2-1-2010

Early Life Conditions and Cause-Specific Mortality in Finland

Irma T. Elo
University of Pennsylvania, popelo@pop.upenn.edu

Pekka Martikainen
University of Helsinki

Mikko Myrskylä
Max Planck Institute for Demographic Research

Early Life Conditions and Cause-Specific Mortality in Finland

Abstract
The purpose of this study is to investigate the relationship between early life socioeconomic status, household structure and adult 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 from the end of 1970 through the end of 1998. 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 find significant associations between early life social and family conditions on all cause mortality as well as mortality from cardiovascular and alcohol related diseases, accidents and violence; with protective effects of higher childhood SES varying between 10% and 30%. These associations are mediated through adult educational attainment and other socio-demographic characteristics. 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.

Keywords
Socioeconomic status, Household structure, Mortality, Finland

Disciplines
Demography, Population, and Ecology | Social and Behavioral Sciences | Sociology

Comments
Elo, Irma T. 2010. "Early Life Conditions and Cause-Specific Mortality in Finland." PARC Working Paper Series, WPS 10-04.

2-1-2010

Early Life Conditions and Cause-Specific Mortality in Finland

Irma T. Elo
University of Pennsylvania, popelo@pop.upenn.edu

Early Life Conditions and Cause-Specific Mortality in Finland

Irma T. Elo
Population Studies Center & Department of Sociology
University of Pennsylvania

Pekka Martikainen
Department of Sociology
University of Helsinki

Mikko Myrskylä
Max Planck Institute for Demographic Research
Rostock, Germany

An earlier version of this paper was presented at the annual meetings of the Population Association of America, Detroit, MI, April-May 2009. This research was supported by a pilot project grant from the Population Aging Research Center (PARC), University of Pennsylvania, with funding from the National Institute on Aging (P30 AG12836). We thank Ye Wang for invaluable programming assistance.

ABSTRACT

The purpose of this study is to investigate the relationship between early life socioeconomic status, household structure and adult 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 from the end of 1970 through the end of 1998. 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 find significant associations between early life social and family conditions on all cause mortality as well as mortality from cardiovascular and alcohol related diseases, accidents and violence; with protective effects of higher childhood SES varying between 10% and 30%. These associations are mediated through adult educational attainment and other socio-demographic characteristics. 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 disease load, SES, place of residence and other household characteristics contribute to adult disparities in health and mortality (Beebe-Dimmer et al. 2004; Blackwell et al. 2001; Hayward and Gorman 2004; Kuh et al. 2002; Laaksonen et al. 2005; Osler et al. 2005; Preston et al. 1998). Among the pathways 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).

The purpose of this paper is to investigate the associations between childhood SES and 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, 1998. The Finnish data constitute a unique register based data set that does not rely on individual recall of early life family characteristics, educational attainment, occupation, and other life course trajectories. The results contribute to the accumulating evidence on the associations between early life family context and adult cause-specific mortality.

BACKGROUND

Studies of the effects of childhood characteristics and 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; 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 differential impact of childhood conditions on various disease processes reflected in differing associations between early life characteristic 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).

Most relevant to the present study is prior research examining associations between childhood SES and other family characteristics and adult health and mortality. Most studies find significant relationships between childhood SES, measured by father's occupation and/or parental education, housing characteristics and/or family income and various measures of adult

health (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, however, typically substantially attenuated with controls for adult SES, but often remain significant depending on the health outcome and the range of controls included in the models. 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 (Elo et al. 2008; Hummer 1993; O'Campo et al. 2008) 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 outcomes 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 the associations

typically being larger than those of childhood characteristics in models adjusting for both sets of factors (e.g. Pensola and Martikainen 2003, Martikainen et al. 2009). There is also some evidence from prior studies suggesting 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).

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 original sample have been subsequently linked to census and death records beginning in 1970 using unique person identifiers by Statistics Finland. In addition to the 1950 census we utilize information from the 1970, 1975, 1980 and 1985 censuses. The prospective follow-up to death records extends to December 31, 1998. The linked death certificate data provide date of death and cause of death based on 8^{th}, 9^{th} or 10^{th} 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 revisions of the ICD. Individuals who either died or moved out of the country (mainly to Sweden) between 1950 and 1970 cannot be linked to the 1970 census. After 1970 about 99% of the records have been linked to both census and death records.

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 whether early life conditions predict middle age mortality (between ages 35-64), we base our analysis on individuals who were ages 0-14 at the time of the 1950 census and who were living in single

mother, single father or two parent families. We linked the children to a mother and/or a father using unique family identifiers and information on the parents' age and the relationship of family members to the head of the family. In the 1950 sample data set, there were 116,622 children ages 0-14. We exclude children who were known to have died before age 35 (n=1,001) and those who were not present in the censuses of 1970, 1975, 1980 or 1985, either because they had died before 1970 or had moved out of Finland (n=15,065). These exclusions result in a sample of 100,556 children ages 0-14 in 1950. We further exclude cases for which we had unrealistic values for the mother's and the father's age at the child's birth (n=364) and individuals for whom we cannot obtain adult characteristics from the censuses when the individual was 30-44 years old (n=1,469); for further detail see below. Our final sample consists of 98,723 children ages 0-14 in 1950.

Explanatory variables

All childhood characteristics are obtained from the 1950 census. These characteristics tap into family's SES, 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). We measure the family's social class by the occupational class of the family head, which is based on the father's occupation, except in mother only families when the mother's occupation is used. In 1950 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. Our coding of social class is based on prior Finnish studies (Notkola et al. 2002, Martikainen et al. 2004). In addition, we include parental education which is an additional measure of SES and has been associated with child health and educational outcomes in numerous studies (e.g., Case et al. 2002, 2005). In addition to its association with social class, education

has been hypothesized to be related to accumulated knowledge, skills, resources, and decision making and problem solving skills (Mirowsky and Ross 2003; Cutler et al. 2006; Smith 2007). We code parental education to the highest level of schooling of either the mother or the father when both parents are present. In these families parents' educational attainment is 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.

Based on preliminary analysis that examined two measures of early life housing conditions, namely home ownership and household crowding, we found the latter measure to be a stronger predictor of mortality in middle age and is included here. This variable is coded as the number of persons per heated room in the dwelling. Finally, we include a measure of family type which distinguishes among mother only families, father only families, and families where both parents are present.

Our adult characteristics come from censuses of 1970, 1975, 1980 or 1985. We begin mortality follow-up at age 35. Our sample individuals reached age 35 between 1971 and 1985. Whenever possible we obtain adult characteristics from the census that is closest to the time after the individual had his/her 35^{th} birthday. If the person had died prior to that census but after reaching age 35, we link the person to the previous census. In addition, when the individual is not present in the ideal census we search for his/her characteristics in the prior or next available census. For 98.4% of the individuals the adult characteristics come from the census when she/he was 35-39 years old, for 1.2% when she/he was 30-34 years, and for 0.4% when the subject was 40-44 years.

We selected several adult socio-demographic characteristics based on prior studies that have shown them to be significant predictors of adult mortality in Finland (Martikainen et al.

1999, 2005, 2007; Koskinen et al. 2007). These include marital status, occupation, labor force attachment, educational attainment and home ownership. In addition, we include an indicator of family formation, namely whether the participant had at least one child. The classifications of the variables are shown in Table 1. In addition to the main explanatory variables of interest outlined above, in all models we control for age, region of residence in 1950, and sex.

Causes of death

In addition to investigating the associations between our explanatory variables and all cause mortality, we conduct separate analysis for cardiovascular diseases, which in prior studies have been linked to early life conditions (Barker 1995; Galobardes et al. 2004). We further hypothesize that childhood family background is a predictor of mortality from alcohol related diseases and from accidents and violence, many of which are also associated with excessive use of alcohol (Herttua et al. 2008). 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, are important causes of middle age mortality in Finland, especially among men (Herttua et al. 2008).

Statistical methods

We use Cox proportional hazards regression 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 63. In the cause-specific mortality models, individuals who died from causes other than the one under investigation are censored at the date of death (Allison 1995; Cox and Oakes 1984). Models are estimated using maximum likelihood estimation techniques in STATA 10 (Stata Corporation 2007). We base our comparisons on the effects of the explanatory variables on hazard ratios based on coefficients from the proportional hazard models ($HR=e^{\beta}$). We used t-tests to assess the

significance of individual coefficients and calculated standard errors corrected for clustering within families.

We present results from three models: Model 1 which shows the associations between each explanatory variable and all-cause or cause-specific mortality controlling for age, sex and region of residence in 1950. In Model 2, we introduce all childhood characteristics simultaneously with controls for age, sex and region of residence in 1950. In Model 3 we add controls for adult characteristics.

RESULTS

Table 1 provides sample characteristics. Just over half of the sample is male and the vast majority (91%) lived with both parents in 1950. Relatively few children grew up in white collar families (15%), i.e., where the family head was employed in professional or administrative occupations, whereas two thirds grew up on small farms (26%) or in families where the father or the mother was an agricultural or manual worker (42%). About 8% lived on somewhat larger farms with at least 10 hectares of land. Reflecting this occupational distribution, only 10% of the parents had education beyond primary school with most others having completed primary school (73%). Close to 20% of the children grew up in relatively crowded households with four or more persons per heated room.

By the time these children had reached age 35, only 14% of those who grew up on farms were farmers, with most children from farm backgrounds having entered lower white collar (25%), or manual occupations (37%) (results not shown). Overall the percentage of farmers was only 6%. Most individuals were employed in upper (14.5%) and lower white collar occupations (29.2%) or as industrial (17%) or other manual workers (19%). Labor force participation among these children in young adulthood was high at 86%. We speculate that many of those not in the

labor force (9%) consisted of individuals on disability pensions and others who were out of the labor force for health reasons (Table 1).

Compared to their parents, the children had attained much higher levels of education with 13% having obtained post-secondary schooling and another 13% upper secondary education. However, close to a half of the children had completed only basic education (48%). Our data also reflect the relatively high rates of home ownership in Finland in the 1970s and 1980s with 70% of the respondents reporting that they owned their own house or apartment. By the time the children reached their mid thirties close to 85% had married at least once, although 10% had separated, divorced or widowed. Only 15% of the respondents had never married. Among all respondents 81% were living with children.

Table 2 shows the distribution of deaths by sex and cause of death. About 9% of the men compared to 3.7% of the women had died by the end of the follow-up period, reflecting the much higher level of mortality among men than women. Males were much more likely to die from heart disease than women; 31% of all male deaths were due to cardiovascular diseases compared to 19% of deaths among women. Similarly, male mortality was much higher than female mortality from alcohol-related diseases, accidents and violence. About 40% of all male deaths were from these causes compared to 24% of female deaths.

Table 3 presents estimated hazard ratios for all-cause mortality from Models 1-3; similar results can be found for cardiovascular disease in Table 4 and for alcohol-related diseases, accidents and violence in Table 5. As seen in Table 3, all childhood characteristics exhibited a significant association with all-cause mortality controlling for age, sex, and region of residence in 1950. For example, children who grew up on farms or in families where mothers or fathers were employed in professional/administrative occupations had lower mortality than children of

agricultural or other workers. Similarly higher parental education was associated with lower mortality at ages 35-63. 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. The hazard ratios for higher SES relative to low SES ranged from 0.90 to about 0.70. As seen in Model 2 these results were robust to controls for all childhood characteristics simultaneously, although the sizes of the hazard ratios were attenuated.

In Model 3, we added adult characteristics. Not surprisingly the associations between early life conditions and mortality above age 35 were further attenuated, in many instances by over 50%, and all of them did not remain statistically significant (e.g., crowded housing conditions). We continued, however, to find significant associations between all cause mortality and parental occupation, education, and childhood family type. For example, farm background, regardless of farm size, continued to be protective as was having parents with primary school education. Those who grew up on a farm had about 15-20% lower mortality than did children of agricultural or other workers and those with parents who had primary school education had about 8% lower mortality than those whose parents had not completed primary school. In addition, the mortality of children who grew up in a father only family was about 20% 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. Overall, the most important mediating variables were adult occupation and educational attainment. At the same time, marital status and having children also played a role. For example, having children in the family mediated the association between having grown up in a single parent household and

adult mortality (results not shown).

The results for cardiovascular diseases and alcohol-related diseases, accidents, and violence were similar to those discussed above. In the case of cardiovascular diseases, all childhood characteristics predicted cardiovascular disease mortality in middle age (Model 2, Table 4). Similarly, all early life conditions, except family type, exhibited a significant association with mortality from alcohol related diseases, accidents and violence (Model 2, Table 5). In the fully adjusted model, Model 3, which included adult characteristics, the hazard ratios for early life conditions were substantially attenuated. The associations remained significant for parents' occupation, family type, and crowded housing in the case of cardiovascular diseases and parent's occupation and educational attainment in the case of mortality from alcohol related diseases, accidents and violence.

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 relatively small number of female deaths.

Finally, we should note that most adult characteristics remained significant predictors of all cause and cause-specific mortality controlling for early life conditions. Many of these associations were stronger than those of childhood characteristics in the fully adjusted model (Model 3). In particular, having a higher status occupation and higher level of education and owning one's own home reduced the mortality risk in all models (Table 3-5). 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 married individuals from all causes of death examined (Hu and Goldman 1990; Martikainen et al. 2005; Waite and Lehrer 2003). In addition to marital status, having children in the family was an independent predictor of mortality in all models such that those without children exhibited an increased risk of death ranging from 18% for cardiovascular diseases to 35% for alcohol related diseases, accidents and violence.

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 early life conditions 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 1950 census records, are unique in that they provide prospective follow-up of children from early childhood into middle age. Information on childhood SES, family structure, and place of residence, factors related to theoretically important measures of social origins of disease, come from the 1950 Census, and were thus not contaminated by participant recall biases. The subsequent linkage of individuals in the original sample to censuses and death records beginning from the end of 1970 provide information on adult circumstances which in turn made it possible to examine whether the childhood circumstances had long term consequences, net of adult characteristics, or whether their influence was mainly indirect.

We found childhood SES and family characteristics to be significant predictors of all cause mortality as well as deaths from cardiovascular diseases, and alcohol related diseases, accidents, and violence. Without adjustment for adult characteristics having parents with at least primary school education reduced all cause mortality by close to 20%. Similarly children who grew up in upper class or farm families experienced significantly lower adult mortality. In contrast, living in crowded housing or with only one parent was associated with a significant excess risk of death. Similar to other studies, we found that these associations were substantially attenuated by adjustment for adult educational and other socio-demographic characteristics, which themselves were significant predictors of middle age mortality controlling for childhood characteristics. 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.' At the same time, we continued to find an enduring association between family SES, parental education, and family type on mortality at middle age.

The individuals in our study were born between 1935 and 1950 and thus our results are most relevant for these birth cohorts. It is possible that associations between childhood socio-demographic conditions on adult mortality vary by birth cohort. It may be argued that they have either become 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, 2004). 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. Thus, one explanation for what may be somewhat weaker effects of parental SES observed for children in the 1950 as opposed to the 1970 census may be associated with the fact that lower social class families were more select or marginalized in 1970 than in 1950. At the same time, one reason for the strong predictive power of the adult characteristics on middle age mortality in the present study may be reflective of the rapid increase in educational and job opportunities in new sectors of the economy, resulting in rapid intergenerational social mobility during the study period. Such improvements may have helped mitigate possible negative consequences of early life disadvantage.

Of interest is also our finding that having grown up on a farm was protective for all cause mortality as well as deaths from cardiovascular diseases and from alcohol-related causes, accidents and violence, controlling for adult characteristics. Children born in the fourteen years prior to the 1950 census either lived through World WWII, were born during the war, or shortly

thereafter. Farm residence during this period may have been especially protective, for example, by mitigating the effects of food rationing. Alternatively or in addition, farm residence in childhood may be related to a healthier life style in adulthood. 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 appear to have been one of the pathways through which rural residence was associated with adult male mortality (Hayward and Gorman 2004). For the later Finnish birth cohorts born before 1970 the protective effect of being a son of a farmer was also evident for alcohol related, accidental and violent causes, but not for cardiovascular diseases (Pensola and Valkonen 2002).

Finally, we also find 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 having own children, factors that were also strong predictors of all cause and cause-specific mortality in middle age.

We should also note limitations of these analyses and suggest future next steps. As noted earlier, about 15% of the children in the original sample could not be linked to the 1970 Finnish census or to censuses thereafter. Some of these individuals had died before 1970, but mostly they were young adults who migrated to Sweden in the late 1960s. In Table 6, we compare our analytic sample to those children who were lost to follow-up, i.e., those who could not be linked either to census or death records from 1970 onward. As seen in Table 6, these individuals are more likely to be women than men and come from lower SES backgrounds compared to individuals included in our analytic sample. However, these differences are not large.

Additional next steps consist of an investigation of possible interactions between childhood and adult SES and family type to assess more thoroughly the cumulative and/or compensatory effects of adult characteristics. Second, we are updating the mortality follow-up to 2007. The additional linkage to death records will enable us to carry out more detailed cause-specific analyses and also to evaluate whether the associations between childhood characteristics and adult mortality are more important at certain life stages in adulthood.

REFERENCES

Allison, P. D. 1995. Survival Analysis Using SAS: A Practical Guide. Cary, NC: Institute Press.

Barker, D. J. 1995. Fetal origins of coronary heart disease. *British Medical Journal* 311(6998): 171-174.

Beebe-Dimmer, J., J.W. Lynch, G. Turrell, S. Lustgarten, T. Raghunathan, and G.A. Kaplan. 2004. Childhood and adult socioeconomic conditions and 31-year mortality risk in women. *American Journal of Epidemiology* 159:481-490.

Blackwell, D. L., M. D. Hayward, and E. M. Crimmins. 2001. Does childhood health affect chronic morbidity in later life? *Social Science and Medicine* 52(8): 1269-1284.

Case, A., D. Lubotsky, and C. Paxson. 2002. Economic status and health in childhood: the origins of the gradient. *American Economic Review* 92(5): 1308-1334.

Case, A., A. Fertig, and C. Paxson. 2005. The lasting impact of childhood health and circumstance. *Journal of Health Economics* 24(2): 365-389.

Costa, L. D. 1993. Height, weight, wartime stress, and older age mortality: evidence from the union army records. *Explorations in Economic History* 30(4): 424-449.

Cox, D. and D. Oakes. 1984. *Analysis of Survival Data*. London: Chapman and Hall.

Cutler D, Deaton A. Lleras-Muney. 2006. The determinants of mortality. *Journal of Economic Perspectives* 20(3):97-120.

Duncan, G. J., W. J. Yeung, J. Brooks-Gunn, and J. R. Smith. 1998. How much does childhood poverty affect the life chances of children? *American Sociological Review* 63(3): 406-423.

Elman, C. and A. M. O'Rand. 2004. The race is to the swift: socioeconomic origins, adult education, and wage attainment. *American Journal of Sociology* 110(1): 123-160.

Elo, I. T. and S. H. Preston. 1992. Effects of early-life conditions on adult mortality: a review. Population Index 58(2): 186-212.

Elo, I. T. and S. H. Preston. 1996. Educational differentials in mortality: United States, 1979-1985. *Social Science and Medicine* 42(1): 47-57.

Galobardes, B., J.W. Lynch, and G. Davey Smith. 2004. Childhood socioeconomic circumstances and cause-specific mortality in adulthood: Systematic review and interpretation. *Epidemiologic Reviews* 6: 7-21.

Haas SA. 2006. Health selection and the process of social stratification: the effect of childhood health on socioeconomic attainment. *Journal of Health and Social Behavior* 47: 339–354

Haas, A. S. 2008. Trajectories of functional health: the 'long arm' of childhood health and socioeconomic Factors. *Social Science and Medicine* 66(4): 849-861.

Hayward, M. D. and B. K. Gorman. 2004. The long arm of childhood: the influence of early-life social conditions on men's mortality. *Demography* 41(1): 87-107.

Herttua K., P. Mäkelä, and P. Martikainen. 2008. Changes in alcohol-related mortality and its socioeconomic differences after a large reduction in alcohol prices: a natural experiment based on register data. *American Journal of Epidemiology* 168(10):1110-8.

Hu, Y. and N. Goldman. 1990. Mortality differentials by marital status: An international comparison. *Demography* 27(2): 233–250.

Huang, C. and I.T. Elo. 2009. Mortality of the oldest old Chinese: The role of early life nutritional status, socioeconomic conditions, and sibling sex composition. *Population Studies* 63: 7-20.

Hummer RA. 1993. Racial differences in infant mortality in the US: an examination of social

and health determinants. *Social Forces* 72:529-54
Kauhanen, L., H. M. Lakka, J.W. Lynch, and J. Kauhanen. 2006. Social disadvantages in childhood and risk of all cause death and cardiovascular disease in later life: a comparison of historical and retrospective childhood information. *International Journal of Epidemiology* 35(4): 962-968.
Kohler, I. V. and B. J. Soldo. 2005. Childhood predictors of late-life diabetes: the case of Mexico. *Social Biology* 52(3/4): 113-131.
Koskinen S., K. Joutsenniemi, T. Martelin, and P. Martikainen. 2007. Mortality differences according to living arrangements. *International Journal of Epidemiology* 36:1255-64.
Kuh, D. and M. E. J. Wadsworth. 1993. Physical health status at 36 years in a British national birth cohort. *Social Science and Medicine* 37(7): 905-916.
Kuh, D., R. Hardy, C. Langenberg, M. Richards, and M. E. Wadsworth. 2002. Mortality in adults aged 26-54 years related to socioeconomic conditions in childhood and adulthood: post war birth cohort study. *British Medical Journal* 325(7372):1076-1080.
Laaksonen, M., O. Rahkonen, P. Martikainen, and E. Lahelma. 2005. Socioeconomic position and self-rated health: the contribution of childhood socioeconomic circumstances, adult socioeconomic status, and material resources. *American Journal of Public Health* 95(8): 1403-1409.
Lawlor, D.A., J.A.C. Sterne, P. Tynelius, G. Davey Smith, and F. Rasmussen. 2006. Association of childhood socioeconomic position with cause-specific mortality in a prospective record linkage study of 1,839,384 individuals. *American Journal of Epidemiology* 164: 907-915.
Luo, Y. and L. Waite. 2005. The impact of childhood and adult SES on physical, mental, and cognitive well-being in later life. *Journal of Gerontology* Series B: Psychological Science and Social Science 60(2): S93-S101.
Loucks, E.B., J.W. Lynch, L. Pilote, R. Fuhrer, N.D. Almeida, H. Richard, G. Agha, J.M. Murabito, and E.J. Benjamin. 2009. *American Journal of Epidemiology* 169:829-836.
Lynch, J. W., G. A. Kaplan, R. D. Cohen, J. Kauhanen, T. W. Wilson, N. L. Smith, and J. T. Salonen. 1994. Childhood and adult socioeconomic status as predictors of mortality in Finland. *Lancet* 343(8896): 524-527.
Martikainen P. 1995. Socioeconomic mortality differentials in men and women according to own and spouse's characteristics in Finland. *Sociology of Health & Illness* 17: 353-375.
Martikainen P., and T. Valkonen. 1999. Bias related to the exclusion of the economically inactive in studies on social class differences in mortality. *International Journal of Epidemiology* 28:899-904.
Martikainen P., N. Mäki, A. Karisto, and O. Rahkonen. 2004. Helsinkiläisten suurten ikäluokkien ammatillisen eliitin sosiaalinen ja maantieteellinen tausta. *Yhteiskuntapolitiikka* 69:31-38.
Martikainen P., T. Martelin, S. Koskinen, E. Nihtilä, and K. Majamaa. 2005. Increasing differences in mortality by marital status from 1975 to 2000: changes in sociodemographic, household and cause of death structure. *Population Studies* 59(1):99-116.
Martikainen P., J. Blomgren, and T. Valkonen. 2007. Change in the total and independent effects of education and social class on mortality from 1971 to 2000. *Journal of Epidemiology and Community Health* 61(6):499-505.
Martikainen P., T. Valkonen, and H. Moustgaard. 2009. The effects of individual taxable income, household taxable income, and household disposable income on mortality in Finland,

1998−2004. *Population Studies* 63: 147- 162.
Melchior, M., T.E. Moffitt, B.J. Milne, R. Poulton, and A. Caspi. 2007. Why do children from socioeconomically disadvantaged families suffer from poor health when they reach adulthood? A life-course study. *American Journal of Epidemiology* 166: 966-974.
Mirowsky J, Ross CE. 2003. *Education, Social Status and Health*. New York: Aldine De Gruyter
Moody-Ayers, S., K. Lindquist, S. Sen, and K.E. Covinsky. 2007. Childhood social and economic well-being and health in older age. *American Journal of Epidemiology* 166:1059-1067.
Notkola, V., T. Martelin, and S. Koskinen. 2002. Socioeconomic Position in Childhood and Adult Cardiovascular Mortality in 1971–98 in Finland – Register-Based Follow-Up Study of a Large Sample from the 1950 Census. *Yearbook of Population Research in Finland* 38: 13–23.
Osler, M., A.M. Andersen, G.D. Batty, and B. Holstein. 2005. Relation between early life socioeconomic position and all cause mortality in two generations: a longitudinal study of Danish men born in 1953 and their parents. *Journal of Epidemiology and Community Health* 59:38-41.
Pensola T.H., and T. Valkonen. 2002. Effect of parental social class, own education and social class on mortality among young men. *European Journal of Public Health* 12(1):29-36.
Pensola T., and P. Martikainen. 2003. Cumulative social class and mortality from various causes in young men. *Journal of Epidemiology and Community Health* 57(9):745-51.
Pensola T., and P. Martikainen. 2003. Effect of the living conditions in the parental home and youth paths on social class differences in mortality among women. *Scandinavian Journal of Public Health* 31(6):428-438.
Power, C., S. Matthews, and O. Manor. 1996. Inequalities in self rated health in the 1958 birth cohort: lifetime social circumstances or social mobility?, British Medical Journal 313(7055): 449-453.
Preston, S. H. and P. Taubman. 1994. Socioeconomic differences in adult mortality and health status, in L. G. Martin and H. Preston (eds.), *Demography of Aging*. Washington, DC: National Academy Press, pp. 279-318.
Preston, S. H., M. E. Hill, and G. L. Drevenstedt. 1998. Childhood conditions that predict survival to advanced ages among African-Americans. *Social Science and Medicine* 47(9): 1231-1246.
Stata Corporation. 2007. *Stata 10*. College Station, TX: Stata Corporation.
Statistics Finland. 1997. Vuoden 1950 väestälaskennan otosaineiston käsikirja (Handbook of the 1950 census sample). Helsinki, Finalnd: Statistics Finland.
Strand, B.H. and A. Kunst. 2006. Childhood socioeconomic position and cause-specific mortality in early adulthood. *American Journal of Epidemiology* 165: 85-93.
Smith JP. 2007. The impact of socioeconomic status on health over the life-course. *The Journal of Human Services* XLII: 739-764
van de Mheen, H., K. Stronks, C. W. Looman, and J. P. Mackenbach. 1998. Does childhood socioeconomic status influence adult health through behavioral factors? *International Journal of Epidemiology* 27(3): 431-437.
Waite, L. J. and E.L. Lehrer. 2003. The benefits from marriage and religion in the United States: A comparative analysis. *Population and Development Review* 29(3): 255–277.
Zeng, Y., D. Gu, and K. C. Land. 2007. The association of childhood socioeconomic conditions with healthy longevity at the oldest-old ages in China. *Demography* 44(3): 497-518.

TABLE 1: Sample Characteristics (%), Finland 1950 and 1970-85 (N=98,723)

	Entire sample	Deaths
Gender		
Male	52.0	73.2
Female	48.0	26.8
Childhood Characteristics, Ages 0-14		
Occupation of family head[a]		
Professional/administrative	15.0	12.7
Agricultural and other workers	41.7	45.2
Farmers with < 10 hectares	25.9	25.8
Farmers with ≥ 10 hectares	8.1	6.7
Other[b]	9.3	9.6
Parental Education[c]		
Less than primary school	16.5	22.4
Primary school	73.2	69.2
Past primary school	10.2	8.3
Housing Conditions		
< 2 people per heated room	32.1	28.5
2-3 people per heated room	31.9	31.3
3-4 people per heated room	16.4	17.3
4+ people per heated room	18.4	21.8
Missing	1.1	1.2
Family type		
Both parents	90.9	87.5
Mother only	7.8	10.4
Father only	1.3	2.1
Adult Characteristics		
Marital Status		
Never married	15.4	26.9
Married	74.5	57.3
Separated/divorced/widowed	10.0	15.8
Has children		
No	19.2	33.5
Yes	80.8	66.5
Occupation		
Upper white collar	14.5	8.5
Lower white collar	29.2	17.7
Manual worker – industry	16.5	19.6
Manual worker – other	18.7	21.5
Farmer	6.3	5.5
Self-employed	5.3	4.7
Unknown, including students	9.3	22.5
Labor force attachment		
In the labor force	85.7	76.4
Not in the labor force, excl. housewives	8.9	20.0
Housewife	5.4	3.6
Education (years)		
9 years – basic	47.8	61.1
10-11 years – lower secondary	26.3	22.2
12 years – upper secondary	12.9	9.6
13+ years – post secondary	12.9	7.1
Home ownership		
Owner	69.9	56.3
Renter	17.1	24.5
Employer provides	8.8	9.2
Unknown	4.1	10.0

[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.

TABLE 2: Distribution of Deaths by Cause, Ages 35-63, Finland 1970-1998

	Men		Women	
Causes of death	*#*	*%*	*#*	*%*
All Causes	4,817	100.0	1,762	100.0
Cardiovascular disease	1,509	31.3	335	19.0
Alcohol-related[a], suicide, accidents & violence	1,955	40.6	427	24.2
All other diseases	1,353	28.1	1,000	56.8
Mean years of follow-up				
Alive (censored)	19.5 (s.d. 4.3)		19.7 (s.d. 4.3)	
Dead	13.2 (s.d. 6.6)		13.7 (s.d. 6.5)	

[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 for All Cause Mortality, Ages 35-63, Finland 1970-1998 (N=98,723)

Characteristic	Model 1[a]	Model 2[a]	Model 3[a]
***Gender** (Male)*[b]	0.38**	0.38**	0.40**
Female			
Childhood Characteristics			
Occupation of family head[c] *(workers)*			
Professional/administrative	0.76**	0.83**	0.94
Farmers with < 10 hectares	0.84**	0.84**	0.87**
Farmers with ≥ 10 hectares	0.70**	0.74**	0.82**
Other	0.91*	0.92	0.95
Parental Education[d] *(< primary school)*			
Primary school	0.81**	0.84**	0.92*
Past primary school	0.70**	0.82**	0.98
Housing Conditions (< 2 people)			
2-3 people per heated room	1.12**	1.06	1.00
3-4 people per heated room	1.16**	1.08*	0.97
4+ people per heated room	1.32**	1.19**	1.01
Family type (both parents)			
Mother only	1.16**	1.13**	1.07
Father only	1.38**	1.33**	1.20*
Adult Characteristics			
Marital Status (married)			
Never married	2.30**		1.59**
Separated/divorced/widowed	2.45**		1.69**
Has children (yes)			
No	2.09**		1.27**
Occupation (other manual worker)			
Upper white collar	0.50**		0.72**
Lower white collar	0.69**		0.79**
Manual worker – industry	0.93*		0.95
Farmer	0.70**		0.86*
Self-employed	0.80**		0.92
Labor force attachment (in the labor force)			
Not in the labor force, excl. housewives	2.95**		1.35**
Housewife	1.17*		1.27**
Education (9 years)			
10-11 years	0.76**		0.86**
12 years	0.66**		0.86**
13+ years	0.45**		0.65**
Home ownership (renter)			
Owner	0.58**		0.75**
Employer provides	0.68**		0.89*

[a] Model 1 shows individual effects for each explanatory variable controlling for age, sex and region of residence in 1950. Model 2 and Model 3 show adjusted effects also controlling for age and region of residence in 1950.
[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.
** p-value ≤ 0.01; * p-value ≤ 0.05

TABLE 4: Hazard Ratios for Cardiovascular Disease Mortality, Ages 35-63, Finland 1970-1998 (N=98,723)

Characteristic	Model 1[a]	Model 2[a]	Model 3[a]
***Gender** (Male)*[b]			
Female	0.23**	0.23**	0.24**
Childhood Characteristics			
Occupation of family head[c] *(workers)*			
Professional/administrative	0.63**	0.76**	0.89
Farmers with < 10 hectares	0.78**	0.78**	0.80**
Farmers with ≥ 10 hectares	0.70**	0.79*	0.86
Other	0.88	0.92	0.94
Parental Education[d] *(< primary school)*			
Primary school	0.78**	0.82**	0.90
Past primary school	0.57**	0.75*	0.94
Housing Conditions (< 2 people)			
2-3 people per heated room	1.31**	1.23**	1.15*
3-4 people per heated room	1.39**	1.27**	1.13
4+ people per heated room	1.53**	1.35**	1.13
Family type (both parents)			
Mother only	1.24**	1.21*	1.16*
Father only	1.33	1.28	1.16
Adult Characteristics			
Marital Status (married)			
Never married	2.09**		1.51**
Separated/divorced/widowed	2.13**		1.51**
Has children (yes)			
No	1.82**		1.18**
Occupation (other manual worker)			
Upper white collar	0.39**		0.61**
Lower white collar	0.70**		0.83*
Manual worker – industry	0.95		0.96
Farmer	0.72**		0.89
Self-employed	0.87		1.03
Labor force attachment (in the labor force)			
Not in the labor force, excl. housewives	2.67**		1.47**
Housewife	1.12		1.20
Education (9 years)			
10-11 years	0.78**		0.87*
12 years	0.61**		0.84
13+ years	0.35**		0.60**
Home ownership (renter)			
Owner	0.59**		0.74**
Employer provides	0.69**		0.91

[a] Model 1 shows individual effects for each explanatory variable controlling for age, sex and region of residence in 1950. Model 2 and Model 3 show adjusted effects also controlling for age and region of residence in 1950.
[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.
** p-value ≤ 0.01; * p-value ≤ 0.05

TABLE 5: Hazard Ratios for Alcohol-Related Diseases, Accidents & Violence, Ages 35-63, Finland 1970-1998 (N=98,723)

Characteristic	Model 1[a]	Model 2[a]	Model 3[a]
***Gender** (Male)*[b]			
Female	0.23**	0.23**	0.25**
Childhood Characteristics			
Occupation of family head[c] *(workers)*			
Professional/administrative	0.79**	0.83*	0.94
Farmers with < 10 hectares	0.80**	0.80**	0.86**
Farmers with ≥ 10 hectares	0.64**	0.68**	0.81*
Other	0.90	0.91	0.95
Parental Education[d] *(< primary school)*			
Primary school	0.76**	0.79**	0.86**
Past primary school	0.76**	0.88	1.05
Housing Conditions (< 2 people)			
2-3 people per heated room	1.12*	1.07	1.00
3-4 people per heated room	1.14*	1.07	0.95
4+ people per heated room	1.33**	1.20**	1.00
Family type (both parents)			
Mother only	1.15	1.11	1.04
Father only	1.31	1.25	1.12
Adult Characteristics			
Marital Status (married)			
Never married	2.58**		1.70**
Separated/divorced/widowed	3.56**		2.29**
Has children (yes)			
No	2.52**		1.35**
Occupation (other manual worker)			
Upper white collar	0.49**		0.67**
Lower white collar	0.62**		0.71**
Manual worker – industry	0.86*		0.89
Farmer	0.55**		0.71**
Self-employed	0.76**		0.89
Labor force attachment (in the labor force)			
Not in the labor force, excl. housewives	2.96**		1.16
Housewife	1.15		1.30
Education (9 years)			
10-11 years	0.79**		0.91
12 years	0.66**		0.90
13+ years	0.48**		0.72**
Home ownership (renter)			
Owner	0.52**		0.72**
Employer provides	0.63**		0.84*

[a] Model 1 shows individual effects for each explanatory variable controlling for age, sex and region of residence in 1950. Model 2 and Model 3 show adjusted effects also controlling for age and region of residence in 1950.
[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.
** p-value ≤ 0.01; * p-value ≤ 0.05

TABLE 6: Comparison of childhood characteristics between those included in the analytic sample (N=98,723) and those who either had migrated out of Finland or who had died prior to 1970 (N=15,065), 1950 Finnish Census

Characteristic	Analytic sample (N=98,723)	Those who migrated or died prior to 1970 (15,065)
Age in 1950 (mean and sd)		
Gender		
Male	52.0	44.2
Female	48.0	55.8
Childhood Characteristics, Ages 0-14		
Occupation of family head[a]		
Professional/administrative	15.0	12.5
Agricultural and other workers	41.7	47.2
Farmers with < 10 hectares	25.9	24.0
Farmers with ≥ 10 hectares	8.1	6.0
Other[b]	9.3	10.3
Parental Education[c]		
Less than primary school	16.5	20.1
Primary school	73.2	71.6
Past primary school	10.2	8.0
Housing Conditions		
< 2 people per heated room	32.1	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	18.4	22.7
Missing	1.1	1.6
Family type		
Both parents	90.9	88.2
Mother only	7.8	9.9
Father only	1.3	1.8
Region of residence in 1950		
Helsinki region	7.5	7.1
Rest of Uusimaa	5.8	6.6
Western Finland	39.3	39.1
Eastern Finland	47.4	47.2

[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.