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Child's age at parental death and university education

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ABSTRACT

Losing a parent due to premature death is generally associated with negative child outcomes. However, the study of possible (modifying) effects of the child's age and family background has been neglected in previous research. In this paper, we analyse the relationship between the child's age at parental death and the child's university education, and we study whether the possible association is modified by the child's family background. We apply ordinary least square regression and linear sibling fixed effect models to high-quality Finnish Census Panel data, consisting of 88,727 children born between 1982 and 1990. According to our results, the negative influence of parental death varies by the child's age; the consequences of parental death for young children were the most adverse. Interestingly, the influence of parental death seemed not to vary by family background.

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KEYWORDS Parental death; maternal death; paternal death; social inheritance; higher education; children

Introduction

All parents eventually die, but losing a parent due to death during one's childhood is generally associated with negative outcomes, both in terms of educational achievement (e.g. Amato and Anthony 2014; Prix and Erola 2017; Steele *et al.* 2009) and mental health problems such as depression and internalizing or externalizing problems (e.g. *Cerel et al. 1999*, 2006; Lin *et al.* 2004; Wolchik *et al.* 2006). While increased wealth and improved health care have reduced the prevalence of experiencing an early parental death, it still remains an important indicator of social inequality, even in developed societies. Seven per cent of children lose a parent when they are under 24 years old in Finland (authors calculations),

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a proportion that is similar those found in many other western societies (Fronstin *et al.* 2001; Jonsson and Gähler 1997).

The influence of parental death is likely not the same for every child. The possible influence may be modified by the child's age at parental death and the child's family background. Previous studies (e.g. Ermisch and Francesconi 2001; Lehti *et al.* 2017) suggest that the timing of negative events in the life course modifies their effects on intergenerational attainment so that events such as a parental death could be more harmful at a specific age, e.g. around the age when educational choices should be made. However, there are only two studies that have addressed the issue of age in the case of parental death (Fronstin *et al.* 2001; Steele *et al.* 2009); these studies compared very broad groups of children and adolescents. Thus, they did not allow us to draw conclusions about the specific ages when experiencing parental death could be especially harmful. Previous literature on social inheritance suggests that the influence of losses, including parental death, may be different for children from different social backgrounds and that an advantaged family background may protect from the negative outcomes (Grätz 2015; Prix and Erola 2017).

Many studies (e.g. Corak 2001; Steele *et al.* 2009) assume that parental death is an exogenous event and that it is only slightly correlated with unobserved attributes of family background. However, early parental death is rare in Western countries, and thus those parents who die are highly selected. We aim to address some of the selection problem by using sibling fixed effects (FE) model which allows us to take account unobserved heterogeneity better than often used methods such as ordinary least square (OLS) regression (Adda *et al.* 2011; Björklund *et al.* 2007; Francesconi *et al.* 2010; Grätz 2015; Steele *et al.* 2009).

In our study, we contribute to the literature by considering both the importance of a child's age at parental death and family background. Using Finnish register data, we examine the age-specific effects of parental death on children's university education with sibling FE models. We study parental deaths occurring at any time during childhood and youth, from birth to 23 years of age, and investigate whether the link between the child's age at parental death and the child's educational attainment differs by family background.

Background and hypothesis

Many studies have found that parental death has a negative association with children's adulthood outcomes, such as education (e.g. Amato and

Anthony 2014; Gimenez *et al.* 2013; Prix and Erola 2017). When a parent dies, the child loses many resources associated with the deceased parent. The lost parental resources are of many types, including economic, social and human capital. Perhaps the most obvious lost resource is income because the family loses the income that had been (potentially) provided by the deceased parent. The importance of lost economic resources may nonetheless be small in a country like Finland with extensive income transfers for those in need and free-of-charge educational system.

The amount of social capital and social networks available to the child is also likely to decrease as a consequence of parental death. Although all family members may share some parts of the social networks of a parent (Pinderhughes *et al.* 2001), at least some of these networks are likely to disappear after death. This phenomenon may be particularly true in the case of role modelling and social networks acquired through the parent's work that could otherwise be helpful, for example, in making educational choices (Kramarz and Skans 2014). Unlike economic resources, the lost social capital may be difficult to replace, especially by institutional means.

Similarly, the human capital of the deceased parent is no longer directly advantageous to the child. Parents contribute to their children's development by parenting, and these parenting skills are associated with the parents' level of education (Guo and Harris 2000; Thomsen 2015). Parents may contribute to their children's education by helping with school work and providing informed advice on educational choices (Björklund and Salvanes 2010). These contributions of the parent end at parental death and can be expected to result in lowered success in schooling (Steele *et al.* 2009). Overall, we hypothesize that:

> H1 Parental deaths are followed by a lower educational achievement of the children (general effect of parental death hypothesis).

The effects by age

The age of the child at the time of parental death may also matter in terms of the child's outcomes. One reason is that for young children family background has a strong influence (Mare 1980; Pfeffer 2008), but while growing up, children become more and more socially and economically independent of their parents (Müller and Karle 1993). In the previous literature studying the parental presence, the years lived with the father and mother have particularly positive associations with various outcomes, such as children's cognitive skills, education, income, and wealth (Lang and Zagorsky 2001). Parental influence slowly diminishes over time and

is replaced by other, extra-familial factors. For example, the social networks of the deceased parent may eventually be replaced by the social connections of the other adults and peers involved in the children's life. Because of these reasons, the existing research suggests that early family resources are the most decisive for adult socioeconomic outcomes (Duncan and Brooks-Gunn 2000; Erola 2012; Heckman 2006).

Thus, parental deaths occurring early during a life course may have more negative long-term effects than deaths occurring later; the children lose access to the different types of resources of their parents and miss the advantages associated with the accumulation of resources over time. We should expect that:

> H2 Parental death is more harmful the younger the child is (childhood hypothesis).

On the other hand, deaths occurring close to the age when educational decisions are made may be more consequential. The death of a parent is a traumatic experience that may directly weaken performance in school (Dowdney 2000) and can consequently make the transition to the consequent level of education harder. Children may also be sensitive to the remaining parent's emotional stress, and it may be that the remaining parent's ability to support education choices is restricted after the death has occurred (c.f. Andersen 2013). This phenomenon leads to our competing hypothesis regarding the child's age at parental death:

> H3 Parental death is most harmful around the ages when educational choices are made (adolescence hypothesis).

The gender of the deceased parent may also modify the age effect. A recent Finnish study showed that maternal education has the greatest effect in early childhood on child outcomes, whereas paternal education has effects in adolescence (Erola *et al.* 2016). This finding suggests that maternal death could be more adverse than paternal death in early childhood, and paternal death, in turn, may have a greater influence (than maternal death) during adolescence. Thus, we hypothesize that:

> H4 Maternal death is more adverse during childhood than paternal death, and paternal death is more adverse during adolescence than maternal death (gender of deceased parent and child's age hypothesis).

The influence of parental death by family background

We may consider the alternative hypotheses on the heterogeneous effects by parental background. Previous literature on social inheritance suggests

that the influence of losses may be different for children from different family backgrounds (Grätz 2015; Prix and Erola 2017). According to the theory of maximally and effectively maintained inequality (Lucas 2001; Raftery and Hout 1993), intergenerational educational inequality is persistent because individuals from advantaged family backgrounds are more able to access advantageous educational options than their peers from lower family backgrounds. In this way, the model suggests that inequalities in educational and later occupational attainment are maintained from one generation to another. Consequently, the effect of parental death on the child's education may be especially pronounced for children from a high family background as they have the most to lose in terms of (potential) resources. On the other hand, according to the cumulative disadvantage theory (O'Rand 2009), parental death should be most adverse for children of less advantageous social backgrounds because when negative life-events or scarcity of resources accumulate, this accumulation should more greatly reduce the children's probability for university education.

Thus, the competing hypotheses regarding the family background are:

> H5 Parental death is more negatively associated with a child's university education when the child has a high family background compared to children from a low family background, because parental death interferes with social inheritance (high family background hypothesis).

> H6 Parental death is more negatively associated with a child's university education when the child has a low family background compared to children from a high family background, because of the accumulation of disadvantages (low family background hypothesis).

Even though most studies find a negative association between parental death and the child's outcomes (e.g. Amato and Anthony 2014; Prix and Erola 2017; Steele *et al.* 2009), other studies do not (Biblarz and Gottainer 2000; Francesconi *et al.* 2010). A potential reason for mixed findings may be compensation. The previous literature suggests that some lost resources of the parents can be compensated for by other resources available in the immediate family (Erola and Kilpi-Jakonen 2017; Grätz 2015; Prix and Erola 2017). In particular, a stepparent may compensate for the loss of the biological parent, for instance, by contributing to parenting and the economic needs of the household (Erola and Jalovaara 2016). Re-partnering may also have a positive effect on the parental time available to spend with children (Amato and Anthony 2014; Steele *et al.* 2009). Hence, our hypothesis is that:

H7 The presence of a stepparent can reduce the possible negative association between parental death and child's education (compensation hypothesis).

However, the evidence for a stepparent's positive influence is not consistent; some studies also found that living in a stepfamily after divorce is adverse for children (Biblarz and Gottainer 2000; Jonsson and Gähler 1997). Changes in family structure, such as re-partnering, are generally associated with negative outcomes for children, which may explain part of the negative effect found in these studies.

Finland should provide an ideal context for exploring the interplay between the child's age at experiencing parental death and family background. Previous studies suggest that socioeconomic differences in mortality in Finland are still rather large (Mackenbach *et al.* 2017). On the other hand, other studies show that Finland is a strongly egalitarian welfare state, providing income transfers for those at need; in addition, free of charge education has been particularly effective in reducing intergenerational social disparities in educational and socioeconomic attainment (Erola *et al.* 2018; Jäntti *et al.* 2006; Pfeffer 2008). Thus, due to the national context, we expect that experiencing parental death in the first place should be strongly dependent on the family background, but the impact of experiencing parental death itself should not great due to the institutional compensation by the extensive welfare state. Parental education is likely more strongly related to child outcomes than family income because the effect of income as such on children's achievements has been shown to be very small (Erola *et al.* 2016; Mayer 1997). In addition, some lost economic resources are also institutionally compensated for the surviving spouse and children under the age of 18 through survivors' pensions. The level of this compensation is based on the primary beneficiary's (i.e. the deceased parent's) gainful employment (Hietaniemi and Ritola 2007). Thus, we expect that:

H8: Parental education is more strongly related to child's educational outcomes than family income (parental education and income).

Data and methods

Data

For our analyses, we used the high-quality registered-based dataset, the Finnish Growth Environment Panel (FinGEP). The FinGEP is based on a sample of 10% of the individuals who permanently lived in Finland in 1980. All cohabiting or married partners and biological children of the

sample persons during their lives have been linked to them, and all individuals were followed until 2014. In our analysis, we focus on the children of the sample persons. The advantage of register-based data is that, in contrast to survey data, they do not suffer from non-response or response bias. In our case this means, for example, that information for both parents of the children is always available for us if parenthood has been registered and both parents lived in Finland at the time of birth.

Our modelling approach relies on sibling FE and, therefore, our analytic sample includes only siblings who were born in 1982–1990, thus excluding singletons and those who were the only child of their family born within the year range. In our data, 87% of the families had more than one child. We excluded children who lost both of their parents before the age of 24 (240 cases) because it would be very difficult to analyse the importance of family resources for the consequences of death if a child had lost both of the biological parents. The fully orphaned children would not live with their parents any more, and the missing resources would necessarily be replaced by institutions or adoptive parents. For those who have lost their father, 21% had a stepfather at some point in their life before age 18 years. The equivalent proportion of those losing their mother and having a stepmother was 24% (Table 1).

In the first part of our analyses, we model the full sibling data (N = 88,727). In the second part, we examine within-family differences observed in subsamples of 5211 (paternal death) and 1717 (maternal death) who experienced parental death before the age of 24 years and compare the results to the control group, which consists of individuals who experienced parental death later than the age of 23 years.

Table 1. Descriptive statistics.

Variable	Total population (%)	Paternal death	Maternal death
University enrolment	21	15	17
Parental death	.	5	2
Female	49	49	47
Stepparent[a]	.	21	24
Parental education[b]			
Primary	7	13	12
Secondary	67	70	67
Tertiary	26	17	21
	Mean (SD)	Mean (SD)	Mean (SD)
Child's age at parental death	.	15 (6)	16 (6)
Family income[c]	664,174 (158,942)	631,151 (164,480)	637,053 (167,312)
Family income (100 centiles)[c]	45 (24)	40 (24)	41(24)
N	81,799	5211	1717

[a]Stepparent after parental death.
[b]Highest parental education (dominance), measured when child was 0–18 years.
[c]Total family income when child was 5–18 years.

In our final data, 7% of children had lost a parent, 2% a mother and 5% a father, when they were 23 or younger (Table 1). The average age of experiencing parental death was approximately 15 years. Our outcome is dummy coded as 1 for 'child has enrolled in university education or completed it by the age of 24 years', and 0 for 'not enrolled or completed university education'. In the analysed data, 21% of the total population and 15–17% of the bereaved children either completed or enrolled in university by the age of 24 years (Table 1).

The measured characteristics of the family background include family income and parental education. Yearly information on the income of the parents in our data is available from 1987 to 2010. It follows that we can track the family income for each child at age 5–18 years, independently of the birth year. We use this information, unique for each child in the family born in different years, to compute the average of the total family income during childhood and youth. Thus, family income is simply a sum of all income when child was 5–18 years old. The income measure contains all earnings and taxable income transfers in a household, such as universal child allowance and widow's and children's pensions, before taxes.[1] It also includes possible income of the stepparent for those years when stepparent lived in the same household as the child. The total family income was 664,174 euros on average and 631,151–637,053 euros for bereaved families. In the analysis, income is divided into family income centiles.

Parental education was measured as the highest parental education (i.e. dominance principle), and it was categorized into primary, secondary (including vocational and general tracks) and tertiary education (including those with a bachelor's degree or higher). Parental education was measured when the child was 18. Parents of the bereaved children were less educated than the parents of non-bereaved children (Table 1).

To conclude, bereaved children had a less advantageous family background than non-bereaved children, and bereaved children had a 7% lower probability of university education than non-bereaved children.

Methods

Many studies (Corak 2001; Steele *et al.* 2009) assume that parental death is an exogenous event and that it is only slightly correlated with unobserved attributes of family background. However, Amato and Anthony (2014) note that it is important to appreciate that parents may 'self-select' into

[1]Unfortunately, information on taxes is not available for all years.

death by risky behaviour. Early parental death is rare in Western countries, and thus those parents who die are highly selected; in addition, some causes of death, such as suicides and accidents, are over-represented (Erikson and Torssander 2009; Mackenbach *et al.* 2017; Statistics of Finland 2014a; Torssander and Erikson 2010). Individuals who belong to lower social classes have a higher risk for early death than those who belong to higher social classes (Erikson and Torssander 2009; Mackenbach *et al.* 2017; Torssander and Erikson 2010). Thus, any analysis of the influence of premature parental death is likely to be strongly influenced by socioeconomic selection. Only part of this selection can be explained by observed parental characteristics. In our data, selection is clear: the parents of the bereaved children are less educated and have lower incomes compared to their counterparts (Table 1).

Traditional OLS regression estimates may be misleading if important unobserved factors accounting for selection are missing from the model. One way to control for the selection of that is related to parental death is to use FE models (Amato and Anthony 2014; Elstad and Bakken 2015; Grätz 2015). In our study, we compare linear OLS regression results to linear sibling FE results in order to determine whether this selection introduces bias to the results.

In sibling FE models, any effects that are shared by siblings, observed or not, are automatically controlled for but cannot be estimated. This fact applies to many of the parental characteristics all siblings are exposed to, such as their occupational standing, but also to the controlled characteristics that are less frequently controlled, such as personality, skills and traits. The estimated effects, on the other hand, are based on the characteristics that distinguish siblings (Grätz 2015). Age is one of those factors. Excluding twins, biological siblings always experience the same family events at different ages. In our study, we exploit this age variation for the identification of the effect of parental death (see Figure 1).

Sibling FE models also have their limitations. First, the method assumes that parents treat their children exactly the same and that children respond to this treatment similarly (Carbonneau *et al.* 2002; Jenkins *et al.* 2003; Steele *et al.* 2009). However, parents can treat their children differently. Even if the parents did treat children in the same way, children can react to that differently. These and other unobserved factors that are not shared among siblings can lead to biased estimates even in sibling FE models. In our case, the role of unshared confounders should be weak compared to shared confounders because the main confounders in the case of parental death are at the parental level (c.f., Grätz 2015).

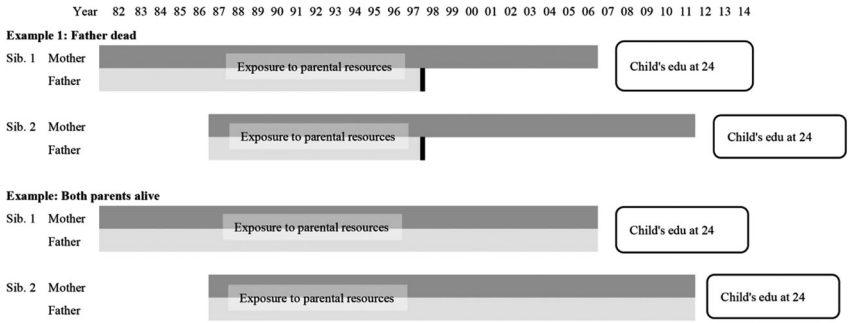

Figure 1. An illustration of the sibling FE model which shows the variation of exposure to parental resources between siblings by age. The follow-up period starts when child is born and it is symbolized as grey bars. In the example 1, the father dies in 1997 (black line) thus exposure to his resources ends then. The mother is alive so exposure to her resources continues till the end of the follow-up period, that is, when the child is 24 years of age. The child´s education is measured at the end of the follow-up period. In the example 2, both parents are alive whole follow-up period.

Because of this, our estimates cannot be considered as causal in a strict sense but perhaps as close to causal estimates as possible.

Second, sibling FE models can only be estimated in families with two or more children, and it is possible that parental death influences singletons differently to those with siblings (Francesconi *et al.* 2010). Our robustness analysis nonetheless showed that the estimates for multi-child families did not differ from sibling samples including all children, including single- and multi-child families (see online Appendix Table OA1).

Results

Maternal and paternal death on children's education

We find that children whose parent has died are less likely to enrol in university compared to those children whose parents are alive (Table 2). Children whose mother has died have a 3.5 percentage point lower probability of entering a university, and those who have lost father have a 7.7 percentage point lower probability. Thus, we find support for our *hypothesis 1* (general effect of parental death). Paternal death seems more adverse compared to maternal death; therefore, in the following analysis, we examine mothers and fathers separately.

Figure 2 shows the proportion of university-educated children by child's age when a parent died in contrast to children who have not lost

Table 2. Mother's or father's death and child's university education at the age of 24 years.

	OLS	
	Mother	Father
Parental death	−0.035**	−0.077***
(ref: no death)	(0.011)	(0.006)
Female	0.046***	0.046***
	(0.003)	(0.003)
Constant	0.189***	0.192***
	(0.002)	(0.002)
N	88,727	88,727
R^2	0.003	0.005

Notes: Standard errors in parentheses. OLS regression.
*$p < .05$.
**$p < .01$.
***$p < .001$.

a parent before the age of 24 years. The negative association between parental death and the child's education weakens consistently with age. Thus, we find support for *hypothesis 2* (childhood most adverse), but we do not find support for *hypothesis 3* (adolescence most adverse). Because the age effect is quite linear, we use the linear age-variable in the following analysis to simplify the interpretation of the results.

Does family background matter?

In this section, we employ a sibling FE model in order to consider unobserved family-level characteristics, including social background. In the following models, we use subsamples of children (paternal death $N = 5211$; maternal death $N = 1717$) who have lost their parent before or after the age of 23 years.

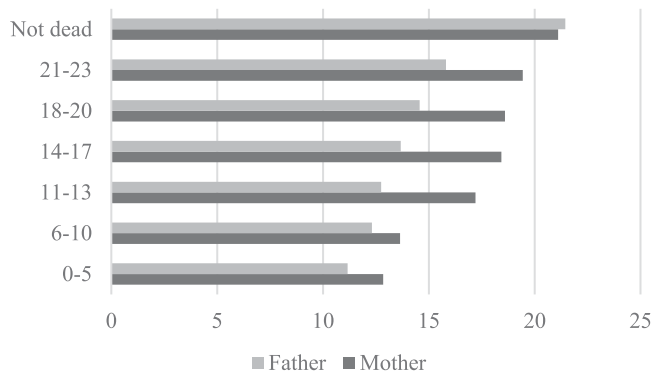

Figure 2. The proportion of university-educated children by child's age when a parent died compared to those whose parents are alive ($N = 88{,}727$).

Table 3. Estimates of child's university education at the age of 24 years and *father's* death.

	OLS				FE		
	Model 1	Model 2	Model 3	Model 4	Model 1	Model 2	Model 3
Child's age at paternal death[a]	0.003**	0.003**	0.002*	0.001	0.009**	0.009**	0.010**
	(0.001)	(0.001)	(0.001)	(0.001)	(0.003)	(0.003)	(0.003)
Female	0.041***	0.041***	0.044***	0.044***	0.042**	0.042**	0.042**
	(0.010)	(0.010)	(0.009)	(0.009)	(0.013)	(0.013)	(0.013)
Family income[b]		0.001	0.000	0.000		−0.000	−0.000
		(0.000)	(0.000)	(0.000)		(0.001)	(0.001)
Parental education[c]							
Secondary			0.058***	0.058***			
			(0.010)	(0.010)			
Tertiary			0.335***	0.334***			
			(0.020)	(0.020)			
Stepparent[d]				−0.041**			0.031
				(0.013)			(0.038)
Constant	0.080***	0.074***	−0.010	0.013	−0.022	−0.004	−0.019
	(0.014)	(0.017)	(0.016)	(0.019)	(0.048)	(0.069)	(0.071)
N	5211	5211	5211	5211	5211	5211	5211
R^2	0.006	0.006	0.103	0.105	0.011	0.011	0.011

Notes: Standard errors in parentheses. OLS regression and linear sibling fixed effects model.
[a]Ref. Those children who have lost their parent after the age of 22 years.
[b]Total family income when child was 5–18 years.
[c]Ref. Primary, measured when child was 0–18 years.
[d]Stepparent after parental death.
*$p < .05$.
**$p < .01$.
***$p < .001$.

Table 4. Estimates of child's university education at the age of 24 years and *mother's* death.

	OLS				FE		
	Model 1	Model 2	Model 3	Model 4	Model 1	Model 2	Model 3
Child's age at maternal death[a]	0.005**	0.004*	0.003*	0.002	0.013*	0.013*	0.012*
	(0.002)	(0.002)	(0.002)	(0.002)	(0.006)	(0.006)	(0.006)
Female	0.044*	0.045*	0.041*	0.040*	0.034	0.034	0.033
	(0.019)	(0.019)	(0.018)	(0.018)	(0.024)	(0.024)	(0.024)
Family income[b]		0.001	0.000	0.000		−0.000	−0.000
		(0.000)	(0.000)	(0.000)		(0.002)	(0.002)
Parental education[c]							
Secondary			0.059**	0.063**			
			(0.020)	(0.020)			
Tertiary			0.395***	0.399***			
			(0.034)	(0.034)			
Stepparent[d]				−0.045			−0.011
				(0.026)			(0.062)
Constant	0.086**	0.065	−0.024	0.006	−0.040	−0.023	−0.018
	(0.030)	(0.034)	(0.034)	(0.038)	(0.093)	(0.127)	(0.130)
N	1717	1717	1717	1717	1717	1717	1717
R^2	0.008	0.010	0.143	0.145	0.012	0.012	0.012

Notes: Standard errors in parentheses. OLS regression and linear sibling fixed effects model.
[a]Ref. Those children who have lost their parent after the age of 22 years.
[b]Total family income when child was 5–18 years.
[c]Ref. Primary, measured when child was 0–18 years.
[d]Stepparent after parental death.
*$p < .05$.
**$p < .01$.
***$p < .001$.

We find that the older the child is at parental death, the more likely the child enters university education (Tables 3 and 4). Each additional year with both parents alive increases the probability of university education by 1 percentage point in the FE models. There is a substantial difference between the OLS and FE model results, indicating that unobserved variables at the family level play a major role (Tables 3 and 4). The estimates are much stronger in the FE than in the OLS models, underlying the importance of controlling for unobserved variables. The weaker OLS estimates suggest that selection actually *reduces* the negative association of parental death. A similar phenomenon is reported by Grätz (2015) in the case of parental divorce in Germany.

Interestingly, the selection effect appears to be equally strong for maternal and paternal deaths – in both cases, the negative effect size grows approximately 0.1 after fixing the family background. Estimates of paternal and maternal deaths are similar both in the OLS and FE models. This finding indicates that bereaved families are similar regardless of the gender of the deceased parent.

We also tested the interaction between child's gender and child's age at parental death (both for maternal and paternal deaths) but the interaction was not statistically significant (see online Appendix Table OA2). Thus, we do not find support for *hypothesis 4* (gender of the deceased parent and child's age) – the gender of the child or parent do not seem to matter.

Having a stepparent is negatively associated with a child's university education, but only in the OLS models for paternal death (Table 3, Model 4). In the case of the FE models, controlling for having a stepparent does not greatly change the estimates, but for the OLS regression, it does; controlling for having a stepparent reduces the estimate of parental death and the significance disappears. We also tested interaction between child's age at parental death and having a stepparent, but the interaction was not statistically significant (see online Appendix Table OA2). Thus, we do not find support for *hypothesis 7* – a stepparent cannot compensate for the negative effects of parental death.

The association between parental death and educational outcome of the child was not modified by family income, as seen in both the OLS and the FE models. This finding suggests that the increased economic strain experienced by the families does not explain the negative effect of parental death. This finding might be because of the extensive Finnish social security system, which may compensate for the economic losses to some degree. Controlling for parental education reduced the estimates of parental death in the OLS regression, which suggests that parental education plays a

Table 5. Child's university education by child's age at parental death and parental education (dominance).

	Father dead			Mother dead		
	Primary	Secondary	Tertiary	Primary	Secondary	Tertiary
Child's age at parental death[a]	0.009	0.010**	0.013	0.017*	0.010	0.011
	(0.005)	(0.003)	(0.011)	(0.007)	(0.006)	(0.018)
Family income[b]	0.001	−0.002	0.006	−0.006	−0.002	0.010
	(0.001)	(0.001)	(0.005)	(0.003)	(0.002)	(0.008)
Female	0.082***	0.027	0.098*	0.001	0.035	0.047
	(0.023)	(0.014)	(0.047)	(0.035)	(0.025)	(0.075)
Stepparent[c]	0.010	0.048	−0.070	0.125	0.101	−0.275
	(0.064)	(0.040)	(0.157)	(0.187)	(0.066)	(0.166)
Constant	−0.191	−0.002	−0.126	−0.010	−0.011	−0.141
	(0.102)	(0.079)	(0.311)	(0.168)	(0.133)	(0.498)
N	690	3645	876	211	1148	358
R^2	0.074	0.011	0.019	0.122	0.015	0.046

Notes: Standard errors in parentheses. Sibling fixed effects model.
[a]Ref. Those children who have lost their parent after the age of 22 years.
[b]Total family income when child was 5–18 years.
[c]Stepparent after parental death.
*$p < .05$.
**$p < .01$.
***$p < .001$.

significant role. Thus, we find support for hypothesis 8 (parental education and income). Parental education is more strongly associated with the child's educational outcomes than family income.

However, as Table 5 shows, the influence of the child's age at parental death seems not to depend on the educational level of the parents. The estimates of child's age at parental death were similar for all parental education groups (even though most of the estimates were not significant due to a limited number of children). In addition, the interaction between parental education and child's age at parental death was not significant (see Appendix Table A1) nor the interaction between family income and child's age at parental death (Appendix Table A1). Thus, we do not find support for *hypothesis 5* (high family background) or *hypothesis 6* (low family background). It seems that the influence of the child's age at parental death is similar for all children. Thus, although early parental death is selected by parental socioeconomic background, the influence of the death on children seems not.

Robustness analysis

In addition to the analyses reported in detail above, we also performed many robustness analyses in order to obtain a better picture of the phenomenon. We studied whether the association between the child's

age at parental death and child's education is similar for secondary education (see online Appendix Tables OA4, OA5 and OA6). These findings were similar to Prix and Erola (2017): when using parental death-dummies and OLS regression we found that parental death is negatively associated with child's secondary education. However, we did not find that the child's *age* at parental death has an influence on the child's secondary education. There are few explanations as to why the results were different in the case of secondary education for child's age. First, the prevalence of parental death is much lower before the completion of secondary education (i.e. child's age of 16) than after it and therefore the models have much less statistical power. Second, only 11% of adolescents under the age of 25 did not have a completed secondary degree (Statistics of Finland 2014b). Thus, the variation in the outcome may be too small: most children had at least a secondary degree.

We also determined whether including the cause of parental death matters. Because sibling share the same cause of parental death, it is not possible to determine this with the FE models; thus, we used the OLS regression. We found that the association between child's age at parental death and child's education did not differ by the causes of death (see online Appendix Table OA3).

Additionally, in order to consider whether the possible association of the child's age at parental death and the child's university education is different for children of single- and multi-child families, we conducted an OLS analysis on single-child families. However, the estimates were once again quite similar and thus single- and multi-child families seem not to differ (see online Appendix Table OA1).

We also tested different measure of parental education. In our original analysis, parental education was measured as the parental highest education by the child's age of 18, but we also tested whether measuring the highest parental education at child's birth changes results. However, the results did not change thus measuring parental education at birth or by the age of 18 seems both valid (Results available from the first author).

Conclusion

Early parental death has been generally associated with negative outcomes for children (e.g. Amato and Anthony 2014; Prix and Erola 2017; Steele *et al.* 2009). However, it has remained less clear what creates a negative effect. We contributed to this literature by studying whether the association between parental death and educational outcomes is modified by

the child's age at the time of bereavement and whether the influence of child's age at parental death differs by family background.

We studied the association of child's age at parental death and children's university education using high-quality Finnish register-based data with OLS and linear sibling FE models. The limitation of the OLS regression in these types of analyses is that it considers only the observed family characteristics. This limitation is often problematic because early parental death includes great selection by both observed and unobserved family background characteristics and is difficult to measure objectively and without considerable bias if using only OLS. The sibling FE models take into account the unobserved parental and environmental level characteristics that all siblings share. This approach should effectively reduce the selection effects, producing less biased estimates for the association of child's age at parental death and child's education than the OLS models.

Our results show that the children who experienced parental death during childhood and youth had a weaker educational attainment at the age of 24 years compared to those not having experienced parental death, and the association was more negative the younger the child was. The negative association is particularly clear once the family background selection into the deaths is accounted for with the sibling FE model. The background selection appeared to play a similar role both in the case of the mother's and the father's death and there were no statistically significant differences between experiencing the mother's or father's death.

We found that even though early parental death itself is selected by parental socioeconomic background, the influence of parental death on children by child's age seems not. Thus, it seems that the influence of parental death on child's education did not vary by family background. We used both parental education and family income as a measure of family background, finding that parental education seems to be the best measure of family background. This is in line with previous findings by Erola *et al.* (2016). This might be due to the extensive Finnish free-of-charge education and generous social security system. Additionally, other institutional arrangements, such as special pensions paid to both the widow and the bereaved children may reduce the importance of the lost economic resources.

According to our findings, the earlier parental death is experienced, the more negatively it seems to be associated with a child's education. Our results indicate that the linearly reducing negative association by age is unaffected by a child's sensitive periods, such as transitions to either

primary or secondary school at the ages of 7 and 15 years, respectively. This finding suggests that the negative association is not due to temporary shock but due to the long-term effects, perhaps to the accumulated consequences of losing a parent. We did not find evidence that having a stepfather after parental death would compensate for the lost resources. In fact, we found a negative association in OLS regression and non-significant association in FE models. Our OLS findings are similar to those of Steele *et al.* (2009) and Jonsson and Gähler (1997).

The comparison of effect size and to previous studies is hard because other studies have not studied the child's age at parental death and there are not many studies that have used sibling FE model. With regard to the effect size, we can conclude that child's age matters: if a child is 17 years old when a parent dies, that child has 15.3% higher probability to enter the university if compared to a child who lost a parent when she/he was 1 year old. We expect that the findings would be similar also in other Nordic countries because they have similar welfare and educational system. The contrasts may be stronger in countries where parents and their resources play a more important role on child's education and access to health services.

As with all studies, our study had both weaknesses and strengths. The largest weakness of our study is that the data do not allow us to measure the quality of parenting, the interaction between parents and children, and the children's medical data. On the other hand, the strengths of our study include both the data and the methods used. The data allow us to test, for example, whether the possible associations are different for maternal and paternal deaths, different ages of the child and different backgrounds. In addition, unlike the data used in many of the previous studies, our dataset is large enough to avoid the most power problems often linked to the studies on this topic (Amato and Anthony 2014). Additionally, the methods used in this study allow us to address the selection associated with early death in a more thorough manner.

Taken together, our study leads to the conclusion that, although the negative association between child's age at parental death and child's education is related to long-term accumulated consequences associated with the event, the negative effects are mostly related to non-economic factors. Altogether, our study demonstrates that the length of the overlapping life courses between parents and children is important for a child's educational attainment, which, at least according to our results, is independent of the family background. These findings suggest that if the negative effects of early parental death are to be reduced, the policy

interventions should be targeted by the age of the children, rather than only by differentiating them by socioeconomic background.

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APPENDIX

Table A1. Results of interaction models of family income and parental education and child's age at parental death on child's university education at the age of 24 years.

	Father	Mother	Father	Mother
Child's age at death[a]	−0.001	0.009	0.009	0.016
	(0.005)	(0.009)	(0.009)	(0.017)
Family income[b]	−0.005*	−0.001	< −0.001	< −0.001
	(0.002)	(0.003)	(0.001)	(0.002)
Family income[b] #	<0.001	<0.001		
Child's age at death[a]	(0.001)	(0.001)		
Female	0.042**	0.033	0.042**	0.030
	(0.013)	(0.024)	(0.013)	(0.024)
Stepparent[c]	0.031	−0.009	0.031	−0.016
	(0.038)	(0.062)	(0.038)	(0.062)
Parental education[d]				
Secondary			0.006	0.246
			(0.311)	(0.569)
Tertiary			0.004	−0.442
			(0.335)	(0.617)
Parental education[d] # Child's age at death[a]				
Secondary			0.001	−0.008
			(0.009)	(0.018)
Tertiary			−0.002	−0.001
			(0.011)	(0.020)
Constant	0.158	0.018	−0.021	−0.081
	(0.100)	(0.158)	(0.279)	(0.517)
R^2	0.014	0.012	0.011	0.026
N	5211	1717	5211	1717

Notes: Standard errors in parentheses. Sibling fixed effects models.
[a]Ref. Those children who have lost their parent after the age of 22 years.
[b]Total family income when child was 5–18 years.
[c]Stepparent after parental death.
[d]Ref. Primary, measured when child was 0–18 years.
*$p < .05$.
**$p < .01$.
***$p < .001$.