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Children's educational attainment, occupation, and income and their parents' mortality

Irma T. Elo¹, Pekka Martikainen^{2,3,4}, and Mikko Aaltonen²

¹University of Pennsylvania

²University of Helsinki

³Stockholms University and Karolinska Institute

⁴The Max Planck Institute for Demographic Research

Abstract

Using data from Finland, this paper contributes to a small but growing body of research regarding adult children's education, occupation, and income and their parents' mortality at ages 50+ in 1970–2007. Higher levels of children's education are associated with 30–36 per cent lower parental mortality at ages 50–75, controlling for parents' education, occupation, and income. This association is fully mediated by children's occupation and income, except for cancer mortality. Having at least one child educated in healthcare is associated with 11–16 per cent lower all-cause mortality at ages 50–75, an association that is largely driven by mortality from cardiovascular diseases. Children's higher white-collar occupation and higher income is associated with 39–46 per cent lower mortality in the fully adjusted models. At ages 75+, these associations are much smaller overall and children's schooling remains more strongly associated with mortality than children's occupation or income.

Keywords

cause-specific mortality; educational attainment; occupation; income; children's SES; parents' mortality

Introduction

Socio-economic (SES) inequalities in mortality continue to be an active area of investigation in multiple disciplines (Kitagawa and Hauser 1973; Elo and Preston 1996; Smith 2007; Cutler et al. 2008; Elo 2009; Martikainen et al. 2009; Chapman et al. 2010; Goldman and Smith 2011; Martikainen et al. 2014). Most studies of SES health inequalities in developed countries have focused on the associations between health and mortality in adulthood and one's own SES, with a more recent interest in the role of childhood circumstances, including

Please direct all correspondence to Irma T. Elo, Population Studies Center, University of Pennsylvania, 3718 Locust Walk, Philadelphia, PA 19104, USA; or by popelo@pop.upenn.edu.

Pekka Martikainen is at the Department of Social Research, University of Helsinki; Centre for Health Equity Studies (CHESS), Stockholm University; the Karolinska Institute & the Max Planck Institute for Demographic Research. Mikko Aaltonen is at the University of Helsinki.

parental SES, on health and mortality at older ages. Most studies, although not all, have found that higher SES in childhood and adulthood is associated with lower mortality later in life (Lynch and Smith 2005; Strand and Kunst 2006; Wilson et al. 2007; Kravdal 2008; Case and Paxson 2010). Prior research has also shown that the educational level of one spouse is associated with the mortality of the other spouse (Kravdal 2008; Skalická and Kunst 2008), suggesting that familial ties can exert influence on health outcomes beyond a person's own SES or that of their parents.

The most recent extension has been a focus on the association between adult children's SES and the health and mortality of their parents (Zimmer et al. 2002, 2007, 2016; Torssander 2013, 2014; Friedman and Mare 2014; Yahirun et al. 2016). We have contributed to this small but growing body of research by building on and extending previous work in the following ways: first, in addition to educational attainment we included information about whether any of the children were educated in a healthcare field. We put forward the hypothesis that having a child with such expertise may confer additional benefits to parents beyond education per se. Such children are likely to be better informed of lifestyle factors important for good health and provide their parents support in following or adopting these lifestyles. Children employed in healthcare are also more knowledgeable about healthcare options and can assist parents in navigating the healthcare system. Furthermore, such children may provide their parents with better informed emotional and instrumental support.

Second, most prior studies have focused on the association between adult children's education and the mortality of their parents. To our knowledge, only one previous study has examined multiple measures of children's SES and parental mortality in developed countries (Torssander 2014). Additional analyses of the children's occupational status and income are warranted to help illuminate which aspects of the children's SES are predictive of their parents' mortality and whether such associations vary by context. Thus, in addition to educational attainment, we included children's income and occupation.

Third, we analysed both all-cause and cause-specific mortality, examining mortality from cardiovascular diseases, lung cancer, 'other cancers', and 'accidents, violence, and suicide'. Cardiovascular diseases and lung cancer are prominent causes of death at ages 50 and above and have been associated with children's educational attainment in prior studies (Friedman and Mare 2014; Torssander 2014). Deaths from accidents and violence, which are more common among lower SES individuals, can be related to heavy alcohol consumption (Herttua et al. 2008). Additionally, we stratified all analyses by the parents' age at death, using two categories—age 50 up to the 75th birthday (50–75) and ages 75 and above—because the contributions of the listed causes of death vary by age at death. We expected that the associations between children's SES and parental mortality would be more pronounced at younger than at older parental ages at death. Opportunities for children to influence the health of their parents at the oldest ages may be more limited.

In all models, we controlled for the parents' own educational attainment, occupation, and income. We based the analyses on high quality census and death record data that are not subject to recall error or misreporting bias. The data came from a large sample of families in

Finland that were followed from the 1950 Census of Population to subsequent quinquennial censuses (1970–1985) and from death records (1970–2007).

Finland, like many other developed countries, experienced educational expansion and transformation of its economy during the twentieth century. In Finland, these changes accelerated after the Second World War, in a period of rapid industrialization, urbanization, and expanding educational opportunities, with increasing employment in professional and service occupations and declining employment in agriculture. These changes resulted in substantial occupational and educational mobility for the children of the cohorts included in these analyses. Thus, the children were better educated compared with their parents, and better educated children were more likely to have access to white-collar employment and greater financial resources than their less well-educated counterparts (Saarivirta 2010). Although Finland is similar to other Scandinavian countries, in that ageing parents do not co-reside with their children typically (De Vos and Sandefur 2002), intergenerational family support is common and children are important caregivers for their parents in old age (Harvey et al. 1995; Tomassini et al. 2004; Blomgren et al. 2008).

Children's socio-economic status and the health and mortality of their parents

The number of studies investigating the associations between adult children's SES and the health and mortality of their parents remains limited. In societies with high intergenerational mobility in educational attainment and occupational status, it is feasible to contend that adult children could provide information, financial help, and other forms of support that would improve their parents' health and well-being. Such support could be particularly beneficial during a period when medical knowledge and advances in treatments are improving rapidly, as was the case with heart disease and some cancers, leading causes of death in developed countries during the latter half of the twentieth century and the beginning of the twenty-first (Feldman et al. 1989; Laatikainen et al. 2005).

One of the first studies to examine the association between children's education and the health of their parents used the Survey of Health and Living Status of the Elderly in Taiwan (HLSET). In that study, the authors investigated whether children's higher educational attainment conferred health benefits to their parents by improving the parents' physical functioning at ages 60 and above (Zimmer et al. 2002). The results were consistent with the study hypothesis that children's higher educational attainment would be associated with reduced levels of parents' functional limitations, controlling for the parents' own educational attainment and income. These findings have been replicated in Mexico, based on the Mexican Health and Aging Study (MHAS), where the authors documented fewer functional limitations at ages 50 and above among parents with more highly educated children. In addition, children's financial resources were negatively associated with parents' functional limitations, suggesting that education and income were likely to contribute to parents' health through independent pathways (Yahirun et al. 2016).

Evidence for lower mortality among parents with more highly educated children comes from studies in Taiwan, Sweden, and the United States (US). In research also based on the

HLSET, Zimmer et al. (2007) found that children's schooling was not only a significant predictor of parental mortality, but that children's educational attainment appeared to be particularly important for reducing mortality at ages 60 and above among parents who already had severe health problems at the start of the mortality follow-up. Friedman and Mare (2014) subsequently extended the analysis of children's schooling and parental mortality to the US, based on data from the 1992–2006 waves of the Health and Retirement Study (HRS). The authors documented significantly lower mortality at ages 50 and above among parents of sons and daughters with higher levels of education, independent of the parents' own educational attainment, income, and wealth. They further showed that this association was particularly strong for lung cancer and chronic lower respiratory diseases, causes of death that are closely linked to smoking. That parents' smoking behaviour was implicated in these findings was demonstrated by the fact that parents of more educated children were less likely to have ever smoked and more likely to have quit smoking than parents of children with lower levels of schooling. Parents of more highly educated children were also more likely to engage in rigorous physical activity at least three times a week. Controlling for these health behaviours explained part of the association between children's educational attainment and the mortality of their parents—results that are consistent with the hypothesis that more educated children could influence their parents' health by encouraging healthy behaviours such as exercise, and by discouraging unhealthy behaviours such as smoking.

Further, a study based on multi-generation register-based data from Sweden has documented significantly lower mortality among parents of children with higher levels of schooling, adjusting for the education, occupation, and income of both parents (Torssander 2013). These findings held when accounting for shared but unobserved familial characteristics that were taken into account in estimates of sibling fixed effect models in the parents' generation. In a related study looking at alternative measures of children's SES—namely children's educational attainment, occupation, and income—children's educational attainment was found to be the most robust predictor of parents' overall mortality at ages 61 to 80, as well as mortality from cardiovascular diseases, overall cancer mortality, and mortality from breast and lung cancer, but not prostate cancer (Torssander 2014).

That children's socio-economic position can benefit the health of their parents does not appear to be a recent phenomenon. Using data from the Utah Population Database (UPDB) for cohorts born from 1864 to 1883, Zimmer et al. (2016) found children's higher SES to predict lower mortality among their parents in a historical US population. In that study, children's SES was measured by the Nam–Powers socio-economic status score, which in addition to occupation also takes into account income and education associated with a given occupation (Nam and Boyd 2004). The association was weaker for parental mortality at ages 60 and above than at ages 40–59, although it did remain significant at the older ages.

Possible pathways linking children's socio-economic status to their parents' mortality

There are a number of potential pathways through which children's SES could influence the health of their parents. The results from previous studies suggest that one of the mechanisms is linked to health-related behaviours. Better educated children are likely to be better

informed about the benefits of healthy behaviours, and may thus encourage their parents to give up smoking, take up exercise, and adopt healthy lifestyles more generally. As noted previously, parents of better educated children were less likely to smoke and more likely to quit smoking or to engage in physical activity than parents of children with lower levels of schooling in the US (Friedman and Mare 2014). In both Sweden and the US, children's education was also a significant predictor of lung cancer mortality, which is closely related to smoking (Ibid.; Torssander 2014).

Education has also been posited to influence mortality through improved decision-making and problem-solving skills, by increasing one's ability to acquire information, and through cognitive and non-cognitive skills, such as motivation, persistence, and self-control (Grossman 1972; Lleras-Muney 2005; Cutler et al. 2006; Smith 2007). Consistent with these hypotheses, higher levels of schooling have been related to the adoption and use of medical innovations and compliance with complicated treatment regimens (Goldman and Smith 2002; Lleras-Muney and Lichtenberg 2002; Laatikainen et al. 2005; Elo 2009). Thus, more highly educated children may bring their knowledge and skills to bear in assisting their parents in navigating the healthcare system, communicating effectively with medical personnel, and following prescribed treatments. In Taiwan, children's educational attainment appeared to be more important in reducing the mortality of parents who reported serious illness, suggesting that more highly educated children may influence treatment decisions and access to healthcare resources (Zimmer et al. 2007). Children who are educated in healthcare are likely to further enhance such benefits. Other benefits of having well-educated children may include access to other forms of social, emotional, and instrumental support that can help parents stay active and socially engaged (Torssander 2013; Friedman and Mare 2014). Social support from family members has also been linked to longevity among older adults (Seeman 2000).

Children's educational attainment also influences their own occupational status and earnings—characteristics that may exert an independent influence on parental health and well-being (Yahirun et al. 2016). Children with higher incomes can provide monetary support that can buy access to better housing, specialized equipment, help with household chores, and access to other health-related resources. Children's financial capital could also buffer the parents against stress associated with unexpected expenditures and reduce parental worry about their children's well-being (Torssander 2014). Even within a national healthcare system, monetary resources can help to pay for private healthcare services and other forms of support that are not routinely or fully covered (Keskimäki 2003; Manderbacka et al. 2009). Children's occupational status in turn captures a combination of social and economic characteristics relevant for health that are shared by individuals with similar occupational statuses (Cambois et al. 2001). It reflects individuals' social networks through employment ties that can provide access to health-related information and expertise not otherwise present in the person's family and friendship networks.

Methodological considerations

The previous section outlined the results from prior studies that point to possible mechanisms through which children's educational attainment can benefit their parents'

health. Whether these associations are causal or confounded by unobserved factors that influence both children's education and the health of their parents cannot be established with observational data. Adjusting for observed characteristics of the parents, including their own socio-economic status, may not fully capture unobserved factors—such as cognitive ability, perseverance, self-control, and preference for long-term investments—that are also likely to be related to parents' health (Friedman and Mare 2014). In addition, it is possible that children's educational attainment, and subsequently their occupation and income, have been influenced by the health of their parents. If children's schooling was truncated as a result of parents' ill health, reverse causality may in part account for the observed associations between children's SES and parents' mortality. Even in the absence of high tuition costs and in contexts where schooling is free, parents' ill health could nevertheless influence children's ability to devote themselves to school work and thus truncate their educational attainment with implications for their occupational status and income (Torssander 2013). Research that has addressed the potential role of unobserved factors by adjusting for the parents' unobserved family characteristics that could influence their mortality through sibling fixed effects at the parental level found that this did not substantially attenuate the association between children's educational attainment and the mortality of their parents (Ibid.).

At the same time, there is considerable room for children's schooling, income, and occupational status to influence parents' health and well-being in contexts with expanding educational and employment opportunities in the children's generation. In such settings, well-educated children are likely to be exposed to a wider range of information relevant for maintaining healthy lifestyles and knowledge about advances in health technology, and to have greater access to higher status occupations and financial resources than their parents or their less educated counterparts (Zimmer et al. 2002, 2007; Friedman and Mare 2014). The documented associations in prior studies between children's educational attainment and the mortality of their parents have been surprisingly similar in different contexts such as Sweden, Taiwan, and the US (Zimmer et al. 2007; Torssander 2013, 2014; Friedman and Mare 2014). In addition, the results from all studies have been consistent with theorized causal pathways.

Data and methods

This analysis reported in this paper used a subset of records from a nationally representative 10 per cent sample of households in the 1950 Finnish Census of Population (Statistics Finland 1997). These records have been linked to subsequent quinquennial census records from 1970 to 1985 and to death records up to 31 December 2007 by Statistics Finland using unique person identifiers. The censuses provided information on socio-demographic characteristics of the children and their parents, while the death records provided information on the date and cause of death of the parents based on the eighth, ninth, or tenth revisions of the International Classification of Diseases (ICD), depending on the year of death, with coding of causes made comparable across the ICD revisions by Statistics Finland.

To identify children and parents in the 1950 Census, unique family identifiers, ages of children, and family members' relationships to the household head were used in linking children to their parents (Elo et al. 2014). In this analysis, we investigated the mortality of parents who had children aged 0–14 in the household at the time of the 1950 Census, who were alive at ages 50–59 in 1970 when the mortality follow-up began, and whose children were linked to at least one of the 1970, 1975, 1980, or 1985 Censuses. These parents were aged 30–39 at the time of the 1950 Census, and were chosen as the focal group in the analysis as they were the most likely to have children living at home in 1950. Younger parents were more likely to give birth to additional children after 1950, whereas older parents were more likely to have children who had already moved out of the parental home. We excluded parents who were not linked to the 1970 Census because they had either died or moved out of Finland ($n=4,747$), or because their children had died or moved out of Finland ($n=1,601$). Mortality of children and young adults was already low in Finland in the 1950s and 1960s, and thus non-linkage of children was mostly due to labour migration to Sweden. Our final sample consisted of 29,261 parents, representing 82.2 per cent of the parents aged 30–39 in 1950. Of the 29,261 parents, 25,576 died during the follow-up period 1970–2007.

Children's characteristics

The children's characteristics were obtained from the 1970, 1975, 1980, or 1985 Censuses, when the children were 20–49 years old, depending on their age in 1950 and inclusion in subsequent censuses. If the parent died during the mortality follow-up, the children's characteristics were measured in the census before the death of the parent. We included three measures of children's SES: education, occupation, and income. The variables were created separately for fathers and mothers due to variation in their ages at death. Because we observed multiple children in most families, we considered alternative ways of coding the children's characteristics (Friedman and Mare 2014; Torssander 2013). With respect to educational attainment, we examined the associations between parental mortality and the mean educational attainment of all children in the family as well as the highest level of schooling achieved by any child. Comparisons of models with these alternatives fitted the data equally well and did not alter our main conclusions. We present results from models that include the highest level of schooling achieved by any child: basic or primary (9 years), lower secondary (10–11 years), upper secondary (12 years), and post-secondary (13+ years) education. We also included dummy variables indicating whether the most highly educated child was a son or a daughter, or whether both a son and a daughter had the same level of schooling. Based on the detailed occupational coding available in the census, we further examined whether there is an additional health benefit to parents if at least one of their children was educated in healthcare (e.g., was employed as a doctor, a nurse, or a health aide) by introducing a dummy variable to indicate whether any of the children had such an occupation.

Following the same logic, we coded children's occupation based on the highest occupational class achieved by any child: upper white-collar, lower white-collar, farmer/self-employed, manual worker, and 'other'. The 'other' category included students and unknown/missing occupations. Our third SES measure was individual taxable income, which has been linked

to these data from the Finnish Tax Administration and the Social Insurance Institution by Statistics Finland. It comprised all forms of taxable income, including wages, capital income, and taxable income transfers. We experimented with several alternatives for coding this income variable, including the highest income of any child and average income of all children. We found that the best fit to the data was obtained by an income measure that reflected the children's longer-term financial resources. For each child, we calculated their average income adjusted for inflation, based on the censuses to which they were matched, and then calculated the average income of all children in the family (referred to as the children's average income). This income variable was then divided into quintiles. Because income was subject to frequent fluctuations, this coding helped to smooth out such fluctuations over time. In addition, we controlled for the number of siblings, as parents with more children could have a higher chance of having children with higher education or occupational status.

Parents' characteristics

The parents' characteristics were obtained from the 1970 Census before the start of the mortality follow-up. These characteristics included: marital status, education, occupation, and taxable income. Each parent's marital status was categorized as married, divorced, single, or widowed. Where information on marital status was missing in the 1970 Census, we replaced it with the value from the 1950 Census (n=398). We also controlled for the parent's gender in models that were not estimated separately for fathers and mothers. Parents' education and occupation were coded into the same categories as those of their children. In addition, we controlled for the taxable income of the father and the mother in 1970, based on information linked from the Finnish Tax Administration and the Social Insurance Institution, which we coded into tertiles.

Causes of death

We modelled all-cause mortality and also mortality from cardiovascular diseases (CVD), lung cancer, 'other cancers', and 'accidents, violence, and suicide' separately. CVD was the most common cause of death in our data and it has been closely associated with one's own educational attainment in Finland and elsewhere (Elo et al. 2006; Elo 2009). Lung cancer was also a common cause of death at ages 50 and above and has played an important role in changing SES gradients in mortality in Finland, especially among men (Preston et al. 2011; Martikainen et al. 2013). In the 'other cancers' category, 60.4 per cent of the deaths consisted of cancers (other than lung cancer) for which smoking is a known risk factor (e.g., kidney, liver, oesophagus, oral cavity, pancreas, stomach, bladder, and uterine (IARC 2004)) or that were less lethal if detected early and for which screening is widely available (e.g., colon, breast, cervical, and prostate cancer). In Finland, many of the deaths from 'accidents, violence, and suicide' are linked to alcohol consumption and thus they are at least in part related to health behaviours (Mäki and Martikainen 2009).

Statistical methods

We used Cox proportional hazards regression to estimate the associations between our independent variables and both all-cause and cause-specific mortality, with age as the timescale. Mortality follow-up started on 1 January 1971 and extended to the end of 2007.

Preliminary analyses indicated that the associations between children's characteristics and parental mortality varied with the age at death of the parent. Thus, we stratified all analyses into two age groups—mortality between ages 50 and 75 and at ages 75 and above. At ages 50–75 individuals who were alive at exact age 75 were censored on that date, and above age 75 those who were alive at the end of 2007 were censored on that date. Individuals who died from causes other than the one under investigation were censored either on their date of death or at age 75 (in the analyses below age 75) or the end of mortality follow-up (in the analyses of mortality at ages 75 and above). For all-cause mortality, we estimated separate models for mothers and fathers, following previous literature, but in the cause-specific analyses we pooled men and women together. Preliminary analysis indicated that the associations between children's characteristics and the parents' cause-specific mortality did not vary between mothers and fathers. Cluster-robust standard errors were calculated to account for clustering of the observations within families.

To assess the separate and joint influences of the children's characteristics on parents' mortality we estimated the following models, which all controlled for parental characteristics and number of siblings: Model 1a also controlled for educational attainment and gender of the most highly educated child and whether any child was educated in the healthcare field. Model 1b controlled instead for children's occupation, while Model 1c controlled for children's income. Model 2 included all explanatory variables, thus covering children's education, occupation, and income, as well as all parental characteristics.

Results

Table 1 provides sample characteristics. The hazard ratios for all-cause mortality in the two age groups and their 95 per cent confidence intervals are shown in Tables 2 and 3. Results for cause-specific analyses are shown in Tables 4 and 5 and in Appendix Tables 1 and 2.

The sample of parents consists of 55 per cent mothers and 45 per cent fathers. The mean number of children present in each family in 1950 who are subsequently linked to census records is just over two (Table 1), and thus most parents have at least two children who could provide support. The vast majority of the parents are married, with less than 20 per cent widowed, single, or divorced, reflecting the fact that single parenthood and divorce were still relatively rare in Finland among this generation of parents.

Table 1 reveals considerable intergenerational educational and occupational mobility. For example, 84 per cent of the parents have only a basic level of education compared with 25 per cent of their most highly educated children, whereas 25 per cent of the most highly educated children in each family have received post-secondary schooling, compared with only 4 per cent of the parents. The children are also much more likely to have studied health-related subjects than their parents: 13 per cent of the sample have at least one child educated in healthcare vs. only about 1 per cent of the parents with this education (result not shown).

Intergenerational occupational mobility is also common. Over three-quarters of the parents are either self-employed or farmers (35 per cent) or hold manual occupations (41 per cent), and only 6 per cent are employed in upper white-collar occupations (Table 1). In contrast, in

over three-quarters of the families at least one child is employed in upper (36 per cent) or lower white-collar (41 per cent) occupations. Thus, there is considerable potential for the children to be better informed, have greater access to health-related information and financial resources, and to benefit from distinct social networks through employment than is the case for their parents.

Children's socio-economic status and all-cause mortality of their parents

Results for ages 50–75—All measures of children's SES exhibit a significant association with all-cause mortality among fathers and mothers at ages 50–75 (Models 1a–1c, Table 2). Note that all models also control for all parental characteristics (parents' marital status and their educational attainment, occupation, and income). Consistent with prior studies, higher levels of children's education predict significantly lower mortality of both parents in a stepwise fashion, such that the parents whose most highly educated child has post-secondary education have 30–36 per cent lower mortality than fathers and mothers of children who have only basic education (Model 1a, Table 2). In addition, having at least one child whose education is in healthcare reduces the mortality of fathers by 11 per cent and of mothers by 16 per cent (Table 2).

Children's occupational status is also a significant predictor of mortality for both parents, controlling for parents' own characteristics. Fathers whose child(ren) are employed in lower or upper white-collar occupations experience mortality hazards that are 26 and 43 per cent, respectively, below those of fathers whose children are employed in manual occupations. The respective advantages for mothers are similar, at 28 and 47 per cent, respectively. Mortality is also significantly lower for fathers and mothers whose child is a farmer or self-employed (Model 1b, Table 2). Children's higher average income is also associated with significantly lower mortality among both mothers and fathers, controlling for the parents' own characteristics (Model 1c, Table 2).

Model 2 (Table 2) presents the fully adjusted associations at ages 50–75. Among the children's SES measures, the mortality advantage associated with the children's educational attainment is attenuated more markedly than with either occupation or income. Because educational attainment is predictive of children's occupational status and income, the benefits of the children's higher educational attainment are explained by children's occupational status and financial resources. At the same time, having a child who is educated in a health profession continues to be protective, although the coefficient remains statistically significant only for mothers at the 5 per cent level. Both parents also benefit from having a daughter who is the most highly educated child or a daughter who has the same level of schooling as the most highly educated son.

Children's occupational status and average income both remain significant predictors of all-cause mortality, and these associations are not substantially attenuated in Model 2 compared with Models 1b and 1c for either fathers or mothers (Table 2). Overall, the associations between the children's educational attainment, occupational status, and income and the mortality of their parents are similar for mothers and fathers. In a pooled model (not shown), none of the interactions between the gender of the parent and the children's SES measures are statistically significant.

Results for ages 75 and above—The results for children's SES and the mortality of parents at ages 75 and above differ from the associations at ages 50–75. Of the children's SES measures, their educational attainment is the most robust predictor of old age mortality for both parents. Fathers whose child(ren) have post-secondary schooling experience around a 16 per cent lower hazard of dying than fathers whose most highly educated child has only basic education, controlling for the father's own characteristics. The respective advantage for mothers is similar at 18 per cent (Model 1a, Table 3). These associations remain similar with the introduction of controls for the children's occupation and income (Model 2, Table 3). Having a child educated in healthcare or a daughter who has a higher or similar level of education to a son does not confer additional benefits at these older ages.

In contrast, children's income does not predict the mortality of fathers, whether examined separately (Model 1c, Table 3) or jointly with the other measures of children's SES (Model 2, Table 3). Similarly, children's occupational status is not a significant predictor of the mortality of fathers in the fully adjusted model. In Model 2, children's income is not a significant predictor of mortality for mothers either, and children's occupational status is less important than at ages 50–75. In a pooled model (not shown), none of the interactions between the gender of the parent and the measures of the children's SES are statistically significant.

Children's socio-economic status and cause-specific mortality of their parents

In the analyses of cause-specific mortality, we pooled the data for mothers and fathers and controlled for the parent's gender. In Tables 4 and 5, we present the results from the model that controls for all characteristics of children and parents (Model 2). Appendix Tables A1 and A2 present the results from Models 1a–1c.

Results for ages 50–75—Over half of all deaths between ages 50 and 75 in the data set are due to cardiovascular diseases. Lung cancer accounts for 8.4 per cent of all deaths and is more common among fathers than mothers (Martikainen et al. 2013). Mortality from 'other cancers' makes up 20.1 per cent of deaths, with deaths from 'accidents, violence, and suicide' representing 4.5 per cent. Together these four cause-of-death groups account for 86.9 per cent of all deaths in this age group.

Each measure of children's SES is separately a significant predictor of mortality from cardiovascular diseases, lung cancer, and 'other cancers', controlling for the parents' own characteristics (Appendix Table A1), such that higher levels of children's schooling, higher occupational status, and higher income are each associated with significantly lower mortality among parents. Children's occupational status and income (but not education) also exhibit significant associations with mortality from 'accidents, violence, and suicide'. In addition, having a child who is educated in healthcare is a significant predictor of CVD mortality.

In the fully adjusted model (Table 4), children's educational attainment remains a significant predictor of lung cancer deaths, such that parents whose most highly educated child has post-secondary education have a 26 per cent lower hazard of dying compared with parents of children with basic education. Having a child who is educated in a healthcare field is protective for CVD mortality. Parents who have a daughter with a higher or similar level of

schooling as the most highly educated son have significantly lower mortality from CVD and ‘other cancers’ than parents whose most highly educated child is a son.

Children’s occupational status and income remain significant predictors of mortality from all four cause-of-death groups in the fully adjusted model (Table 4). Parents of children who work in upper white-collar occupations have a mortality advantage ranging from 37 per cent for lung cancer to 50 per cent for mortality from ‘accidents, violence, and suicide’ relative to parents whose children are manual workers. Similarly, children’s higher levels of income are associated with significantly lower mortality from all four causes of death.

Results for ages 75 and above—At ages 75 and above, cardiovascular diseases also account for over half of all deaths in the data set, whereas deaths from ‘other cancers’ account for 14.8 per cent, lung cancer for about 2.6 per cent and ‘accidents, violence, and suicide’ for 3.1 per cent of all deaths. Together these four cause-of-death groups make up 73.3 per cent of all deaths above age 75 (Table 5).

At these older ages, children’s educational attainment, rather than occupational status or income, is the most robust predictor of mortality from CVD. It remains a significant predictor of parents’ CVD mortality, not only in Model 1a (Appendix Table A2) but also in the fully adjusted model (Table 5). The mortality hazard from CVD is 16 per cent lower for parents whose most highly educated child has post-secondary education compared with parents whose children have basic education. Parents whose children have lower or upper secondary schooling also have significantly lower mortality (9 per cent and 11 per cent, respectively) than parents whose children have basic education. Children’s educational attainment is also associated with lower mortality from lung cancer and ‘other cancers’, although these associations are not statistically significant.

CVD mortality is also significantly lower for parents whose children are employed in lower or upper white-collar occupations compared with parents of children employed in manual occupations in the fully adjusted model. In contrast to mortality at ages 50–75, children’s financial resources do not predict lower mortality of the parents from any of the cause-of-death groups examined (Table 5).

Discussion

This study has contributed to a small but growing literature on the association between children’s SES and the mortality of their parents. Further, we have documented that these associations vary by cause of death and age at death of the parent. Our results are consistent with previous studies that have demonstrated that children’s educational attainment is predictive of their parents’ mortality and that these associations vary by cause of death (Zimmer et al. 2007; Torssander 2013, 2014; Friedman and Mare 2014) as well as the parents’ age at death (Zimmer et al. 2016).

In this study, children’s educational attainment was a significant predictor of mortality at ages 50–75 and 75 and above, controlling for parents’ own education, income, and occupation. In the younger age range, however, the significant association between children’s schooling and parents’ all-cause mortality was mediated by the children’s

occupational status and income, although education remained a significant predictor of mortality from lung cancer. In contrast, at ages 75 and above children's educational attainment was a significant predictor of all-cause mortality, controlling for parents' own characteristics as well as children's occupation and income. The main cause of death contributing to this association was CVD.

We further contended that children who were healthcare professionals were likely to be especially well informed of the health consequences of harmful lifestyles and could help parents confronted with ill health to navigate the healthcare system. Consistent with this expectation, we documented significantly lower all-cause mortality at ages 50–75 among parents who had at least one child who worked in the healthcare field. This association was the most pronounced for mortality from CVD. We speculate that this result is related to parents' healthier lifestyles and superior information about treatment options for heart disease. We also found that if a daughter was the most highly educated child, parents experienced significantly lower all-cause mortality and mortality from CVD, lung cancer, 'other cancers', and 'accidents, violence, and suicide' at ages 50–75. In the absence of information on the types of support that more highly educated daughters may provide, we suggest that one plausible explanation is that daughters maintain closer ties to their parents than do sons, and daughters are also more likely than sons to provide both emotional and other forms of social support to their parents (Grundy and Read 2012). Thus, daughters with higher levels of schooling may be particularly well prepared to assist parents in communicating with healthcare professionals and negotiating the intricacies of the public healthcare system and available private resources.

Although we cannot determine whether these associations are causal or confounded by unobserved characteristics that determine both children's educational attainment and parents' health over and above parents' own education, income, and occupation, these associations are consistent with the pathways through which children's schooling are believed to influence parents' health and well-being. They are also consistent with prior studies that point to the important role that children's schooling can play in influencing health behaviours and lifestyle factors that are closely linked to heart disease and lung cancer (Friedman and Mare 2014; Torssander 2014). Future studies might attempt to tease out the causal effect of children's education on parents' mortality by examining educational reforms that provide exogenous variation in children's schooling (Pekkarinen et al. 2009).

Children's educational attainment also predicts their occupational status and income, which we expected could influence parents' health through distinct pathways. Consistent with this expectation we found that children's higher occupational status and higher income both predict significantly lower parental mortality at ages 50–75, when the children themselves are at the prime working ages. We suggest that the income–mortality association is most likely related to the provision of material resources, such as paying for household help in the case of illness, access to private healthcare services, and other forms of material support. Furthermore, well-to-do children do not have to rely on their parents' financial resources, and parents do not need to worry about their children's current and future financial well-being (Torssander 2013). The finding that the gradient between children's mean income and parents' mortality is similar in all cause-of-death groups examined is consistent with the

notion that children's financial resources are less of an indicator of specific health-related information or lifestyle factors and more an indicator of the provision of a broad range of material support. Finally, the significant association between children's occupational status and parental mortality is likely to reflect engagement in social networks beyond family and friends, through employment and access to a broader range of information and health-related expertise. However, we should be somewhat cautious in interpreting the size of these associations, in case children's income and occupational status are affected by reverse causality, that is, by the possibility that poor health is shared among all siblings and their parents. In this case, associations between children's income and occupational status and the mortality of their parents could be biased upwards and, therefore, we could overestimate their possible causal associations. We should also note that children's occupational status and income were less predictive of parents' mortality at ages 75 and above than educational attainment.

Our results with respect to children's income and occupation differ in some respects from those documented in Sweden in an earlier study, in which children's educational attainment was a more robust predictor of parents' mortality than their children's income or occupation (Torssander 2014). Reasons for differences in the findings include differences in the age range of the parents at baseline and the time period of mortality follow-up. In the study reported in this paper, we examined parental mortality from baseline ages 50–59 up to age 75 and at ages 75 and above, covering a period from 1971 to 2007. In contrast, the ages of the parents at the start of the mortality follow-up in the Swedish study ranged from 61 to 74 at baseline (for birth cohorts born between 1926 and 1940), with six years of mortality follow-up between 2002 and 2007 inclusive (Torssander 2014). Consistent with Torssander's (2014) study, we also found children's educational attainment to be the most robust predictor of parental mortality at ages 75 and above. We speculate that opportunities for children's SES to influence parental mortality at the oldest ages are more limited than at younger parental ages at death.

In addition, the differences between our results and Torssander's with respect to income may be related to the way in which children's income was measured. Torssander (2014) used the highest income of any child, measured in 2001 before the start of the mortality follow-up. In our study, the income measure reflected the average financial resources of all children measured across more than one census before the death of the parent and thus was less subject to any year-on-year volatility in income. In preliminary analysis, when we used the highest income of any child measured only at one time point, the association between children's income and parents' mortality was weak. In addition, although Sweden and Finland are similar social welfare states, it is also possible that differences in study context, beyond time period and age range, also contribute to differences in the results.

Conclusions

Using register-based data from Finland, we found that children's higher SES, whether measured by their educational attainment, occupation, or income, predicted lower mortality among their parents aged 50 and above in 1970–2007, controlling for parents' own educational attainment, occupational status, and income. These associations varied by cause

of death and parents' age at death. At ages 50–75, the association between children's education and parents' all-cause mortality was mediated by their occupation and income, except for mortality from lung cancer. Furthermore, parents whose children were educated in healthcare had significantly lower mortality from causes of death that are related to long-term behavioural characteristics, suggesting that at least part of the association may be causal. At the same time, higher occupational status and income were significant predictors for parents' mortality from CVD, lung cancer, 'other cancers', 'accidents, violence, and suicide', suggesting that that children's education, income, and occupational status may be operating through distinct pathways. At ages 75 and above, children's educational attainment was the most robust predictor of parents' mortality and this association was largely due to significantly lower parental mortality from CVD. Further studies are needed to examine the potential pathways of influence, the role of intergenerational social mobility, and unobserved characteristics that could confound the observed associations. In addition, because the intergenerational patterns of exchange between generations are likely to change with a shifting societal context, it will be important to replicate the findings of this study for later birth cohorts.

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Table 1

Sample characteristics, Finland 1970–85 (percentage or mean with standard deviation)

Characteristics	Entire sample N=29,261	Fathers N=13,186	Mothers N=16,075	p-value fathers vs. mothers
<i>Children's characteristics, 1970–85</i>				
<i>Highest educational attainment of any child</i>				
Basic (9 years)	25.0	24.3	25.5	0.004
Lower secondary (10–11 years)	30.5	30.4	30.7	
Upper secondary (12 years)	20.0	20.9	19.3	
Post-secondary (13+ years)	24.5	24.4	24.5	
<i>Highest occupational class of any child</i>				
Manual worker	13.6	14.2	13.1	0.000
Farmer/self-employed	9.2	9.0	9.4	
Lower white-collar	40.6	41.0	40.4	
Upper white-collar	35.5	34.5	36.3	
Other/missing	1.0	1.3	0.8	
<i>Highest income quintile of any child</i>				
1 st quintile (low income)	20.0	21.7	18.6	0.000
2 nd quintile	20.0	20.6	19.5	
3 rd quintile	20.0	20.2	19.8	
4 th quintile	20.0	19.1	20.7	
5 th quintile (high income)	20.0	18.4	21.3	
<i>Any child educated in healthcare</i>				
No	86.8	87.0	86.7	0.577
Yes	13.2	13.0	13.3	
<i>Sex of the most highly educated child</i>				
Male	42.6	43.2	42.2	0.115
Female	39.9	39.8	40.0	
Same for both	17.5	17.0	17.8	
<i>Number of children (mean, sd)^a</i>	2.2 (1.2)	2.1 (1.2)	2.2 (1.3)	0.000
<i>Parents' characteristics in 1970</i>				
<i>Age (mean, sd)</i>	54.6 (2.9)	54.7 (2.9)	54.6 (2.9)	0.000
<i>Sex</i>				
Male	45.1	100.0	–	
Female	54.9	–	100.0	
<i>Educational attainment</i>				
Basic (9 years or less)	84.0	80.6	86.8	0.000
Lower secondary (10–11 years)	7.8	8.0	7.6	
Upper secondary (12 years)	4.2	5.7	2.9	
Post-secondary (13+ years)	4.0	5.8	2.6	
<i>Occupation</i>				
Manual worker	41.2	43.5	39.3	0.000

Characteristics	Entire sample N=29,261	Fathers N=13,186	Mothers N=16,075	p-value fathers vs. mothers
Farmer/self-employed	34.7	34.5	34.9	
Lower white-collar	14.8	13.0	16.2	
Upper white-collar	6.2	7.5	5.1	
Other/missing	3.1	1.5	4.5	
<i>Income</i>				
1 st tertile (low income)	33.4	6.8	55.1	0.000
2 nd tertile	33.3	35.4	31.6	
3 rd tertile (high income)	33.3	57.8	13.3	
<i>Marital status</i>				
Married	83.7	93.8	75.4	0.000
Divorced/single	4.9	3.1	6.4	
Widowed	11.4	3.1	18.2	

^aRefers to the number of children in the household in 1950 who were subsequently linked to the Census of Population in 1970, 1975, 1980, or 1985.

Source: 1950 Finnish Census records linked to 1970–85 Censuses and to 1970–2007 death records.

Table 2

Hazard ratios for all-cause mortality at ages 50–75, mothers and fathers separately, Finland 1971–96

	Model 1a	Model 1b	Model 1c	Model 2
Fathers				
<i>Children's characteristics</i>				
<i>Highest educational attainment of any child (Basic 9 years)</i>				
Lower secondary (10–11 years)	0.82 (0.77–0.88)	–	–	0.87 (0.81–0.93)
Upper secondary (12 years)	0.80 (0.74–0.87)	–	–	1.00 (0.92–1.10)
Post-secondary (13+ years)	0.70 (0.64–0.76)	–	–	1.05 (0.95–1.17)
<i>Any child educated in healthcare field (No)</i>				
Yes	0.89 (0.82–0.97)	–	–	0.93 (0.85–1.01)
<i>Sex of the most highly educated child (Male)</i>				
Female	0.91 (0.86–0.96)	–	–	0.78 (0.74–0.84)
Same for both	0.92 (0.85–0.99)	–	–	0.85 (0.78–0.92)
<i>Number of children^a</i>	1.07 (1.05–1.10)	1.09 (1.07–1.12)	1.06 (1.04–1.08)	1.10 (1.08–1.13)
<i>Highest occupational class of any child (Manual worker)</i>				
Farmer/self-employed	–	0.78 (0.70–0.87)	–	0.72 (0.65–0.80)
Lower white-collar	–	0.74 (0.68–0.80)	–	0.78 (0.72–0.85)
Upper white-collar	–	0.57 (0.52–0.62)	–	0.61 (0.55–0.67)
Other/missing	–	2.40 (1.90–3.04)	–	1.67 (1.31–2.13)
<i>Highest income quintile of any child (1st quintile)</i>				
2 nd quintile	–	–	0.77 (0.71–0.82)	0.77 (0.72–0.84)
3 rd quintile	–	–	0.62 (0.57–0.67)	0.61 (0.57–0.67)
4 th quintile	–	–	0.56 (0.52–0.61)	0.54 (0.50–0.59)
5 th quintile (high income)	–	–	0.55 (0.51–0.60)	0.54 (0.49–0.59)
<i>Number of observations</i>	13,186			
<i>Number of deaths</i>	6,344			

	Model 1a	Model 1b	Model 1c	Model 2
Mothers				
<i>Children's characteristics</i>				
<i>Highest educational attainment of any child (Basic 9 years)</i>				
Lower secondary (10–11 years)	0.79 (0.73–0.86)	–	–	0.84 (0.77–0.92)
Upper secondary (12 years)	0.74 (0.67–0.82)	–	–	0.94 (0.85–1.05)
Post-secondary (13+ years)	0.64 (0.57–0.71)	–	–	0.98 (0.86–1.12)
<i>Any child educated in healthcare field (No)</i>				
Yes	0.84 (0.75–0.93)	–	–	0.86 (0.78–0.96)
<i>Sex of the most highly educated child (Male)</i>				
Female	0.95 (0.88–1.02)	–	–	0.83 (0.77–0.90)
Same for both	0.86 (0.78–0.95)	–	–	0.83 (0.76–0.91)
<i>Number of children^a</i>	1.10 (1.07–1.13)	1.10 (1.08–1.13)	1.07 (1.04–1.10)	1.12 (1.10–1.15)
<i>Highest occupational class of any child (Manual worker)</i>				
Farmer/self-employed	–	0.78 (0.69–0.88)	–	0.71 (0.62–0.81)
Lower white-collar	–	0.72 (0.66–0.79)	–	0.76 (0.69–0.84)
Upper white-collar	–	0.53 (0.48–0.59)	–	0.59 (0.52–0.67)
Other/missing	–	1.92 (1.42–2.59)	–	1.37 (1.01–1.87)
<i>Highest income quintile of any child (1st quintile)</i>				
2 nd quintile	–	–	0.77 (0.70–0.85)	0.78 (0.71–0.86)
3 rd quintile	–	–	0.64 (0.58–0.71)	0.64 (0.58–0.71)
4 th quintile	–	–	0.59 (0.53–0.65)	0.58 (0.52–0.64)
5 th quintile (high income)	–	–	0.54 (0.49–0.59)	0.55 (0.49–0.61)
<i>Number of observations</i>	16,075			
<i>Number of deaths</i>	4,041			

^aRefers to the number of children in the household in 1950 who were alive prior to the death of the parent or the end of mortality follow-up.

Notes: Reference category in parentheses. 95 per cent confidence intervals included in parentheses. Models 1a–1c and Model 2 also control for fathers' or mothers' marital status, educational attainment, occupation, and income.

Source: As for Table 1.

Table 3

Hazard ratios for all-cause mortality at ages 75 and above, mothers and fathers separately, Finland 1996–2007

	Model 1a	Model 1b	Model 1c	Model 2
Fathers				
<i>Children's characteristics</i>				
<i>Highest educational attainment of any child (Basic 9 years)</i>				
Lower secondary (10–11 years)	0.96 (0.89–1.04)	–	–	0.96 (0.89–1.03)
Upper secondary (12 years)	0.88 (0.81–0.96)	–	–	0.88 (0.81–0.97)
Post-secondary (13+ years)	0.84 (0.77–0.91)	–	–	0.83 (0.75–0.92)
<i>Any child educated in healthcare field (No)</i>				
Yes	0.99 (0.92–1.08)	–	–	1.00 (0.92–1.08)
<i>Sex of the most highly educated child (Male)</i>				
Female	1.01 (0.95–1.07)	–	–	1.00 (0.94–1.07)
Same for both	1.04 (0.96–1.12)	–	–	1.04 (0.96–1.12)
Number of children ^a	1.05 (1.03–1.08)	1.05 (1.03–1.08)	1.04 (1.02–1.07)	1.05 (1.02–1.08)
<i>Highest occupational class of any child (Manual worker)</i>				
Farmer/self-employed?	–	0.92 (0.82–1.03)	–	0.92 (0.82–1.03)
Lower white-collar	–	0.92 (0.84–1.00)	–	0.95 (0.86–1.04)
Upper white-collar	–	0.87 (0.79–0.95)	–	0.97 (0.87–1.08)
Other/missing	–	0.92 (0.63–1.34)	–	0.95 (0.65–1.39)
<i>Highest income quintile of any child (1st quintile)</i>				
2 nd quintile	–	–	1.05 (0.96–1.15)	1.06 (0.97–1.17)
3 rd quintile	–	–	1.03 (0.95–1.12)	1.05 (0.97–1.15)
4 th quintile	–	–	0.95 (0.88–1.04)	0.99 (0.90–1.08)
5 th quintile (high income)	–	–	0.96 (0.88–1.04)	1.01 (0.92–1.12)
Number of observations	6,842			
Number of deaths	5,961			

	Model 1a	Model 1b	Model 1c	Model 2
Mothers				
Children's characteristics				
Highest educational attainment of any child (Basic 9 years)				
Lower secondary (10–11 years)	0.93 (0.88–0.98)	–	–	0.94 (0.88–0.99)
Upper secondary (12 years)	0.86 (0.81–0.92)	–	–	0.90 (0.84–0.97)
Post-secondary (13+ years)	0.82 (0.76–0.87)	–	–	0.85 (0.79–0.93)
Any child educated in healthcare field (No)				
Yes	0.97 (0.91–1.03)	–	–	0.98 (0.91–1.04)
Sex of the most highly educated child (Male)				
Female	0.97 (0.93–1.02)	–	–	0.98 (0.93–1.03)
Same for both	0.96 (0.90–1.02)	–	–	0.97 (0.91–1.04)
Number of children ^a	1.06 (1.04–1.08)	1.06 (1.04–1.08)	1.05 (1.03–1.07)	1.07 (1.05–1.09)
Highest occupational class of any child (Manual worker)				
Farmer/self-employed?	–	0.99 (0.90–1.08)	–	0.98 (0.89–1.08)
Lower white-collar	–	0.88 (0.82–0.94)	–	0.91 (0.85–0.98)
Upper white-collar	–	0.82 (0.77–0.88)	–	0.89 (0.82–0.97)
Other/missing	–	0.93 (0.69–1.25)	–	0.91 (0.68–1.23)
Highest income quintile of any child (1 st quintile)				
2 nd quintile	–	–	0.98 (0.91–1.05)	0.99 (0.92–1.06)
3 rd quintile	–	–	0.91 (0.85–0.97)	0.93 (0.86–0.99)
4 th quintile	–	–	0.90 (0.85–0.97)	0.93 (0.87–1.00)
5 th quintile (high income)	–	–	0.93 (0.87–0.99)	0.98 (0.91–1.06)
Number of observations	12,034			
Number of deaths	9,230			

^aRefers to the number of children in the household in 1950 who were alive prior to the death of the parent or the end of mortality follow-up.

Notes: Reference category in parentheses. 95 per cent confidence intervals included in parentheses. Models 1a–1c and Model 2 also control for fathers' or mothers' marital status, educational attainment, occupation, and income.

Source: As for Table 1.

Table 4

Hazard ratios for cause-specific mortality at ages 50–75, fathers and mothers combined, fully adjusted model (Model 2), Finland 1971–1996

	Cardiovascular disease	Lung cancer	Other cancers	Accidents, violence, and suicide
<i>Children's characteristics</i>				
<i>Highest educational attainment of any child (Basic 9 years)</i>				
Lower secondary (10–11 years)	0.86 (0.80–0.92)	0.81 (0.68–0.96)	0.91 (0.81–1.03)	0.78 (0.61–1.00)
Upper secondary (12 years)	0.98 (0.89–1.07)	0.72 (0.57–0.91)	1.08 (0.93–1.26)	1.33 (0.99–1.78)
Post-secondary (13+ years)	1.03 (0.92–1.15)	0.74 (0.55–0.98)	1.23 (1.03–1.47)	1.26 (0.88–1.81)
<i>Any child educated in healthcare field (No)</i>				
Yes	0.91 (0.83–1.00)	0.89 (0.70–1.13)	0.94 (0.81–1.08)	0.84 (0.60–1.17)
<i>Sex of the most highly educated child (Male)</i>				
Female	0.79 (0.74–0.84)	0.85 (0.72–1.00)	0.77 (0.69–0.86)	0.75 (0.59–0.94)
Same for both	0.80 (0.74–0.88)	0.91 (0.74–1.12)	0.85 (0.75–0.98)	0.79 (0.60–1.05)
<i>Number of children^a</i>	1.13 (1.10–1.16)	1.16 (1.10–1.23)	1.07 (1.03–1.11)	1.04 (0.96–1.13)
<i>Highest occupational class of any child (Manual worker)</i>				
Farmer/self-employed	0.78 (0.70–0.87)	0.56 (0.42–0.75)	0.63 (0.53–0.76)	0.53 (0.36–0.79)
Lower white-collar	0.78 (0.72–0.85)	0.75 (0.61–0.91)	0.73 (0.64–0.84)	0.63 (0.48–0.83)
Upper white-collar	0.60 (0.53–0.66)	0.63 (0.49–0.82)	0.57 (0.48–0.68)	0.50 (0.35–0.71)
Other/missing	1.66 (1.29–2.13)	1.26 (0.72–2.23)	1.39 (0.95–2.03)	1.21 (0.60–2.44)
<i>Highest income quintile of any child (1st quintile)</i>				
2 nd quintile	0.78 (0.72–0.85)	0.70 (0.58–0.86)	0.71 (0.62–0.82)	0.91 (0.69–1.19)
3 rd quintile	0.62 (0.57–0.68)	0.52 (0.42–0.64)	0.65 (0.56–0.74)	0.57 (0.43–0.77)
4 th quintile	0.55 (0.50–0.61)	0.54 (0.43–0.67)	0.54 (0.47–0.63)	0.46 (0.33–0.63)
5 th quintile (high income)	0.56 (0.50–0.62)	0.45 (0.35–0.58)	0.53 (0.46–0.62)	0.52 (0.37–0.72)
<i>Number of observations</i>	29,261	29,261	29,261	29,261
<i>Number of deaths</i>	5,601	875	2,085	467

^aRefers to the number of children in 1950 and who were alive prior to the death of the parent or the end of mortality follow-up.

Notes: Reference category in parentheses. 95 per cent confidence intervals are included in parentheses. Model 2 controls for fathers' and mothers' marital status, educational attainment, occupation, and income, and the gender of the parent.

Source: As for Table 1.

Hazard ratios for cause-specific mortality at ages 75 and above, fathers and mothers combined, fully adjusted model (Model 2), Finland 1996–2007

Table 5

	Cardiovascular disease	Lung cancer	Other cancers	Accidents, violence, and suicide
<i>Children's characteristics</i>				
<i>Highest educational level of any child (Basic 9 years)</i>				
Lower secondary (10–11 years)	0.91 (0.86–0.97)	1.13 (0.87–1.48)	1.06 (0.94–1.20)	1.15 (0.87–1.52)
Upper secondary (12 years)	0.89 (0.82–0.96)	0.71 (0.50–1.00)	0.92 (0.80–1.07)	1.01 (0.73–1.41)
Post-secondary (13+ years)	0.84 (0.76–0.92)	0.77 (0.51–1.16)	0.91 (0.77–1.07)	1.05 (0.73–1.51)
<i>Any child educated in healthcare field (No)</i>				
Yes	1.02 (0.96–1.10)	0.78 (0.56–1.08)	0.95 (0.84–1.08)	1.09 (0.83–1.42)
<i>Sex of the most highly educated child (Male)</i>				
Female	0.99 (0.93–1.05)	1.17 (0.91–1.49)	1.08 (0.97–1.20)	1.04 (0.83–1.30)
Same for both	1.02 (0.95–1.09)	1.17 (0.86–1.58)	1.05 (0.92–1.20)	0.82 (0.60–1.12)
<i>Number of children^a</i>	1.08 (1.06–1.10)	1.17 (1.07–1.27)	1.01 (0.97–1.05)	1.02 (0.93–1.11)
<i>Highest occupational class of any child (Manual worker)</i>				
Farmer/self-employed	0.91 (0.83–1.01)	0.86 (0.55–1.34)	1.22 (1.00–1.50)	0.81 (0.52–1.27)
Lower white-collar	0.85 (0.79–0.92)	0.85 (0.61–1.20)	1.19 (1.02–1.40)	0.88 (0.63–1.23)
Upper white-collar	0.86 (0.78–0.94)	0.86 (0.57–1.30)	1.20 (1.00–1.44)	1.01 (0.69–1.47)
Other/missing	0.83 (0.60–1.14)	1.87 (0.66–5.32)	0.90 (0.47–1.72)	1.23 (0.37–4.01)
<i>Highest income quintile of any child (1st quintile)</i>				
2 nd quintile	1.02 (0.94–1.10)	1.26 (0.91–1.76)	0.97 (0.84–1.12)	1.42 (1.04–1.94)
3 rd quintile	0.99 (0.91–1.06)	1.01 (0.72–1.44)	0.96 (0.83–1.11)	1.10 (0.80–1.51)
4 th quintile	0.97 (0.89–1.05)	1.14 (0.80–1.62)	0.96 (0.83–1.11)	1.04 (0.75–1.44)
5 th quintile (high income)	1.00 (0.92–1.09)	1.17 (0.79–1.73)	1.09 (0.93–1.28)	0.95 (0.67–1.35)
<i>Number of observations</i>	18,876	18,876	18,876	18,876
<i>Number of deaths</i>	8,009	397	2,253	474

^aRefers to the number of children in the household in 1950 who were alive prior to the death of the parent or the end of mortality follow-up.

Notes: Reference category in parentheses. 95 per cent confidence intervals are included in parentheses. Model 2 controls for fathers' and mothers' marital status, educational attainment, occupation, and income, and the gender of the parent.

Source: As for Table 1.

Appendix Table A1

Hazard ratios for cause-specific mortality at ages 50–75, fathers and mothers combined, Models 1a–1c, Finland 1971–96

	Cardiovascular diseases			Lung cancer		
	Model 1a	Model 1b	Model 1c	Model 1a	Model 1b	Model 1c
<i>Children's characteristics</i>						
<i>Highest educational attainment of any child (Basic 9 years)</i>						
Lower secondary (10–11 years)	0.81 (0.75–0.87)	–	–	0.77 (0.65–0.91)	–	–
Upper secondary (12 years)	0.77 (0.71–0.84)	–	–	0.58 (0.47–0.73)	–	–
Post-secondary (13+ years)	0.67 (0.61–0.73)	–	–	0.51 (0.40–0.64)	–	–
<i>Any child educated in health care field (No)</i>						
Yes	0.88 (0.80–0.96)	–	–	0.86 (0.68–1.08)	–	–
<i>Sex of the most highly educated child (Male)</i>						
Female	0.91 (0.85–0.96)	–	–	1.01 (0.87–1.18)	–	–
Same for both	0.86 (0.79–0.93)	–	–	0.98 (0.80–1.20)	–	–
<i>Number of children^a</i>	1.10 (1.08–1.13)	1.11 (1.09–1.14)	1.07 (1.05–1.10)	1.13 (1.07–1.20)	1.14 (1.08–1.21)	1.11 (1.05–1.17)
<i>Highest occupational class of any child (Manual worker)</i>						
Farmer/self-employed	–	0.84 (0.76–0.94)	–	–	0.62 (0.47–0.83)	–
Lower white-collar	–	0.74 (0.68–0.80)	–	–	0.66 (0.55–0.80)	–
Upper white-collar	–	0.56 (0.51–0.61)	–	–	0.47 (0.38–0.58)	–
Other/missing	–	2.33 (1.83–2.96)	–	–	1.88 (1.09–3.26)	–
<i>Highest income quintile of any child (1st quintile)</i>						
2 nd quintile	–	–	0.77 (0.71–0.83)	–	–	0.69 (0.57–0.84)
3 rd quintile	–	–	0.62 (0.57–0.67)	–	–	0.51 (0.42–0.62)
4 th quintile	–	–	0.57 (0.52–0.62)	–	–	0.53 (0.43–0.65)
5 th quintile (high income)	–	–	0.56 (0.51–0.61)	–	–	0.42 (0.33–0.52)
<i>Number of observations</i>	29,261			29,261		
<i>Number of deaths</i>	5,601			875		

	Other cancers			Accidents, violence, and suicide		
	Model 1a	Model 1b	Model 1c	Model 1a	Model 1b	Model 1c
Children's characteristics						
<i>Highest educational attainment of any child (Basic 9 years)</i>						
Lower secondary (10–11 years)	0.86 (0.76–0.97)	–	–	0.73 (0.57–0.94)	–	–
Upper secondary (12 years)	0.86 (0.75–0.90)	–	–	0.99 (0.76–1.29)	–	–
Post-secondary (13+ years)	0.81 (0.70–0.93)	–	–	0.77 (0.57–1.03)	–	–
<i>Any child educated in health care field (No)</i>						
Yes	0.91 (0.79–1.05)	–	–	0.80 (0.57–1.11)	–	–
<i>Sex of the most highly educated child (Male)</i>						
Female	0.87 (0.81–0.98)	–	–	0.88 (0.72–1.08)	–	–
Same for both	0.90 (0.79–1.03)	–	–	0.85 (0.64–1.12)	–	–
<i>Number of children^a</i>	1.04 (1.00–1.08)	1.06 (1.02–1.10)	1.03 (1.00–1.07)	1.01 (0.93–1.10)	1.03 (0.95–1.11)	1.12 (1.10–1.15)
<i>Highest occupational class of any child (Manual worker)</i>						
Farmer/self-employed	–	0.70 (0.58–0.84)	–	–	0.59 (0.40–0.87)	–
Lower white-collar	–	0.70 (0.62–0.80)	–	–	0.64 (0.49–0.83)	–
Upper white-collar	–	0.58 (0.51–0.70)	–	–	0.53 (0.40–0.71)	–
Other/missing	–	2.05 (1.42–2.60)	–	–	1.91 (0.98–3.72)	–
<i>Highest income quintile of any child (1st quintile)</i>						
2 nd quintile	–	–	0.72 (0.63–0.82)	–	–	0.92 (0.71–1.20)
3 rd quintile	–	–	0.67 (0.59–0.77)	–	–	0.61 (0.46–0.81)
4 th quintile	–	–	0.58 (0.51–0.67)	–	–	0.52 (0.39–0.70)
5 th quintile (high income)	–	–	0.58 (0.51–0.68)	–	–	0.59 (0.44–0.80)
<i>Number of observations</i>	29,261			29,261		
<i>Number of deaths</i>	2,085			467		

^aRefers to the number of children in the household in 1950 who were alive prior to the death of the parent or the end of mortality follow-up.

Notes: Reference category in parentheses. 95 per cent confidence intervals are included in parentheses. Models 1a–1c control for fathers' and mothers' marital status, educational attainment, occupation, and income, and the gender of the parent.

Source: As for Table 1.

Appendix Table A2

Hazard ratios for cause-specific mortality at ages 75 and above, fathers and mothers combined, Models 1a–1c, Finland 1996–2007

	Cardiovascular diseases			Lung cancer		
	Model 1a	Model 1b	Model 1c	Model 1a	Model 1b	Model 1c
<i>Children's characteristics</i>						
<i>Highest educational attainment of any child (Basic 9 years)</i>						
Lower secondary (10–11 years)	0.90 (0.85–0.96)	–	–	1.12 (0.86–1.47)	–	–
Upper secondary (12 years)	0.85 (0.79–0.91)	–	–	0.69 (0.50–0.96)	–	–
Post-secondary (13+ years)	0.80 (0.74–0.86)	–	–	0.76 (0.54–1.05)	–	–
<i>Any child educated in health care field (No)</i>						
Yes	1.02 (0.95–1.09)	–	–	0.77 (0.56–1.08)	–	–
<i>Sex of the most highly educated child (Male)</i>						
Female	0.97 (0.92–1.02)	–	–	1.11 (0.89–1.39)	–	–
Same for both	1.00 (0.94–1.07)	–	–	1.14 (0.86–1.53)	–	–
<i>Number of children^a</i>	1.07 (1.05–1.09)	1.08 (1.06–1.10)	1.06 (1.04–1.08)	1.16 (1.06–1.25)	1.17 (1.08–1.26)	1.13 (1.05–1.22)
<i>Highest occupational class of any child (Manual worker)</i>						
Farmer/self-employed	–	0.92 (0.83–1.01)	–	–	0.86 (0.56–1.33)	–
Lower white-collar	–	0.83 (0.77–0.89)	–	–	0.79 (0.58–1.09)	–
Upper white-collar	–	0.79 (0.73–0.85)	–	–	0.67 (0.48–0.94)	–
Other/missing	–	0.84 (0.61–1.14)	–	–	1.58 (0.58–4.30)	–
<i>Highest income quintile of any child (1st quintile)</i>						
2 nd quintile	–	–	1.01 (0.93–1.09)	–	–	1.17 (0.85–1.62)
3 rd quintile	–	–	0.97 (0.90–1.04)	–	–	0.90 (0.65–1.27)
4 th quintile	–	–	0.94 (0.88–1.02)	–	–	0.95 (0.68–1.33)
5 th quintile (high income)	–	–	0.95 (0.88–1.02)	–	–	0.90 (0.64–1.27)
<i>Number of observations</i>	18,876			18,876		
<i>Number of deaths</i>	8,009			397		

	Other cancers			Accidents, violence, and suicide		
	Model 1a	Model 1b	Model 1c	Model 1a	Model 1b	Model 1c
Children's characteristics						
<i>Highest educational attainment of any child (Basic 9 years)</i>						
Lower secondary (10–11 years)	1.07 (0.95–1.21)	–	–	1.16 (0.88–1.52)	–	–
Upper secondary (12 years)	0.96 (0.84–1.04)	–	–	1.02 (0.75–1.38)	–	–
Post-secondary (13+ years)	0.98 (0.85–1.12)	–	–	1.07 (0.79–1.46)	–	–
<i>Any child educated in health care field (No)</i>						
Yes	0.95 (0.84–1.08)	–	–	1.08 (0.83–1.40)	–	–
<i>Sex of the most highly educated child (Male)</i>						
Female	1.07 (0.98–1.18)	–	–	1.09 (0.89–1.34)	–	–
Same for both	1.06 (0.93–1.20)	–	–	0.83 (0.61–1.13)	–	–
<i>Number of children^a</i>	1.01 (0.97–1.05)	1.01 (0.97–1.04)	1.02 (0.98–1.05)	1.03 (0.95–1.12)	1.02 (0.94–1.11)	1.01 (0.93–1.09)
<i>Highest occupational class of any child (Manual worker)</i>						
Farmer/self-employed	–	1.24 (1.01–1.51)	–	–	0.81 (0.52–1.26)	–
Lower white-collar	–	1.18 (1.02–1.37)	–	–	0.90 (0.66–1.23)	–
Upper white-collar	–	1.14 (0.97–1.33)	–	–	0.97 (0.70–1.34)	–
Other/missing	–	0.87 (0.46–1.65)	–	–	1.02 (0.32–3.23)	–
<i>Highest income quintile of any child (1st quintile)</i>						
2 nd quintile	–	–	0.96 (0.83–1.11)	–	–	1.43 (1.05–1.94)
3 rd quintile	–	–	0.94 (0.81–1.08)	–	–	1.10 (0.80–1.51)
4 th quintile	–	–	0.91 (0.79–1.04)	–	–	1.06 (0.78–1.44)
5 th quintile (high income)	–	–	1.01 (0.88–1.15)	–	–	0.97 (0.71–1.34)
<i>Number of observations</i>	18,876			18,876		
<i>Number of deaths</i>	2,253			474		

^aRefers to the number of children in the household in 1950 who were alive prior to the death of the parent or the end of mortality follow-up.

Notes: Reference category in parentheses. 95 per cent confidence intervals are included in parentheses. Models 1a–1c control for fathers' and mothers' marital status, educational attainment, occupation, and income, and the gender of the parent.

Source: As for Table 1.