Early Life Family and Socioeconomic Conditions and Cause-Specific Mortality in Finland

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ABSTRACT

We studied the relationship between early life socioeconomic status, household structure and adult all cause and cause-specific mortality in Finland among cohorts born in 1936-1950. We based the analyses on a 10% sample of households drawn from the 1950 Finnish Census of Population with the follow-up of household members in subsequent censuses and death records beginning from the end of 1970 through the end of 2007. The Finnish data constitute a unique register based data set that does not rely on individual recall of early life social conditions, parental educational attainment, family type, and other life course trajectories. We found significant associations between early life social and family conditions on all cause mortality as well as mortality from cardiovascular diseases, lung cancer and alcohol related diseases, accidents and violence, with protective effects of higher childhood SES varying between 10% and 30%. These associations were mostly mediated through adult educational attainment and other socio-demographic characteristics, suggesting that the indirect effects of childhood socioeconomic and family conditions were more important than their direct effects. The results imply that long-term adverse health consequences of disadvantaged early life social circumstances may be mitigated by investments in educational and employment opportunities in early adulthood.

INTRODUCTION

Although socioeconomic (SES) inequalities in mortality have been well documented in Europe and the United States (Elo and Preston 1996; Martikainen 1995; Preston and Taubman 1994), their causes are less well understood. Until recently, most studies of SES inequalities in adult health focused solely on adult characteristics. However, as evidence on the associations between childhood characteristics and adult health outcomes has accumulated, increased attention is now being paid to the cumulative effects of social origins on health outcomes throughout the life course (e.g., Blackwell et al. 2001; Costa 1993; Elo and Preston 1992; Haas 2008; Hayward and Gorman 2004). The evidence from this research suggests that early life nutritional status and health, childhood SES, place of residence and other household characteristics contribute to disparities in adult health and mortality (Beebe-Dimmer et al. 2004; Blackwell et al. 2001; Case et al. 2005; Hayward and Gorman 2004; Kuh et al. 2002; Laaksonen et al. 2005; Osler et al. 2005; Preston et al. 1998). Among the mechanisms through which early life environment is hypothesized to influence adult health include indirect mechanisms operating through attained adult characteristics (e.g., SES and lifestyle factors) and direct effects of childhood health (Preston et al. 1998; Case and Paxson 2010).

The purpose of this paper is to investigate the associations between childhood family characteristics on all-cause and cause-specific mortality in Finland during the latter half of the twentieth century. We base the analyses on a 10% sample of households drawn from the 1950 Finnish Census of Population with the follow-up of household members in subsequent censuses and death records beginning in the end of 1970 through December 31, 2007. The Finnish data constitute a unique register based data set that enables us to follow individuals from childhood into census and death records through adulthood. In these data, information on childhood characteristics are not based on individual recall of early life family circumstances or on reports

of attained educational attainment, occupation, and other life course trajectories. The results contribute to the accumulating evidence on the associations between early life conditions and adult cause-specific mortality.

BACKGROUND

Studies of the effects of childhood characteristics on adult health and mortality have increased substantially in recent years based on data from both developed (e.g., Blackwell et al. 2001; Galobardes et al. 2004; Haas 2008; Hayward and Gorman 2004; Lawlor et al. 2006; Melchior et al. 2007; Pensola and Valkonen 2002; Strand and Kunst 2006;) and developing countries (Huang and Elo 2009; Kohler and Soldo 2005; Zeng et al. 2007). Early childhood environment has been proposed to have direct effects on adult health and mortality through exposure to physiological scarring (e.g., childhood infectious diseases, nutritional deprivation, adverse in utero environment) or acquired immunity, and indirect effects through attained adult circumstances or health selection (Barker 1995; Hayward and Gorman 2004; Huang and Elo 2009; Preston et al. 1998). Evidence further points to a differential impact of childhood conditions on various disease processes reflected in differing associations between early life characteristics and cause-specific mortality (Galobardes et al. 2004). For example, these associations appear to be stronger for heart disease than for overall cancer mortality, although they appear to vary by cancer type (Galobardes et al. 2004; Lawlor et al. 2006; Strand and Kunst 2006). There is also some evidence that early life conditions play a role in substance abuse (Melchior et al. 2007) and in mortality from accidents and violence, although evidence here is more limited (Galobardes et al. 2004; Lawlor et al. 2006; Strand and Kunst 2006; Pensola and Valkonen 2002; Pensola and Martikainen 2003).

Several prior studies have documented significant associations between childhood SES, measured by father's occupation and/or parental education, housing characteristics and/or family income and various adult health outcomes (e.g., Blackwell et al. 2001; Haas 2008; Moody-Ayers et al. 2007) and mortality (e.g., Loucks et al. 2009; Osler et al. 2005; Strand and Kunst 2006). These associations are typically substantially attenuated with controls for adult SES, but can remain significant depending on the health outcome and the range of controls included in the statistical model. In addition to childhood SES, others have examined the role of family structure and farm residence on old age mortality in the United States (e.g., Hayward and Gorman 2004; Preston et al. 1998). In both studies, farm residence and living in two parent households was protective, although in the Hayward-Gorman study (2004) the latter result was evident only in two parent families where the mother did not work.

That adult characteristics substantially attenuate the associations between early life conditions and adult health outcomes is not surprising. Children born to disadvantaged families are more likely to be low birth weight and/or preterm (Behrman and Butler 2006; Hummer 1993; Morenoff 2003) and are more likely to experience adverse health events in childhood than children born to wealthier households (Case et al. 2002, 2005; Kuh and Wadsworth 1993). Similarly, higher levels of parental education predict better childhood health and higher levels of education (Haas 2006). Thus children who grow up in higher SES households enter adulthood in better health and with higher levels of education and thus are themselves likely to achieve higher SES and reap the health benefits from greater access to human and financial capital throughout their lives (Lynch et al. 1994; Duncan et al. 1998; Elman and O'Rand 2004; Hayward and Gorman 2004). One of the mechanisms through which this influence may operate is health-related behaviors such as smoking, exercise, and diet (Hayward and Gorman 2004; van de

Mheen et al. 1998). At the same time, most studies find that adult SES and family characteristics remain significant predictors of adult health and mortality with the size of these associations typically being larger than those of childhood characteristics (e.g. Pensola and Martikainen 2003, Martikainen et al. 2009). However, questions remain to what extent the estimates of adult SES on mortality are biased by the unavailability of information on health status in childhood (Smith 2007). Evidence from prior studies further suggest that for upwardly mobile individuals higher attained adult SES helps mitigate the influence of early life hardship on later life health outcomes (Power et al. 1996; Luo and Waite 2005).

In this paper, we examine the effects of early life family background and socio-demographic characteristics attained in early adulthood on adult mortality. Childhood economic status and health influence educational attainment, occupational trajectories and health in young adulthood and thus we hypothesize that the effects of childhood family background on adult mortality operate mainly indirectly through socio-demographic characteristics attained in early adulthood. We also estimate effects of educational attainment, occupation and family characteristics measured in early adulthood on subsequent mortality. We further test whether our results are affected by unobserved heterogeneity by using information on siblings.

DATA AND METHODS

Our analyses are based on a data set that consists of a 10% sample of households drawn from the 1950 Finnish Census of Population (Statistics Finland 1997). All household members in this sample have been linked to subsequent census records beginning in 1970 through 1995 and to death records through December 31, 2007 using unique person identifiers by Statistics Finland. In this paper, we utilize information on the family of origin from the 1950 census and adult characteristics recorded at ages 25-35 from the 1970, 1975, 1980 or 1985 censuses. The linked

death certificate data provide information on the date of death and cause of death based on 8th, 9th or 10th revision of the International Classification of Diseases and Deaths (ICD). Causes of death have been grouped into leading causes of death for which classification is comparable across the various ICD revisions.

The 1950 data contain identifiers for both families and households making it possible to identify members who belonged to the same family. Because of our interest in the associations of childhood family characteristics and mortality between ages 35-72, we base our analysis on individuals who were 0-14 years of age at the time of the 1950 census and who were living in single mother, single father or two parent families. We used unique family identifiers and information on the parents' age and the relationship of family members to the head of the family in linking children to their mother and/or father. In the 1950 census sample, there were 116,622 children aged 0-14. Of these children, we excluded those who were not present in the censuses of 1970, 1975, 1980 or 1985, because they had either died before 1970 or had moved out of Finland before 1970, mostly to Sweden, (n=15,065), and those who were known to have died before age 35 (n=1,001). These exclusions reduced the sample to 100,556 children aged 0-14 in 1950. We further dropped cases for which we had unrealistic values for the mother's (below age 15 and above age 49) and the father's (below age 15 and above age 65) age at the child's birth (n=397) and individuals for whom we could not obtain adult characteristics from the censuses when these individuals were 25-35 years of age (n=1,770). These individuals were present in Finland at some censuses but absent, most likely living abroad, at ages 25-35. Our final sample consisted of 98,389 children ages 0-14 in 1950.

Childhood Characteristics

All information on childhood circumstances was obtained from the 1950 census. These

characteristics tap into broad area level contextual variations captured by region of birth and early life family circumstances characterized by the family's social class, parental education, housing conditions, and family structure; factors that have been found in prior studies to be associated with adult health and mortality (Galobardes et al. 2004; Hayward and Gorman 2004; Strand and Kunst 2006; Valkonen 1987). In addition, we controlled for gender and year of birth, and we distinguished among three birth cohorts by whether or not the individual was born before November 30, 1939, between this date and September 19, 1944 or thereafter. Finland fought two wars against the Soviet Union between late November 1939 and September 1944 and thus our birth cohort variable identifies children born prior to these wars, during the war period, or thereafter.

We differentiated among five Finnish regions: the area surrounding the Finnish capital - Helsinki, the rest of Southern Finland (rest of Uusimaa), Western Finland, Eastern Finland and Lapland, thus capturing the well-known regional differences in mortality between North-East Finland and South-West Finland (Blomgren et al. 2004; Koskinen 1995; Saarela and Finnäs 2009; Valkonen 1987). We measured the individual's childhood socioeconomic circumstances by the father's occupational class, except in mother only families when the mother's occupation was used. In 1950 in Finland, the father's rather than the mother's occupation was more likely to reflect the family's social class when both parents were present. The coding of this variable was based on prior Finnish studies and distinguished among professional/administrative occupations, manual workers, and farmers, with self-employed, other and unknown occupations grouped into an additional category (Notkola et al. 2002, Martikainen et al. 2004). We also included parental educational attainment which has been associated with child health and educational outcomes in prior studies (e.g., Case et al. 2002, 2005) and which has been hypothesized to reflect

knowledge, skills, and problem solving abilities (Mirowsky and Ross 2003; Cutler et al. 2006; Smith 2007). We coded parental education to the highest level of schooling of either the mother or the father when both parents were present. In these families parents' educational attainment was highly correlated; in 79% of the families the mother and the father had the same level of schooling, in 13% the mother had a higher level of education with the reverse being true in 8% of the families.

We examined two measures of childhood housing conditions, namely home ownership and household crowding. We included only household crowding, which was coded as the number of persons per heated room in the dwelling. It reflects family's material resources and housing wealth and it was a stronger predictor of adult mortality than home ownership. We also included a measure of childhood family type which distinguished among mother only families, father only families, and families where both parents were present.

Adult Characteristics

We selected adult characteristics that reflected attained SES and family characteristics as close to age 35 as possible; an age when the study subjects had completed or were near completion of their education and were in the early stages of their occupational careers. Thirty-five was also the age at which mortality follow-up began. These characteristics came from the individual records in the Finnish censuses of 1970, 1975, 1980 or 1985. For close to 99% of the individuals these adult characteristics came from the census record when the person was 30-35 years old and for about 1% when the person was 25-29 years old.

We included the following adult socio-demographic characteristics that have been found to be significant predictors of adult mortality in Finland (Martikainen et al. 1999, 2005, 2007; Koskinen et al. 2007) and elsewhere (Elo and Preston 1996; Preston and Taubman 1994; Smith

2007): marital status, family formation, educational attainment, occupation, labor force attachment, and home ownership. Marital status distinguished among those who had never married, were currently married, and those who had divorced/separated or widowed. As a measure of family formation, we included an indicator of whether there were children in the household at the time of the census. The coding of educational attainment reflected educational thresholds and a wider range of educational levels than was the case in 1950 and was coded as basic or primary (9 years), lower secondary (10-11 years), upper secondary (12 years) and post-secondary (13+ years) education. The 7-category occupational coding distinguished among white collar and manual occupations, farmers, self-employed and other and unknown. Home ownership was coded as owning one's own home or an apartment, received housing from an employer, or the individual was a renter. Home ownership taps into differences in wealth.

Causes of death

In addition to investigating all cause mortality, we conducted separate analysis for cardiovascular diseases, which in prior studies have been linked to early life circumstances (Barker 1995; Galobardes et al. 2004), alcohol related diseases, accidents and violence and lung cancer. Alcohol related diseases, which include among others alcoholic liver disease, alcoholic diseases of the pancreas, alcoholic cardiomyopathy, alcohol dependence syndrome and other mental and behavioral disorders due to alcohol use, were important causes of middle age male mortality in Finland (Herttua et al. 2008). In addition many accidental and violent deaths in Finland were associated with excessive alcohol use (Herttua et al. 2008). Lung cancer, a cause of death closely associated with cigarette smoking, has been associated with childhood background in some prior studies (Galobardes et al. 2004; Lawlor et al. 2006).

Statistical methods

We used Cox proportional hazards regression models to estimate all-cause and cause-specific mortality beginning at age 35 until the end of follow-up, which for the oldest individual was age 72. The model is in the form of: $\log h_i(t) = \log h(t) + \alpha BY_i + \sum_j \beta_j X_{ji} + \sum_k \beta_{ki} X_{ki}$; where *h(t)* is the unspecified baseline hazard function, *t* measures time since age 35, *i* refers to the individual, *j* to childhood conditions, and *k* to adult characteristics; *BY* refers to the individual's year of birth. Individuals who were alive on December 31, 2007 were censored on this date. In the cause-specific mortality models, individuals who died from causes other than the one under investigation were censored at the date of death (Allison 1995; Cox and Oakes 1984). Hazard ratios were calculated based on coefficients from the proportional hazard models ($HR=e^{\beta}$). We used t-tests to assess the significance of individual coefficients and calculated robust standard errors to account for clustering of individuals within families.

We estimated three models: Model 1 included only each explanatory variable of interest as well as year of birth and sex. In Model 2, in addition to year of birth and sex we introduced either all childhood characteristics or all adult characteristics to assess whether, within each set, early life or adult characteristics remained significant predictors of either all cause or cause-specific mortality. Model 3 included year of birth, sex, and all childhood and all adult characteristics.

One of the weaknesses of the above analysis is that the estimated hazard ratios may be biased by genetic or unobserved childhood or other characteristics that influence adult mortality. In an attempt to reduce this bias, we took advantage of the fact that the data contain multiple siblings within the same family. We employed within sibling techniques to control for all unobserved characteristics shared among the siblings regardless of whether these characteristics

were social or genetic in nature. We estimated the fixed effects models using the stratification technique suggested in Allison (2009) which allows for a separate baseline hazard $h_f(t)$ for each family *f*. Because the baseline hazards cancel out of the partial likelihood, this method reduces both the computational burden and the incidental parameter bias. A comparison of the fixed effect estimates to estimates obtained from the standard regression model enabled us to assess the influence of unobserved family background and other unobserved characteristics shared among the siblings on the estimated hazard ratios. In the fixed effect analyses we cannot estimate coefficients for childhood characteristics that are fully shared by all siblings. We identified 14,854 families with two siblings and 12,525 families with 3 or more siblings. All models were estimated using partial likelihood estimation in STATA 10 (Stata Corporation 2007).

RESULTS

Table 1 provides sample characteristics. Just over half of the sample was male, close to half was born after September 19, 1944, and the vast majority (91%) lived with both parents in 1950. About 23% of the children had no siblings, 30% had one sibling and 47% had two or more siblings aged 0-14 in the family at the time of the 1950 census. Relatively few children grew up in white collar families (15%), i.e., where the father or the mother was employed in professional or administrative occupations, whereas over 40% grew up in families where the father or the mother was an agricultural or manual worker, and about a third were children of farmers. Only 10% of the parents had education beyond primary school, and slightly over a third of the children grew up in relatively crowded housing conditions (3 or more people per heated room).

Table 1 also reveals considerable intergenerational occupational and educational mobility. By their early 30s, over 40% of our sample was employed in upper (14%) or lower white collar occupations (29%) and only about 6% were farmers. Most of the others were

employed as industrial (18%) or other manual workers (21%). This intergenerational occupational mobility reflected the rapid change in the economic structure that took place in Finland in the 1950s and 1960s as well as improvements in educational attainment. About 50% of the children had obtained education beyond primary school compared to only 10% of their parents. Labor force participation rate was high among our sample at 83%, although this varied between men (93%) and women (73%). Many of those not in the labor force or who were not housewives (9%) were likely to be individuals on disability pensions and others who were out of the labor force for health reasons (Table 1). Home ownership was also high in Finland in the 1970s and 1980s with 70% of the respondents owning their own house or apartment.

By their early 30s, close to 85% of the sample had married at least once, although 10% reported that they had already separated, divorced or widowed and 81% reported having children in the household. Only 15% of the respondents had never married.

The distribution of deaths by sex and cause of death are shown in Table 2. About 18% of the men compared to 8% of the women had died by the end of the follow-up period, reflecting higher mortality among men than women. Men were much more likely to have died from heart disease than women; 33% of all male deaths were due to cardiovascular diseases compared to 21% of female deaths. Similarly, male mortality was much higher than female mortality from alcohol-related diseases, accidents and violence, and lung cancer. About 38% of all male deaths were from these causes compared to 23% of female deaths.

Childhood characteristics and adult mortality

Table 3 presents estimated hazard ratios for all-cause mortality at ages 35-72 from Models 1-3; similar results (Models 2-3) can be found for cardiovascular disease and lung cancer mortality in Table 4 and for alcohol related disease and accidental and violent mortality in Table

5. As seen in Table 3, all childhood characteristics exhibited a significant association with all-cause mortality controlling for year of birth and sex, except in the case of whether the individual was born before, during or after the war period. For example, children who grew up on large (HR= 0.699) and small (HR= 0.859) farms or in families where mothers or fathers were employed in professional/administrative occupations (HR= 0.769) had significantly lower adult mortality than children of agricultural or other workers. Similarly higher parental education was associated with significantly lower adult mortality. Children who grew up in more crowded housing conditions and in mother or father only families experienced higher mortality in middle age than children who grew up in least crowded housing or in families with both parents present. For example, children who grew up in most crowded compared to least crowded housing conditions had about 30% excess risk of death after age 35. The excess risk for mother and father only families ranged from about 16% to 24% compared to two parent families. Similar to prior studies we found that those born in Eastern Finland experienced excess risk of adult mortality compared to those born in Western or Southern Finland, although not compared to those born in the Helsinki region or in Lapland. As seen in Model 2 of Table 3, the above results were robust to controls for all childhood characteristics simultaneously, although the size of the hazard ratios were attenuated somewhat most notably for household crowding.

In Model 3, Table 3 we controlled for all explanatory variables; i.e., year of birth, sex, all childhood and all adult characteristics. The inclusion of adult characteristics substantially attenuated the associations between early life circumstances and mortality above age 35, in many instances by over 50%, and all characteristics did not remain statistically significant (e.g., parent's educational attainment and crowded housing conditions) (Model 2 versus Model 3). We continued, however, to find significant associations between all cause mortality and region of

birth, parental occupation, and childhood family type. For example, children of farmers, regardless of farm size, experienced abut 15-20% lower mortality than children of agricultural or other workers. The mortality of children who grew up in single parent families was about 10-14% higher than that of children who grew up in two parent families. Further analyses, not presented here, showed that most adult characteristics mediated the associations between childhood conditions and all-cause mortality at middle age. However, the most important mediating variables were adult occupation and educational attainment.

Childhood conditions were also significant predictors of cause-specific mortality although there was some variation by cause of death (Tables 4 and 5). Similar to all cause mortality, childhood characteristics were significant predictors of cardiovascular disease mortality, including whether or not the individual was born before, during, or after the war years. Region of birth, parents' occupation, family type, and our birth cohort variable remained significant after controlling for adult characteristics. Those born before the war had about a 30% higher risk of death from cardiovascular diseases than those born after the war period. Those living in Southern or Western Finland in their childhood had significantly lower mortality than those living in Eastern Finland as did children of farmers, while the risk of death was significantly elevated for children who were living in mother only families in 1950 (Table 4). Children of farmers were also significantly less likely to die from alcohol related causes and accidents and violence than children of workers as were those born in Southern and Western Finland compared to those born in Eastern Finland (Table 5). Higher childhood social class and farm background also appeared to protect against lung cancer death, although the hazard ratios were not statistically significant after controlling for adult characteristics (Model 3 versus Model 2, Table 4).

We also tested for gender interactions with childhood characteristics in Model 3 and found them to be insignificant. These results suggest that the associations between early life conditions and adult mortality did not vary by gender. However, we must be somewhat cautious in drawing this conclusion, given the small number of female deaths.

Adult characteristics

All adult characteristics were also significant predictors of all cause mortality with and without controls for childhood characteristics. In fact adjustment for early life conditions had little impact on the hazard ratios for adult characteristics (Model 2 versus Model 3 of Table 3). Higher SES, whether measured by educational attainment, occupation or home ownership was associated with significantly lower mortality. For example, the fully adjusted hazard ratio for highest level of education compared to primary education (9 years) was 0.633; the fully adjusted hazard ratio for those employed in upper white collar occupations compared to manual workers, other than those employed in industry, was 0.739; and the fully adjusted hazard ratio for those who owned their house or apartment compared to renters was 0.821. These results are consistent with much of the literature on SES and adult mortality in developed countries (Preston and Taubman 1994; Smith 2007) and previous Finnish studies (Martikainen et al. 1999, 2005, 2007). Also similar to prior literature, we found that never married, single, separated and divorced individuals were at a great risk of death than those who were married (Hu and Goldman 1990; Martikainen et al. 2005; Waite and Lehrer 2003). In addition to marital status, living in households with children was associated with lower mortality after age 35.

Most adult characteristics were also significant predictors of cause-specific mortality. In particular, higher levels of schooling and home ownership were associated with significantly lower mortality and being never married, divorced, separated or widowed was associated with

significantly higher mortality from all specific cause-of-death groups examined. Results were somewhat more mixed for occupation, although in general the findings pointed to a protective effect of higher status occupations, except for mortality from alcohol related diseases net of all other adult characteristics (Model 3, Table 5).

Family Fixed Effects

As previously noted, we also estimate models that included family fixed effect to account for unobserved genetic or other predictors of adult mortality shared by the siblings. These models were estimated on a sample of 76,001 individuals who lived in families with at least two children in 1950. As the fixed effects estimation method is based on variation within siblings, sibling-survival combinations where there is no variation cannot contribute to the estimation. Therefore, individuals who lived in families with only one child and siblings from families where all siblings survived to the censoring date do not contribute to the estimation. Furthermore, an additional limitation of these models is that we cannot estimate hazard ratios for characteristics that are shared by all siblings in the family, although such characteristics are fully controlled by the fixed effects.

Table 6 presents results from Model 3 with a family fixed effect for all cause and cause specific mortality. When comparing these results with those from Model 3 in Tables 3-5, we see that the introduction of the family fixed effect resulted in relatively small changes in the hazard ratios of early adult educational attainment, occupation and home ownership for cardiovascular disease mortality, but somewhat stronger attenuation for all cause mortality, especially in the case of education. However, the fixed effect results continued to show significantly lower mortality among individuals with higher levels of education and wealth, as measured by home ownership, and among those employed in white collar occupations. In contrast, we observed

strong attenuation (about 35-40%) in the mortality hazard from all causes and from cardiovascular diseases for individuals who were separated, divorced, or widowed. For example, for cardiovascular disease mortality the hazard ratio associated with being separated, divorced or widowed was 1.781 in Model 3 of Table 4 which controlled for observed family characteristics, but 1.512 in Table 6 which shows the results for Model 3 with controls for family fixed effects. At the same time, the negative effect of having been born before the war period on cardiovascular disease mortality, i.e., before late November 1939, emerged as a significant predictor of all cause mortality (HR=1.225), mainly due to its large and significant association with mortality from cardiovascular diseases (HR=1.649) (Table 6). This birth cohort association was not significant for other cause-of-death groups examined, although the hazard ratio was also sizable for mortality from alcohol related diseases (1.540) in the fixed effect estimates (Table 6).

We also observed a reduction in the hazard ratios for being separated, divorced, or widowed for mortality from lung cancer (HR=2.227 in Model 3 of Table 4 vs. HR=1.772 in Table 6), alcohol related diseases (HR=2.716 in Model 3 of Table 5 vs. HR=1.820 in Table 6) and accidents and violence (HR=2.100 in Model 3 of Table 5 vs. 1.526 in Table 6). However, in contrast to cardiovascular disease mortality, educational attainment was no longer a significant predictor of mortality from alcohol related diseases or accidents and violence, although the results continued to point to a protective effect of education at the highest level. Similarly, the hazard ratios of educational attainment for lung cancer mortality were attenuated. Housing wealth in turn continued to be protective as was white collar employment, although not all estimates remained statistically significant.

DISCUSSION

Most studies of early life conditions on adult outcomes have relied on retrospectively reported data on early life circumstances, which may lead to misleading results regarding the influence of childhood family background and adult health outcomes (e.g., Kauhanen et al. 2006). However, few data sets permit the follow-up of nationally representative samples of children into adulthood (e.g., Kuh et al. 2002; Pensola and Martikainen 2003; Strand and Kunst 2006). The Finnish data used in this study, which was based on a 10% nationally representative sample of households drawn from 1950 census records, are unique in that they provide prospective follow-up of children from early childhood into middle and older ages. Information on childhood SES, family structure, and place of residence, factors related to potentially important measures of social origins of disease, come from the 1950 Census, and thus were not contaminated by participant recall biases. The subsequent linkage of individuals in the original sample to census and death records beginning from the end of 1970 provided information on adult circumstances and subsequent mortality through the end of 2007.

We found childhood SES and family characteristics to be significant predictors of all cause mortality between ages 35 and 72 such that higher childhood family SES was associated with significantly lower mortality above age 35. Without adjustment for adult characteristics having parents with at least primary school education reduced adult mortality by about 10-20%, and having parents who were employed in professional/administrative occupations or who were farmers was associated with about 15-25% reduction in adult mortality. In contrast, living in crowded housing or with only one parent was associated with a significant excess risk of death (Model 2, Table 3). Many of these associations were attenuated by up to about 50% with adjustment for educational attainment and other socio-demographic characteristics measured in

early adulthood. These results are consistent with the hypothesis that early life conditions influence adult health and mortality indirectly via what Preston et al. (1998) refer to as 'correlated environments.' In other words, early life circumstances influenced adult mortality primarily through educational attainment and attained adult socioeconomic status. Individuals raised in more resource rich environments obtained higher levels of schooling and better jobs in early adulthood which in turn translated into health and other benefits later in life.

Children who grow up in wealthier households are also healthier in childhood (e.g., Case et al. 2002, 2005). In the absence of information on childhood health in our data at least some of this health effect was probably captured by our early life socioeconomic controls. In this regard, the finding that having grown up on a farm was associated with significantly lower mortality, controlling for adult characteristics, may be related to better health of children who grew up on farms. Children born in the fourteen years before the 1950 census either lived through the years when Finland was in war against the Soviet Union or were born shortly thereafter. Farm residence during this period may have been especially protective, for example, by mitigating effect of food rationing. Alternatively or in addition, farm residence in childhood may be related to a healthier life style in adulthood. This speculation is consistent with the finding that farm residence was also a significant predictor of mortality from causes that have a large behavioral component, such as alcohol related diseases, lung cancer, and accidents and violence. For later Finnish birth cohorts born between 1956 and 1960 the protective effect of being a son of a farmer was also found for alcohol related, accidental and violent causes of death, but not for cardiovascular diseases net of adult social characteristics (Pensola and Valkonen 2002). Also in the United States, where farm residence in childhood was also associated with lower risk of death at older ages (Hayward and Gorman 2004; Preston et al. 1998), adult life style factors

appeared to have been one of the pathways through which rural residence was associated with lower adult male mortality (Hayward and Gorman 2004).

Similarly our finding that mortality was about 20% higher among children who spent much of their early childhood during the period when Finland fought two wars against the Soviet Union may at least in part be related to childhood health. This association was particularly strong for mortality from cardiovascular diseases, causes of death that have most consistently exhibited a strong association with early life health conditions. This cohort effect was not evident for other causes of death, although the elevated risk for alcohol related diseases was substantial, although not statistically significant. This latter finding also points to a potential cohort difference in health behaviors. We also found persistent regional differences in mortality with those living in Eastern Finland having higher all-cause mortality and mortality from cardiovascular diseases, alcohol related diseases, and accidents and violence than those living in Western and Southern Finland. These results were robust to controls for characteristics measured in young adulthood. It has been hypothesized that these regional mortality differences could be, at least partially, attributed to behavioral and social differences or to genetic differences (Saarela and Finnäs 2009). In this study it was not possible to evaluate the relative importance of these factors. The strongest regional mortality differences, however, were found for accidents and violence which may depend more on behavior than genes, tentatively pointing towards the role of behavioral factors in explaining region of birth effects on mortality.

The individuals in our study were born between 1936 and 1950 and it is possible that associations between childhood socio-demographic conditions on adult mortality may have become either weaker as adverse childhood material conditions have become less common or that they have grown stronger as poverty and other forms of disadvantage are concentrated in

ever smaller population subgroups. In the Finnish case, a rough comparison can be made to a study that was based on a similar design and data sources but draws its sample of children from the 1970 Finnish Census (Pensola and Valkonen 2002; Pensola and Martikainen 2003). Although various methodological differences (e.g. younger ages at death, a shorter follow-up period, and definitions of parental social class) prevent exact comparisons, the results for the more recent birth cohorts nevertheless suggest mortality differentials by parental social class have not disappeared in Finland, if anything these differentials may have grown stronger. For the more recent birth cohorts mortality differentials for accidental and violent deaths for men, for example, were two-fold between the top and bottom parental social class, although they were also largely explained by one's own attained education and class position.

Finland in 1950 was relatively underprivileged, burdened by heavy war debts to the Soviet Union, and with a relatively large segment of its labor force still employed in agriculture. These patterns were also evident in our data with well over half of the children in 1950 living on farms or in lower social class families. In the subsequent decades, however, the development of the industrial and service sectors and widening educational venues quickly opened new opportunities for the younger generations increasing social mobility and a movement away from agriculture. The strong and persistent predictive power of educational attainment, occupation and housing wealth on all cause and cardiovascular disease mortality at ages 35-72 may be related to intergenerational social mobility during the study period. Such improvements may have helped mitigate possible negative consequences of early life disadvantage. At the same time, these results did not hold for all cause-of-death groups examined. For example, the association between educational attainment and mortality from causes of death with a substantial behavioral component, i.e., alcohol related diseases, accidents and violence, and lung cancer,

were in some cases less pronounced than for cardiovascular disease mortality. These results suggest that family specific influences may play a role.

Finally, we also found evidence for the importance of family structure on adult mortality. Individuals, who as children lived in single parent households, were at an increased risk of mortality in middle age, although this association was substantially attenuated with the inclusion of adult characteristics. Two important adult characteristics in this regard were marital status and living with children in young adulthood.

We should also note limitations of these analyses and suggest future next steps. As noted earlier, 15,065 children in the original sample could not be linked to the 1970 or subsequent Finnish censuses or death records after 1970. Some of these individuals had died before 1970, but most were likely to be young adult emigrants to Sweden in the late 1960s. In Appendix Table 1 we compared those who could not be linked either to census or death records from 1970 onward. As seen in this table, individuals lost to follow-up were more likely to be women than men, be born before 1945, come from lower SES backgrounds, be from mother only families and from Lapland. However, although significant these differences were not particularly large and thus unlikely to bias our main findings. In this paper, we measured adult characteristics only in young adulthood. However, it is possible to incorporate information from subsequent censuses which will permit us more fully to assess the role of adult socio-demographic characteristic on mortality.

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Appendix Table 1: Comparison of childhood characteristics obtained from the 1950 Finnish Census between those included in the analytic sample (N=98,389) and those who either had migrated out of Finland or who had died prior to 1970 (N=15,065)

Characteristic	Analytic sample (N=98,389)	Those who migrated or died prior to 1970 (N=15,065)
Gender		
Male	51.8	44.2
Female	48.2	55.8
Birth Cohort		
Prewar years	20.9	23.4
War years	27.5	28.8
Postwar years	51.7	47.8
Region of residence		
Helsinki region	7.5	7.1
Rest of Uusimaa	5.8	6.6
Western Finland	39.4	39.1
Eastern Finland	42.8	38.3
Lapland	4.5	8.9
Occupation of family head[a]		
Professional/administrative	15.1	12.5
Agricultural and other workers	41.8	47.2
Farmers with < 10 hectares	25.8	24.0
Farmers with ≥ 10 hectares	8.1	6.0
Other[b]	9.3	10.3
Parental Education[c]		
Less than primary school	16.4	20.1
Primary school	73.3	72.0
Past primary school	10.3	8.0
Housing Conditions		
< 2 people per heated room	32.2	27.3
2-3 people per heated room	31.9	30.9
3-4 people per heated room	16.4	17.6
4+ people per heated room	18.3	22.7
Missing	1.1	1.6
Family type		
Both parents	91.0	88.2
Mother only	7.8	9.9
Father only	1.3	1.8

[a]Refers to father's occupation, except in mother only households when mother's occupation is used.
[b]Includes self-employed, other and unknown. [c] Highest level of schooling of either the mother or the father.
Chi-square tests between the two samples were all statistically significant, $p \leq 0.01$.

TABLE 1: Sample Characteristics (%), Finland 1950 and 1970-85 (N=98,389)

Characteristics	Entire sample N=98, 389	Deaths N=12,956
Childhood Characteristics- 1950 Census, Ages 0-14		
Gender		
Male	51.8	71.0
Female	48.2	29.0
Number of children in the family		
One	22.7	24.4
Two	30.2	28.2
Three or more	47.1	47.4
Birth cohort		
Prewar years	20.8	33.8
War years	27.5	29.8
Postwar years	51.7	37.5
Region of residence		
Helsinki Region	7.5	8.0
Rest of Uusimaa	5.8	5.6
Western Finland	39.4	36.7
Eastern Finland	42.8	44.9
Lapland	4.5	4.8
Occupation of family head[a]		
Professional/administrative	15.1	12.9
Agricultural and other workers	41.8	44.8
Farmers with < 10 hectares	25.8	25.7
Farmers with ≥ 10 hectares	8.1	6.9
Other[b]	9.3	9.7
Parental Education[c]		
Less than primary school	16.4	20.6
Primary school	73.3	71.1
Past primary school	10.3	8.3
Housing Conditions		
< 2 people per heated room	32.2	29.3
2.0-2.99 people per heated room	31.9	31.3
3.00-3.99 people per heated room	16.4	17.1
4+ people per heated room	18.3	21.2
Missing	1.1	1.1
Family type		
Both parents	90.9	88.2
Mother only	7.8	10.1
Father only	1.3	1.7

TABLE 1: Sample Characteristics (%), Finland 1950 and 1970-85 (N=98,389), Continued

Characteristics	Entire sample N=98, 389	Deaths N=12,956
Adult Characteristics		
Marital Status		
Never married	19.0	27.6
Married	74.4	63.0
Separated/divorced/widowed	6.6	9.3
Children in the household		
No	21.5	27.3
Yes	78.5	72.7
Education (years)		
9 years – basic	49.4	60.8
10-11 years – lower secondary	25.1	21.8
12 years – upper secondary	13.2	9.9
13+ years – post secondary	12.3	7.5
Occupation		
Upper white collar	13.6	8.5
Lower white collar	29.2	20.1
Manual worker – industry	17.7	22.1
Manual worker – other	20.7	24.6
Farmer	6.5	6.7
Self-employed	4.4	4.5
Unknown, including students	8.0	13.6
Labor force attachment		
In the labor force	83.4	81.9
Not in the labor force, excl. housewives	6.7	12.0
Housewife[d]	9.9	6.1
Home ownership		
Owner	56.9	50.0
Renter	26.1	30.2
Employer provides	12.8	12.3
Unknown	4.2	7.5

[a] Refers to father's occupation, except in mother only households when mother's occupation is used.
[b] Includes self-employed, other and unknown.
[c] Highest level of schooling of either the mother or the father.
[d] Among all women 20.5% of the women were housewives.

TABLE 2: Distribution of Deaths by Cause, Ages 35-72, Finland 1970-2007

	Men		Women		Entire Sample	
Causes of death	#	%	#	%	#	%
All Causes	9,197	100.0	3,759	100.0	12,956	100.0
Cardiovascular disease	3,076	33.4	790	21.0	3,866	29.8
Lung cancer	559	6.1	165	4.4	724	5.6
Alcohol-related[a]	1,101	12.0	236	6.3	1,337	10.3
Accidents & violence	1,840	20.0	459	12.2	2,299	17.7
All other diseases	2,631	28.5	2,109	56.1	4,730	36.5
Mean years of follow-up						
Alive (censored)	28.3 (s.d. 4.2)		28.6 (s.d. 4.3)		28.5 (s.d. 4.2)	
Dead	19.2 (s.d. 8.6)		20.2 (s.d. 8.4)		19.5 (s.d. 8.5)	

[a] Alcohol-related causes refer to underlying causes of death related to excessive alcohol consumption, e.g., liver cirrhosis, or alcoholic inflammation of the heart.

TABLE 3: Hazard Ratios (z-statistics) for All Cause Mortality for Finnish Men and Women at Age 35-72 at Death, 1970-2007 (N=98,389)

Characteristic	Model 1	Model 2	Model 3
Childhood Characteristics			
Year of birth	0.991 (-3.98) **	0.997 (-0.43)	0.991 (-1.50)
Gender (Female)[b]			
Male	2.446 (45.93) **	2.455 (46.05) **	2.343 (37.64) **
Birth cohort (postwar years)			
Prewar years	1.077 (1.21)	1.066 (1.03)	1.075 (1.17)
War years	0.984 (-0.42)	0.984 (-0.41)	0.986 (-0.36)
Region of residence (Eastern Finland)			
Helsinki Region	1.008 (0.22)	1.045 (1.21)	1.054 (1.44)
Rest of Uusimaa	0.889 (-2.88) **	0.910 (-2.30) *	0.914 (-2.20) *
Western Finland	0.868 (-6.92) **	0.896 (-5.26) **	0.918 (-4.09) **
Lapland	1.015 (0.33)	0.984 (-0.35)	0.995 (-0.11)
Occupation of family head [c] *(workers)*			
Professional/administrative	0.769 (-9.05) **	0.843 (-5.01) **	0.956 (-1.33)
Farmers with < 10 hectares	0.859 (-6.65) **	0.854 (-6.78) **	0.854 (-6.69) **
Farmers with ≥ 10 hectares	0.699 (-9.46) **	0.756 (-7.20) **	0.789 (-5.97) **
Other	0.924 (-2.45) *	0.948 (-1.64)	0.962 (-1.18)
Parental Education[d] *(< primary school)*			
Primary school	0.852 (-6.89) **	0.896 (-4.59) **	0.955 (-1.90)
Past primary school	0.723 (-8.48) **	0.820 (-4.44) **	0.964 (-0.81)
Housing Conditions (< 2 people)			
2-3 people per heated room	1.099 (4.03) **	1.036 (1.45)	0.983 (-0.71)
3-4 people per heated room	1.155 (5.16) **	1.060 (1.97)	0.966 (-1.20)
4+ people per heated room	1.317 (10.47) **	1.170 (5.48) **	1.025 (0.86)
Family type (both parents)			
Mother only	1.164 (4.98) **	1.143 (4.31) **	1.103 (3.16) **
Father only	1.242 (3.04) **	1.209 (2.62) **	1.141 (1.84)

** p-value ≤ 0.01; * p-value ≤ 0.05. Standard errors are clustered at the family level.

[a] Model 1 shows hazard ratios for each explanatory variable controlling for year of birth and sex. Model 2 shows adjusted hazard ratios for childhood characteristics controlling for year of birth, sex and all childhood characteristics. Model 3 controls for year of birth, sex, all childhood and all adult characteristics. [b] Omitted category in parentheses. [c] Refers to father's occupation, except in mother only households. [d] Highest level of schooling of either the mother or the father.

TABLE 3, continued

Characteristic	Model 1	Model 2	Model 3
Adult Characteristics			
Marital Status (married)			
Never married	1.826 (29.54) **	1.577 (19.90) **	1.572 (19.71) **
Separated/divorced/widowed	2.173 (24.99) **	1.790 (17.82) **	1.767 (17.40) **
Children in the household (yes)			
No	1.472 (19.37) **	1.056 (2.27) *	1.057 (2.28) *
Education (9 years)			
10-11 years	0.765 (-12.02) **	0.820 (-8.90) **	0.828 (-8.42) **
12 years	0.662 (-13.43) **	0.783 (-7.31) **	0.786 (-7.08) **
13+ years	0.492 (-20.66) **	0.628 (-10.39) **	0.633 (-9.89) **
Occupation (other manual worker)			
Upper white collar	0.517 (-18.80) **	0.739 (-6.74) **	0.736 (-6.79) **
Lower white collar	0.715 (-12.38) **	0.808 (-7.32) **	0.809 (-7.27) **
Manual worker – industry	0.954 (-1.79)	0.982 (-0.71)	0.981 (-0.74)
Farmer	0.777 (-6.57) **	0.851 (-4.08) **	0.930 (-1.79)
Self-employed	0.856 (-3.44) **	0.958 (-0.93)	0.972 (-0.62)
Unknown SES, inc. students	1.869 (20.52) **	1.249 (3.32) **	1.261 (3.47) **
Labor force attachment (in the labor force)			
Not in the labor force, excl. housewives	2.396 (31.45) **	1.369 (4.44) **	1.355 (4.29) **
Housewife	0.985 (-0.38)	1.048 (1.11)	1.046 (1.08)
Home ownership (renter)			
Owner	0.773 (-12.62) **	0.804 (-10.33) **	0.821 (-9.32) **
Employer provides	0.837 (-5.93) **	0.972 (-0.93)	0.984 (-0.52)

** p-value ≤ 0.01; * p-value ≤ 0.05. Standard errors are clustered at the family level.

[a] Model 1 shows hazard ratios for each explanatory variable controlling for year of birth and sex. Model 2 shows adjusted hazard ratios for adult characteristics controlling for year of birth, sex and all adult characteristics but not childhood characteristics. Model 3 controls for year of birth, sex, all childhood and all adult characteristics. [b] Omitted category in parentheses.

TABLE 4: Hazard Ratios (z-statistics) for Cardiovascular Disease and Lung Cancer Mortality for Finnish Men and Women at Age 35-72 at Death, 1970-2007 (N=98,389)

	Cardiovascular Diseases		Lung Cancer	
Characteristic	Model 2	Model 3	Model 2	Model 3
Childhood Characteristics				
Year of Birth	0.992 (-0.69)	0.986 (-1.21)	0.979 (-0.79)	0.982 (-0.69)
Gender (Female)[b]				
Male	3.945 (34.39) **	3.732 (28.01) **	3.469 (14.03) **	3.373 (11.88) **
Birth cohort (postwar years)				
Prewar years	1.297 (2.25)*	1.293 (2.22)*	1.017 (0.06)	1.035 (0.13)
War years	1.103 (1.32)	1.111 (1.42)	1.052 (0.30)	1.067 (0.38)
Region of residence (Eastern Finland)				
Helsinki Region	0.882 (-1.79)	0.903 (-1.45)	1.332 (1.97) *	1.323 (1.89)
Rest of Uusimaa	0.792 (-3.00) **	0.797 (-2.92) **	1.036 (0.21)	1.003 (0.02)
Western Finland	0.805 (-5.74) **	0.827 (-5.05) **	1.034 (0.40)	1.053 (0.60)
Lapland	0.875 (-1.68)	0.883 (-1.56)	1.032 (0.17)	1.079 (0.42)
Occupation of family head [c] *(workers)*				
Professional/administrative	0.800 (-3.51) **	0.949 (-0.82)	0.691 (-2.54)*	0.838 (-1.20)
Farmers with < 10 hectares	0.815 (-4.88) **	0.798 (-5.24) **	0.838 (-1.89)	0.868 (-1.50)
Farmers with ≥ 10 hectares	0.810 (-3.15) **	0.811 (-3.03) **	0.649 (-2.62) **	0.741 (-1.76)
Other	0.937 (-1.10)	0.950 (-0.85)	0.930 (-0.54)	0.956 (-0.34)
Parental Education[d] *(< primary school)*				
Primary school	0.858 (-3.64) **	0.923 (-1.91)	0.968 (-0.34)	1.049 (0.50)
Past primary school	0.733 (-3.64) **	0.911 (-1.08)	0.806 (-1.10)	1.035 (0.17)
Housing Conditions (< 2 people)				
2-3 people per heated room	1.091 (1.94)	1.028 (0.62)	1.171 (1.50)	1.067 (0.61)
3-4 people per heated room	1.160 (2.79) **	1.047 (0.86)	1.433 (3.02) **	1.229 (1.73)
4+ people per heated room	1.253 (4.34) **	1.083 (1.51)	1.583 (4.00) **	1.295 (2.25) *
Family type (both parents)				
Mother only	1.253 (4.17) **	1.217 (3.65) **	1.089 (0.67)	1.048 (0.37)
Father only	1.113 (0.78)	1.060 (0.42)	1.472 (1.46)	1.415 (1.31)

** p-value ≤ 0.01; * p-value ≤ 0.05. Standard errors are clustered at the family level.

[a] Model 2 shows adjusted hazard ratios for childhood characteristics controlling for year of birth, sex and all childhood characteristics. Model 3 controls for year of birth, sex, all childhood and all adult characteristics. [b] Omitted category in parentheses. [c] Refers to father's occupation, except in mother only households. [d] Highest level of schooling of either the mother or the father.

TABLE 4, continued

	Cardiovascular Diseases		Lung Cancer	
Characteristic	Model 2	Model 3	Model 2	Model 3
Adult Characteristics				
Marital Status (married)				
Never married	1.599 (11.36) **	1.582 (11.03) **	1.514 (4.29) **	1.521 (4.32) **
Separated/divorced/widowed	1.797 (9.18) **	1.781 (9.01) **	2.264 (5.91) **	2.227 (5.74) **
Children in the household (yes)				
No	0.973 (-0.61)	0.973 (-0.59)	0.852 (-1.48)	0.854 (-1.45)
Education (9 years)				
10-11 years	0.840 (-4.31) **	0.851 (-3.95) **	0.554 (-5.75) **	0.568 (-5.52) **
12 years	0.730 (-4.83) **	0.749 (-4.36) **	0.486 (-4.39) **	0.512 (-4.02) **
13+ years	0.519 (-7.24) **	0.540 (-6.60) **	0.494 (-3.33) **	0.538 (-2.85) **
Occupation (other manual worker)				
Upper white collar	0.678 (-4.58) **	0.687 (-4.35) **	0.625 (-2.21) *	0.635 (-2.13) *
Lower white collar	0.715 (-6.11) **	0.722 (-5.89) **	0.884 (-1.00)	0.890 (-0.94)
Manual worker – industry	0.941 (-1.32)	0.935 (-1.45)	1.065 (0.61)	1.063 (0.58)
Farmer	0.924 (-1.18)	1.025 (0.36)	0.705 (-1.99) *	0.804 (-1.20)
Self-employed	0.954 (-0.58)	0.990 (-0.13)	0.994 (-0.04)	1.019 (0.10)
Unknown SES, inc. students	1.156 (1.17)	1.172 (1.28)	1.355 (0.97)	1.377 (1.02)
Labor force attachment (in the labor force)				
Not in the labor force, excl. housewives	1.555 (3.40) **	1.536 (3.31) **	1.063 (0.18)	1.057 (0.16)
Housewife	1.032 (0.36)	1.032 (0.36)	0.902 (-0.52)	0.901 (-0.52)
Home ownership (renter)				
Owner	0.772 (-6.74) **	0.796 (-5.93) **	0.666 (-4.67) **	0.689 (-4.25) **
Employer provides	0.960 (-0.73)	0.965 (-0.64)	0.883 (-1.00)	0.906 (-0.80)

** p-value ≤ 0.01; * p-value ≤ 0.05. Standard errors are clustered at the family level.

[a] Model 1 shows hazard ratios for each explanatory variable controlling for year of birth and sex. Model 2 shows adjusted hazard ratios for adult characteristics controlling for year of birth, sex and all adult characteristics but not childhood characteristics. Model 3 controls for year of birth, sex, all childhood and all adult characteristics. [b] Omitted category in parentheses.

TABLE 5: Hazard Ratios (z-statistics) for Alcohol Related Diseases and Accidental and Violent Mortality for Finnish Men and Women at Age 35-72 at Death, 1970-2007 (N=98,389)

	Alcohol Related Diseases		Accidents and Violence	
Characteristic	Model 2	Model 3	Model 2	Model 3
Childhood Characteristics				
Year of Birth	1.049 (2.60) **	1.043 (2.28) *	0.995 (-0.35)	0.984 (-1.20)
Gender (Female)[b]				
Male	4.609 (21.06) **	4.272 (17.71) **	3.925 (26.05) **	3.640 (21.74) **
Birth cohort (postwar years)				
Prewar years	1.106 (0.53)	1.175 (0.85)	0.928 (-0.53)	0.937 (-0.46)
War years	0.961 (-0.34)	0.972 (-0.24)	0.944 (-0.65)	0.944 (-0.66)
Region of residence (Eastern Finland)				
Helsinki Region	1.006 (0.06)	0.976 (-0.22)	0.995 (-0.06)	0.990 (-0.12)
Rest of Uusimaa	0.847 (-1.34)	0.853 (-1.27)	0.617 (-4.34) **	0.624 (-4.25) **
Western Finland	0.848 (-2.57) **	0.864 (-2.29) *	0.769 (-5.42) **	0.790 (-4.84) **
Lapland	0.842 (-1.22)	0.867 (-1.01)	1.099 (1.01)	1.099 (1.01)
Occupation of family head [c] *(workers)*				
Professional/administrative	0.772 (-2.60) **	0.882 (-1.25)	0.925 (-1.01)	1.041 (0.51)
Farmers with < 10 hectares	0.720 (-4.47) **	0.770 (-3.51) **	0.849 (-3.05) **	0.875 (-2.44) *
Farmers with ≥ 10 hectares	0.553 (-4.58) **	0.650 (-3.23) **	0.799 (-2.43) *	0.885 (-1.28)
Other	1.006 (0.06)	1.037 (0.38)	0.898 (-1.37)	0.914 (-1.14)
Parental Education[d] *(< primary school)*				
Primary school	0.947 (-0.69)	1.006 (0.07)	0.788 (-4.40) **	0.836 (-3.30) **
Past primary school	0.930 (-0.54)	1.097 (0.68)	0.761 (-2.72) **	0.887 (-1.18)
Housing Conditions (< 2 people)				
2-3 people per heated room	1.040 (0.53)	0.971 (-0.39)	1.135 (2.22) *	1.074 (1.24)
3-4 people per heated room	0.913 (-1.00)	0.819 (-2.18) *	1.118 (1.62)	1.019 (0.27)
4+ people per heated room	1.155 (1.66)	0.988 (-0.14)	1.270 (3.59) **	1.108 (1.54)
Family type (both parents)				
Mother only	1.138 (1.30)	1.072 (0.69)	1.082 (1.02)	1.027 (0.35)
Father only	1.152 (0.61)	1.072 (0.30)	1.223 (1.23)	1.149 (0.86)

** p-value ≤ 0.01; * p-value ≤ 0.05. Standard errors are clustered at the family level.

[a] Model 2 shows adjusted hazard ratios for childhood characteristics controlling for year of birth, sex and all childhood characteristics. Model 3 controls for year of birth, sex, all childhood and all adult characteristics. [b] Omitted category in parentheses. [c] Refers to father's occupation, except in mother only households. [d] Highest level of schooling of either the mother or the father.

TABLE 5, continued

	Alcohol Related Causes		Accidents and Violence	
Characteristic	Model 2	Model 3	Model 2	Model 3
Adult Characteristics				
Marital Status (married)				
Never married	1.483 (5.50) **	1.482 (5.48) **	1.698 (10.01) **	1.676 (9.71) **
Separated/divorced/widowed	2.774 (11.85) **	2.716 (11.54) **	2.114 (10.22) **	2.100 (10.09) **
Children in the household (yes)				
No	1.142 (1.86)	1.141 (1.85)	1.138 (2.35) *	1.133 (2.26) *
Education (9 years)				
10-11 years	0.847 (-2.46) *	0.853 (-2.35) *	0.937 (-1.27)	0.951 (-0.98)
12 years	0.770 (-2.58) **	0.763 (-2.63) **	0.795 (-2.88) **	0.806 (-2.66) **
13+ years	0.571 (-4.13) **	0.563 (-4.11) **	0.656 (-4.00) **	0.666 (-3.74) **
Occupation (other manual worker)				
Upper white collar	0.934 (-0.51)	0.923 (-0.59)	0.712 (-3.20) **	0.720 (-3.06) **
Lower white collar	0.905 (-1.07)	0.901 (-1.10)	0.753 (-4.10) **	0.766 (-3.83) **
Manual worker – industry	1.142 (1.69)	1.141 (1.67)	0.865 (-2.40) *	0.873 (-2.24) *
Farmer	0.706 (-2.31) *	0.817 (-1.31)	0.646 (-4.19) **	0.700 (-3.32) **
Self-employed	1.146 (0.99)	1.150 (1.01)	0.929 (-0.70)	0.969 (-0.30)
Unknown SES, inc. students	1.797 (3.15) **	1.812 (3.20) **	1.264 (1.54)	1.268 (1.56)
Labor force attachment (in the labor force)				
Not in the labor force, excl. housewives	0.688 (-1.79)	0.680 (-1.85)	1.142 (0.81)	1.137 (0.79)
Housewife	0.854 (-0.84)	0.851 (-0.86)	0.914 (-0.71)	0.913 (-0.72)
Home ownership (renter)				
Owner	0.684 (-5.91) **	0.704 (-5.46) **	0.793 (-4.63) **	0.808 (-4.24) **
Employer provides	0.856 (-1.67)	0.871 (-1.49)	0.950 (-0.73)	0.943 (-0.82)

** p-value ≤ 0.01; * p-value ≤ 0.05. Standard errors are clustered at the family level.

[a] Model 2 shows adjusted hazard ratios for adult characteristics controlling for year of birth, sex and all adult characteristics but not childhood characteristics. Model 3 controls for year of birth, sex, all childhood and all adult characteristics. [b] Omitted category in parentheses.

TABLE 6: Hazard Ratios (z-statistics) for All Cause and Cause-Specific Mortality – Model 3, Family Fixed Effects, for Finnish Men and Women at Age 35-72 at Death, 1970-2007 (N=76,001)

Characteristic	All Cause	Cardiovascular Diseases	Lung Cancer	Alcohol Related Diseases	Accidents & Violence
Childhood Characteristics					
Year of birth	1.010 (1.02)	1.020 (1.06)	1.012 (0.26)	1.084 (2.53) *	1.004 (0.20)
Gender (Female)[a]					
Male	2.425 (25.22) **	4.234 (19.48) **	3.443 (7.65) **	4.748 (12.04) **	4.100 (15.97) **
Birth cohort (Postwar years)					
Prewar years	1.225 (2.11) *	1.649 (2.67) **	1.201 (0.41)	1.540 (1.37)	1.110 (0.46)
War years	1.035 (0.57)	1.145 (1.16)	1.293 (0.93)	1.150 (0.71)	1.003 (0.02)
Adult Characteristics					
Marital Status (married)					
Never married	1.536 (10.54) **	1.500 (5.18)**	1.341 (1.60)	1.384 (2.44) *	1.469 (4.16) **
Separated/divorced/widowed	1.446 (6.28) **	1.512 (3.58) **	1.772 (2.28) *	1.820 (3.46) **	1.526 (3.20) **
Children in the household (yes)					
No	1.073 (1.71)	0.990 (-0.12)	1.038 (0.21)	1.046 (0.34)	1.210 (2.01) *
Education (9 years)					
10-11 years	0.888 (-3.01) **	0.804 (-2.90) **	0.587 (-2.77) **	0.908 (-0.74)	1.055 (0.59)
12 years	0.852 (-2.64) **	0.612 (-3.88) **	0.618 (-1.68)	1.044 (0.20)	0.809 (-1.48)
13+ years	0.756 (-3.36) **	0.580 (-3.12) **	0.919 (-0.19)	0.592 (-1.90)	0.779 (-1.25)
Occupation (other manual worker)					
Upper white collar	0.659 (-5.36) **	0.714 (-2.07) *	0.442 (-2.11) *	0.911 (-0.36)	0.634 (-2.46) *
Lower white collar	0.812 (-4.28) **	0.783 (-2.53) *	0.816 (-0.95)	0.864 (-0.88)	0.788 (-2.03) *
Manual worker – industry	0.968 (-0.73)	0.947 (-0.64)	0.940 (-0.33)	1.056 (0.37)	0.917 (-0.85)
Farmer	0.951 (-0.72)	1.003 (0.03)	0.986 (-0.05)	0.902 (-0.37)	0.839 (-1.02)
Self-employed	1.066 (-0.82)	1.109 (0.70)	1.334 (0.84)	0.929 (-0.30)	0.945 (-0.30)
Unknown SES, inc. students	1.190 (1.60)	1.100 (0.44)	1.159 (0.31)	1.455 (1.17)	1.451 (1.52)
Labor force attachment (in the labor force)					
Not in the labor force, excl. housewives	1.481 (3.35) **	1.904 (2.78) **	1.397 (0.64)	0.958 (-0.12)	0.951 (-0.19)
Housewife	1.044 (0.69)	1.106 (0.75)	0.797 (-0.76)	0.697 (-1.37)	0.878 (-0.72)
Home ownership (renter)					
Owner	0.825 (-5.24) **	0.756 (-3.93) **	0.755 (-1.77)	0.602 (-4.21) **	0.777 (-2.91) **
Employer provides	0.991 (-0.18)	0.972 (-0.29)	0.913 (-0.42)	0.746 (-1.75)	0.931 (-0.61)

** p-value ≤ 0.01; * p-value ≤ 0.05.

[a] Omitted category in parentheses.