et al., 2002). Accordingly, we assume that both the entry of a stepparent and the presence of a grandparent provide stability and therefore have a positive effect on survival chances over the life course.

Hypothesis 2a: The arrival of a stepparent during childhood alleviates the negative impact of parental loss on adulthood mortality.

Hypothesis 2b: The presence of a grandparent in the household alleviates the negative impact of parental loss on adulthood mortality.

Even though not always considered in detail, another moderating factor may be the family's socioeconomic status. On one hand, we would expect that upper and middle class families owned more resources to avoid a steep decline in living standards which enabled them to cope with the detrimental consequences of parental death. On the other hand, however, scattered empirical evidence did not show any social class differences for neither maternal orphans nor paternal orphans (Derosas, 2002; van Poppel & van Gaalen, 2009). Furthermore, in recent context, studies analyzing the impact of parental divorce have shown that, in fact, children with a higher socioeconomic background may be more affected by parental separation (Bernardi, Boertien, & Popova, 2014; Mandemakers & Kalmijn, 2014) and similar results are found for parental death (Prix & Erola, 2017). Nevertheless, such studies have been focusing mainly on socioeconomic attainment with a particular focus on education. When health outcomes are considered, it seems that higher social classes are better able to cope with negative shocks. We therefore expect to find a social gradient with regard to

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the link between parental death and adulthood mortality.

Hypothesis 3: Children growing up under higher socioeconomic circumstances have a lower adulthood mortality risk following parental loss in childhood.

Finally, we consider the possibility that adulthood characteristics (socioeconomic and marital status) of children may have a mediating role in the effect of parental death in childhood on adulthood mortality. As described above being married and having a higher social status in adulthood may have a protective effect on mortality and therefore have a mediating effect on the association between parental death in childhood and adulthood mortality. Nevertheless, previous research has found weak mediating effects (Campbell & Lee, 2009; Smith et al., 2014).

Hypothesis 4: The association between parental death in childhood and mortality later in life is robust to the introduction of adulthood characteristics.

2.3. Context

The end of the nineteenth century and beginning of twentieth century in Sweden is considered the period in which industrialization started to take place alongside the first health improvements. The period under study is also characterized by important migration and urbanization patterns. Migration outside Sweden was frequent in particular to North-America where more than 1 million people went between 1850 and 1930 (Norström, 1988; Thomas, 1941). According to the data analyzed in this paper, within the country, the share of people living in an urban towns increased from 15% in the 1880 to 23% in the 1910.

Sweden was characterized by a large presence of nuclear families and late marriages; on average age at marriage was 26 years old for women and 28 years old for men in the early

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1900 with a high percentage that remained unmarried (Persson & Öberg, 1996). A higher age at marriage leads to older ages for parents which might increase the probability of children to lose their parents. Remarriage followed a downward trend in pre-industrial times but was still relatively common in Sweden, especially for men: at the end of the nineteenth century the proportion of individuals remarrying was 10% for me and 4% for women (Lundh, 2003).

Industrialization meant changes on the family level and on the roles of men and women within the household. The period that we study marks the shift from agricultural household economy where both men and women work was aimed at the family's survival to a period in which men moved into the public sphere, while women were at home caring for the household and family (Stanfors & Goldscheider, 2017). The shifting of men into nonagricultural occupation favored the growth of an industrial working class in urban areas (Dribe, Eriksson, & Scalone, 2019).

By the end of the nineteenth beginning of twentieth century, there were already voluntary associations such as orphanages, school, crèches, and other charitable institutions (Sundin & Willner, 2007). While this was more common in cities, such as Stockholm, in rural areas help to orphans and single parents came predominantly from the church or from relief that could be organized on a parish level (Bengtsson et al., 2004, p. 139). Nevertheless, orphans remained more vulnerable than their peers even after accounting for reliefs interventions (Lynch, 2003, p. 144).

3. Data and method

In this paper we use two linked individual-level sources. First, we exploit information from the 1880, 1890, 1900, and 1910 Swedish censuses. The censuses are available in digital form thanks to the Swedish National Archives, have adopted the Integrated Public Use

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Microdata Series (IPUMS) format, and have been published through the North Atlantic Population Project (NAPP). The censuses report detailed information for all Swedish households and their household members as of the end of the census year. Besides basic demographic characteristics such as gender and year of birth, the census include information on individual occupations, civil status, parish and county of birth, and the household structure. Second, we use mortality information derived from the Swedish Death Index (SDI) (Sveriges Släktforskarförbund, 2019). The SDI contains data on sex, date and place of birth and death for all individuals who died in Sweden between 1860 and 2016.

Both sources, censuses and SDI, also report names and surnames of each individual. This allowed us to apply probabilistic linking methods to connect individuals throughout the different censuses and to link these individuals to the SDI, provided that they died in Sweden (see Eriksson, 2015). This means that for all successfully linked individuals we possess information about their parents' and their own characteristics and dates of death. The information contained in the sources is relatively accurate which allowed us to reach relatively high linkage and low false positives rates (linkage rate around 70%). In the analysis, we include all individuals aged 0 to 9 in the 1880 and 1890 censuses. This means that we consider the 1871-1890 cohorts. The main variable of interest, parental loss in childhood, is defined by experiencing the death of a mother and/or a father between the ages 1 and 10. We exclude children who experienced parental loss before turning 1 because the first year of life is particularly sensitive to parental, especially maternal, loss and could potentially confound the results. Age 10 is considered as the maximum threshold as is very likely that individuals at that point in their lives have not yet left the parental home (Dribe, 2000). The exposure variable is divided into full orphans, maternal loss, paternal loss, and those who did not experience parental death before the age of 10. In addition, also those who appear in the

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census with a stepmother or stepfather are defined as half-orphans accordingly. Foster children are included as full orphans. The stepparent variable present in the data was constructed according to certain criteria. For stepmothers they were either identified as stepmother in the source, with an improbable age difference, or identified as spouse of the father; for stepfathers they were either identified as stepfather in the source, or as spouse of the mother.

With regard to parental characteristics, we include controls for parental socioeconomic status (SES) in the census of observation and maternal age at birth. Parental SES is calculated on the basis of the highest SES between mother and father. HISCO codes (van Leeuwen, Maas, & Miles, 2002) are classified into the categorical scheme HISCLASS which groups historical occupations into twelve hierarchical social classes (van Leeuwen & Maas, 2011). We group these twelve HISCLASS categories into three SES groups: non-manual (HISCLASS 1-5), manual (HISCLASS 6, 7, 9, 10, 11, 12), and farmers (HISCLASS 8). We further control for household composition by adding indicators for the presence of a stepparent, of a grandparent, and for household size. We also control for whether the household was located in an urban or rural environment. Eventually, the analyses also include a migration indicator capturing whether the subject is living in the same county of birth, a control for census year and birth year and county of residence fixed effects.

We use a set of OLS regressions to predict age at death which, given the fact that all the cohorts included in our analyses are extinct, corresponds to the cohort life expectancy. We run different models for survivors at different ages; the coefficients can then be interpreted as differences in life expectancy for people who were alive at age 10, 20, 30, 40 and 60. To study differences in the effect of parental death by socioeconomic status of the family we

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include interaction terms between orphan status and family SES. As further analysis we also run OLS model after the age of 30 including the individuals' own SES and marital status.

4. Results

Table 1 reports the descriptive statistics for men and women included in the sample used in the main analysis, namely all children between 0 and 9 years old in the 1880 and 1890 censuses and alive at 10 years old. The sample is evenly split between men and women; 9% of boys and 9.2 % of girls lost at least one parent before turning 10 years old. With regards to the covariates included in the analysis, the table's figures are coherent with the context described above. Grandparents are present in the household for less than 2% of the children, which is in line with the large presence of nuclear families. More than 88% of individuals live in a rural context which confirms that following urbanization the share of people living in urban areas increased over the years, but overall in Sweden the large majority of people was still living in rural areas and working in agriculture, indeed about half of the children have parents working as farmers. In table 1 we also display the mean age at death by orphan status which suggests a penalty in terms of life expectancy that spans from about 2 years in case of paternal loss for both boys and girls to almost 4 years for children who lost both their parents in childhood.

Table 1 here

4.1. Main analysis

Coefficients referring to the difference in life expectancy between children who still had their parents at 10 years old and those who experience parental death in childhood are reported in table 2. For both men and women the loss of either or both parents had a

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significant negative effect on life expectancy that persisted up to 60 years old in case of full orphans for men and paternal orphans for both sexes. The effect for all orphan groups is the largest earlier in life and decreases with time. Men who lost both parents before turning 10 years old and are alive at 10 have, on average, 4 and a half years lower remaining life expectancy ($p<0.001$) compared to those who, at age 10, still had both parents. The negative effect of losing both parents for women is of 3.6 years ($p<0.001$) in the earliest analyzed age group. In relative terms, these values correspond to a 7.0% and 5.4% decrease in life expectancy for men and women respectively. While, for men, having lost both parents in childhood is still associated with over 7 months penalty in life expectancy, the effect of paternal death in the oldest age group although statistically significant it becomes of very small magnitude at age 60.

Table 2 here

In considering maternal versus paternal death, the point estimates suggest a slightly worse outcome in case of maternal loss, mainly in early ages. Nevertheless, confidence intervals overlap in all age groups for both men and women suggesting that for individuals who survived their tenth birthday there was no statistically significant difference between the effects of maternal loss compared to paternal loss.

When looking at the household structure, our results suggest that the presence of a stepparent in childhood has a beneficial effect which lasts until early adulthood for both men and women, while we do not find any association with the presence of a grandparent in the childhood household. A larger household (six people or more) is also associated with a higher age at death on average for women while there is no association for men. However, also in this instance, the effect size is quite small and does not exceed 4.5 months. The first born

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dummy indicated that being the oldest sibling carried a small negative effect for both sexes across all ages. Contrary to the weak effects of household size and birth order, a urban residence is linked, on average, to a sensible decrease in age at death for men of about 2.5 years in early adulthood.

Our findings further highlight differences in life expectancy linked to parental SES at all ages that will be further explored in the following section. While daughters of manual workers have on average the shortest life expectancy in all age groups, for men the pattern more unclear. Sons of farmers have the highest life expectancy throughout all ages and, interestingly, adult sons of parents in non-manual occupations have a small but significant negative effect on life expectancy.

4.2. Parental loss and family socioeconomic status

To investigate the potential role of family SES as moderator of the association between parental death and life expectancy, we include in the model interaction effects between orphan status and family SES. In this way, we can test whether there are differences among those who experienced parental death by family SES. As reported in table 3, we do not find support for such interaction effects. For men in the higher family social class coefficients are positive pointing towards an advantage with respect to the manual category, particularly in adulthood. However, none of the estimates reaches statistical significance. For women, even though there are some significant coefficients in the younger age groups, there is no evidence for a stronger impact of parental loss in any SES category.

Table 3 here

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4.3. Analysis with mediators

Tables 4 displays the regression coefficients for the models including the individuals' own SES and marital status for men and women. In this analysis, we exploit the information from the 1900 and 1910 censuses in which we can observe the characteristics when the individuals are in their 20s and 30s. For both genders, including the subject's adult characteristics attenuates the effect of parental death only slightly with the association between parental death in childhood and adult mortality remaining statistically significant.

The impact of the research person's own SES follows a similar pattern to that observed for parental SES: women in the higher SES category have on average a longer life expectancy, while for men it is detrimental to be in non-manual occupations. Being married, on the other hand, is associated with a longer life expectancy on average for both men and women.

Table 4 here

5. Discussion and conclusions

In this paper we studied the long-term effects of parental loss in childhood on adult mortality. Our results contribute to the current literature in multiple interesting ways. With regards to the short-term effects of parental death our results are in agreement with previous findings and further strengthen the evidence by using a full population sample. For both boys and girls parental loss is significantly associated with a shorter life expectancy, particularly at younger ages, with the effect of maternal loss being slightly larger, but not significantly different from the effect of paternal loss. One of the main contributions of our study is the long-term perspective and on the long-term effects of parental loss in childhood on mortality. We show

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that the effect of parental loss decreases with age and even though it remains statistically significant also at later ages the effect size is very small. These findings confirm our first hypothesis. So far, to our knowledge, only few studies were able to investigate the impact later in life of parental loss in childhood (Campbell & Lee, 2009; Hayward & Gorman, 2004; Smith et al., 2014, 2009). We interpret the decreasing effect of parental loss in childhood as people get older as an increased selection in the group of people who survive, with the more resilient individuals to be alive at age 60. Such increasing selection make the trajectories of life expectancy to converge across different level of exposure.

We further show the positive impact of a stepparent which had been suggested in earlier research (Andersson et al., 1996). In addition, we provide some evidence for the beneficial effect of larger household, especially for women. This result, combined with the negative effect for being the oldest siblings indicate that individuals who had people (a stepparent, an older sibling, or other components of the household) potentially taking care of them in case of parental loss provided a protective effect also in (early) adulthood. These findings offer support for Laslett's (1988) nuclear hardship hypothesis. In terms of the hypotheses formulated earlier we find support for hypothesis 2a but we do not find any conclusive evidence for hypothesis 2b.

Overall, we find that parental SES has a significant effect on children's longevity, small and negative for men and larger and positive for women. This pattern of SES differences in mortality is in line with previous studies (Dribe & Eriksson, 2018). By looking at the interaction effects between orphan status and background SES we did not find any evident pattern. These findings suggest that the impact of parental death did not vary among background social classes, and are in line with previous studies from the Netherlands and Italy (Derosas, 2002; van Poppel & van Gaalen, 2009). Therefore, we do not find support for our

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third hypothesis. One possible explanation for this outcome is that the advantage in terms of material resources that children with a higher SES background was not able to attenuate the negative impact of early parental loss. The lack of a caring figure might have been the most impacting aspect of losing a parent in early life, which went beyond differences in socioeconomic characteristics.

When we added mediators, the effect of interest did not change much. We did find a significant effect of own SES and marital status, but the impact of parental loss in childhood remained significant and the effect size decreased only slightly. This is consistent with previous findings (Campbell and Lee, 2009; Smith et al., 2014) and with our hypothesis number 4. This points towards either a direct effect of parental death on adult mortality or to the fact that there were other pathways through which parental loss affected children's mortality later in life.

A number of limitations should be considered in interpreting these results. Firstly, even though the censuses and the Swedish Death Index have been linked together with high linkage rates creating a "longitudinal" structure, the cross sectional nature of the sources limits the number of observations for individuals in different points in time. Secondly, migration out of the country could be a source of bias if children who experience parental death are more likely to stay. Thirdly, while we control for a wide array of potential confounders, the long-term effect of parental death in childhood on mortality could be related to some common causes such as behaviors, low standard of living, shared genetic, linking parents and offspring longevity and not an effect of parental loss per se. For instance, we are not able to control for shared family characteristics or genetic factors that may explain the correlation between parental loss and offspring death. As a consequence, the results in this paper should be interpreted as correlations and are not able to point to a causal link in a

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definite way. Finally, our analysis including adult characteristics only captures a limited number of possible factors. Perhaps, it would be relevant to include changes that happened to orphaned children closely after parental death, such has changes in living arrangements.

In conclusion, parental death in childhood has effects on mortality that are not limited to the short-term with selection in survival of more resilient individuals making the life expectancy trajectories to converge at older ages. Higher and lower social classes were equally affected by the negative effects of parental loss.

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Table 1. Descriptive statistics for men and women ages 0 to 9 in 1880 and 1890 censuses.

	Men	Women
N	371905	392078
%	48.7	51.3
Both parents	91	90.8
Full orphans	0.6	0.7
Maternal orphans	3.7	3.7
Paternal orphans	4.7	4.8
No stepparent	98.4	98.3
Yes stepparent	1.6	1.7
No granparent	98.1	98.2
Yes granparent	1.9	1.8
Non-manual	12.6	13
Manual	38.8	38.7
Farmers	48.6	48.3
Mother's age at birth <25	13.3	13.1
25<= Mother's age at birth <35	51.3	50.9
Mother's age at birth >=35	35	35.5
NA	0.5	0.5
Household size <6	35.1	34.9
Household size >=6	64.9	65.1
Rural	88.6	88.5
Urban	11.4	11.5
Non migrant	96.8	96.8
Migrant	3.2	3.2
Legitimate	98.4	98.4
Illegitimate	1.6	1.6
Later born	56	55.5
First born	44	44.5
Excess mortality	0.7	0.7
Birth year	1881.4	1881.3
1880 census	43	43.6
1890 census	57	56.4
Mean age at death		
Both parents	66.1	68
Full orphans	62	65.8
Maternal orphans	63.8	65.9
Paternal orphans	64.2	66.4

Note: Excess mortality calculated in year and county of birth and measured as the number of death above the three year moving average in the county (the measure has been rescaled so that 1 unit corresponds to 100 deaths).

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Table 2. Age 0 to 9 in 1880 and 1890 census - parental loss at ages 1 to 9 - Difference in life expectancy for subjects alive at different ages. Models are further controlled for birth year and census county of residence fixed effects. * p < 0.05, ** p < 0.01, *** p < 0.001.

	Men					Women				
	at 10	at 20	at 30	at 40	at 60	at 10	at 20	at 30	at 40	at 60
Both parents	0	0	0	0	0	0	0	0	0	0
Full orphans	-4.473***	-3.510***	-2.013***	-1.269***	-0.621*	-3.570***	-2.074***	-1.287**	-1.075**	-0.242
Maternal orphans	-2.204***	-1.621***	-0.801***	-0.467***	-0.0753	-2.193***	-1.523***	-0.783***	-0.353**	-0.0442
Paternal orphans	-1.856***	-1.379***	-0.763***	-0.462***	-0.195*	-1.764***	-1.026***	-0.582***	-0.414***	-0.235**
Stepparent present	0	0	0	0	0	0	0	0	0	0
Stepparent present	1.750***	1.426***	0.853*	0.396	-0.148	2.503***	1.419***	0.610	0.534	0.0725
Grandparent not present	0	0	0	0	0	0	0	0	0	0
Grandparent present	0.492	0.336	0.338	0.278	0.137	-0.0257	-0.121	-0.0920	-0.117	-0.159
Non-manual	-0.195	-0.373***	-0.603***	-0.625***	-0.184**	1.816***	1.612***	1.213***	0.969***	0.844***
Manual	0	0	0	0	0	0	0	0	0	0
Farmers	1.775***	1.488***	1.113***	0.894***	0.672***	0.754***	0.546***	0.324***	0.315***	0.297***
Mother's age at birth <25	0.0664	-0.0572	-0.111	-0.0582	-0.0466	0.0541	0.0756	0.0847	0.0259	-0.0236
25<= Mother's age at birth <35	0	0	0	0	0	0	0	0	0	0
Mother's age at birth >=35	-0.364***	-0.262***	-0.115	-0.0356	-0.0448	-0.434***	-0.243***	-0.135*	-0.0710	-0.0557
NA	-1.704**	-0.949	-0.588	-0.174	0.323	-2.067***	-0.941	-1.086*	-0.487	0.104
Household size <6	0	0	0	0	0	0	0	0	0	0
Household size >=6	0.0681	0.0224	0.00880	0.0327	0.0441	0.338***	0.360***	0.341***	0.283***	0.264***
Rural	0	0	0	0	0	0	0	0	0	0
Urban	-2.529***	-2.628***	-2.397***	-1.983***	-1.095***	-0.0601	-0.0913	-0.137	-0.156*	0.0251
Not migrant	0	0	0	0	0	0	0	0	0	0
Migrant	0.0195	-0.0725	-0.0350	-0.00598	0.0232	0.247	0.279	0.318*	0.243	0.236*
Legitimate	0	0	0	0	0	0	0	0	0	0
Illegitimate	-0.190	-0.324	-0.339	-0.117	0.103	-0.514	-0.343	0.0963	-0.0987	0.0360
Later born	0	0	0	0	0	0	0	0	0	0
First born	-0.276***	-0.189*	-0.224***	-0.221***	-0.169***	-0.358***	-0.363***	-0.387***	-0.312***	-0.216***
Excess mortality	-0.0565*	-0.0546*	-0.0369	-0.00945	-0.0103	0.00826	0.00470	-0.0197	-0.0157	-0.0196
1880 census	0	0	0	0	0	0	0	0	0	0
1890 census	1.863***	1.470***	2.058***	1.796***	0.798***	3.011***	2.724***	3.165***	2.655***	1.996***
_cons	63.53***	66.31***	69.19***	71.42***	76.40***	65.79***	68.36***	71.00***	73.29***	77.61***
N	371905	355914	333978	314568	263472	392078	375586	355344	335537	286938
adj. R^2	0.008	0.008	0.009	0.010	0.008	0.006	0.007	0.008	0.008	0.009

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Table 3. Age 0 to 9 in 1880 and 1890 census - parental loss at ages 1 to 9 - Difference in life expectancy for subjects alive at different ages. Models include the same control as in table 2. * p < 0.05, ** p < 0.01, *** p < 0.001.

	Men					Women				
	at 10	at 20	at 30	at 40	at 60	at 10	at 20	at 30	at 40	at 60
Both parents	0	0	0	0	0	0	0	0	0	0
Full orphans	-4.117***	-3.472***	-1.940**	-1.236*	-0.245	-2.667***	-1.518*	-1.102*	-1.054*	-0.343
Maternal orphans	-2.131***	-1.529***	-0.716**	-0.465*	-0.0269	-2.567***	-2.013***	-1.095***	-0.591**	-0.130
Paternal orphans	-1.827***	-1.321***	-0.688***	-0.408*	-0.0933	-1.990***	-1.066***	-0.655***	-0.462**	-0.162
Non-manual	-0.234*	-0.402***	-0.629***	-0.640***	-0.186**	1.679***	1.517***	1.176***	0.925***	0.821***
Manual	0	0	0	0	0	0	0	0	0	0
Farmers	1.801***	1.507***	1.140***	0.912***	0.693***	0.708***	0.501***	0.288***	0.290***	0.295***
Both parents # Non-manual	0	0	0	0	0	0	0	0	0	0
Both parents # Manual	0	0	0	0	0	0	0	0	0	0
Both parents # Farmers	0	0	0	0	0	0	0	0	0	0
Full orphans # Non-manual	-0.744	0.572	0.834	0.485	0.336	-0.914	-1.285	-0.780	-0.506	-0.0998
Full orphans # Manual	0	0	0	0	0	0	0	0	0	0
Full orphans # Farmers	-0.723	-0.283	-0.447	-0.244	-1.027*	-2.034*	-0.931	-0.194	0.127	0.288
Maternal orphans # Non-manual	0.495	0.184	0.366	0.291	0.138	1.034	0.919	0.341	0.391	0.313
Maternal orphans # Manual	0	0	0	0	0	0	0	0	0	0
Maternal orphans # Farmers	-0.300	-0.256	-0.289	-0.0771	-0.143	0.520	0.817*	0.598	0.417	0.107
Paternal orphans # Non-manual	0.738	0.507	0.407	0.300	-0.0511	1.451**	0.790	0.215	0.404	0.0686
Paternal orphans # Manual	0	0	0	0	0	0	0	0	0	0
Paternal orphans # Farmers	-0.255	-0.269	-0.281	-0.200	-0.227	0.163	-0.118	0.116	0.00545	-0.190
_cons	63.57***	66.31***	69.20***	71.46***	76.41***	65.90***	68.50***	71.18***	73.44***	77.75***
N	371905	355914	333978	314568	263472	392078	375586	355344	335537	286938
adj. R^2	0.008	0.008	0.009	0.010	0.008	0.006	0.007	0.008	0.008	0.009

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Table 4. Analysis including adulthood characteristics. Age 0 to 9 in 1880 and 1890 census - parental loss at ages 1 to 9 - Difference in life expectancy for subjects alive at different ages. Models are further controlled for birth year and census county of residence fixed effects. * p < 0.05, ** p < 0.01, *** p < 0.001.

	Men						Women					
	at 30	at 30	at 40	at 40	at 60	at 60	at 30	at 30	at 40	at 40	at 60	at 60
Both parents	0	0	0	0	0	0	0	0	0	0	0	0
Full orphans	-2.013***	-1.710***	-1.269***	-1.154**	-0.621*	-0.597*	-1.287**	-1.174**	-1.075**	-1.038**	-0.242	-0.255
Maternal orphans	-0.801***	-0.740***	-0.467***	-0.451***	-0.0753	-0.0755	-0.783***	-0.779***	-0.353**	-0.353**	-0.0441	-0.0546
Paternal orphans	-0.763***	-0.439**	-0.462***	-0.365**	-0.195*	-0.203*	-0.582***	-0.341*	-0.414***	-0.333**	-0.236**	-0.238**
Stepparent present	0	0	0	0	0	0	0	0	0	0	0	0
Stepparent present	0.853*	0.571	0.396	0.290	-0.148	-0.156	0.611	0.451	0.534	0.483	0.0727	0.0829
Grandparent not present	0	0	0	0	0	0	0	0	0	0	0	0
Grandparent present	0.338	0.305	0.278	0.249	0.137	0.123	-0.0920	-0.0646	-0.117	-0.105	-0.159	-0.148
Non-manual	-0.603***	-0.284**	-0.625***	-0.283***	-0.184**	-0.0288	1.213***	1.205***	0.969***	0.934***	0.844***	0.805***
Manual	0	0	0	0	0	0	0	0	0	0	0	0
Farmers	1.113***	1.015***	0.894***	0.814***	0.672***	0.602***	0.324***	0.404***	0.315***	0.354***	0.297***	0.325***
Mother's age at birth <25	-0.111	-0.147	-0.0583	-0.0712	-0.0466	-0.0481	0.0847	0.0475	0.0258	0.0165	-0.0237	-0.0157
25<= Mother's age at birth <35	0	0	0	0	0	0	0	0	0	0	0	0
Mother's age at birth >=35	-0.115	-0.129*	-0.0356	-0.0462	-0.0448	-0.0515	-0.135*	-0.117*	-0.0710	-0.0651	-0.0557	-0.0579
NA	-0.588	-0.428	-0.174	-0.111	0.322	0.321	-1.088*	-1.029*	-0.488	-0.473	0.103	0.0948
Household size <6	0	0	0	0	0	0	0	0	0	0	0	0
Household size >=6	0.00888	0.0494	0.0328	0.0633	0.0441	0.0546	0.341***	0.343***	0.283***	0.280***	0.264***	0.258***
Rural	0	0	0	0	0	0	0	0	0	0	0	0
Urban	-2.397***	-2.189***	-1.983***	-1.810***	-1.095***	-1.014***	-0.137	-0.159	-0.156*	-0.195*	0.0251	-0.0241
Not migrant	0	0	0	0	0	0	0	0	0	0	0	0
Migrant	-0.0351	0.0483	-0.00599	0.0541	0.0232	0.0520	0.318*	0.330*	0.243	0.235	0.236*	0.217*
Legitimate	0	0	0	0	0	0	0	0	0	0	0	0
Illegitimate	-0.339	-0.363	-0.117	-0.133	0.103	0.0953	0.0963	0.0704	-0.0987	-0.106	0.0360	0.0295
Later born	0	0	0	0	0	0	0	0	0	0	0	0
First born	-0.224***	-0.231***	-0.220***	-0.220***	-0.169***	-0.170***	-0.387***	-0.375***	-0.311***	-0.306***	-0.215***	-0.210***
Excess mortality	-0.0369	-0.0382	-0.00945	-0.0104	-0.0103	-0.0103	-0.0197	-0.0211	-0.0157	-0.0163	-0.0196	-0.0197
1880 census	0	0	0	0	0	0	0	0	0	0	0	0
1890 census	2.058***	3.477***	1.796***	2.441***	0.798***	0.998***	3.165***	3.588***	2.656***	2.764***	1.996***	1.935***
RP Non-manual		-0.978***		-1.294***		-0.665***		1.089***		0.733***		0.497***
RP Manual		0		0		0		0		0		0
RP Farmers		1.374***		0.760***		0.477***		-0.412		-0.847**		-0.631**
RP NA		0.0999		0.126*		0.144***		-0.519***		-0.196***		-0.158***
RP Ever married		0		0		0		0		0		0
RP Never married		-2.032***		-0.974***		-0.282***		-0.725***		-0.173***		0.162***
_cons	69.19***	69.77***	71.42***	71.72***	76.40***	76.45***	71.00***	71.55***	73.29***	73.45***	77.61***	77.60***
N	333978	333978	314568	314568	263472	263472	355344	355344	335537	335537	286938	286938
adj. R^2	0.009	0.014	0.010	0.012	0.008	0.009	0.008	0.008	0.008	0.009	0.009	0.009