

When Did the Health Gradient Emerge? Income, Social Class and Mortality, Sweden 1813-2011

TOMMY BENGTTSSON, MARTIN DRIBE, JONAS HELGERTZ

LUND PAPERS IN ECONOMIC DEMOGRAPHY 2018:2

Centre for Economic Demography
Lund University School of Economics and Management
P.O. Box 7083
SE-220 07 Lund, Sweden

www.ed.lu/publications/Lund-Papers-in-Economic-Demography/



CENTRE FOR ECONOMIC DEMOGRAPHY

The Centre for Economic Demography (CED), established in 2006 as a Linnaeus Centre of Excellence, is a multidisciplinary research centre at Lund University with members from the School of Economics and Management, the Faculty of Medicine and the Faculty of Social Sciences. The mission of CED is to promote research and training in population studies. Researchers at the Centre study demographic issues from different perspectives and in a variety of contexts across time and space. More information at www.ed.lu.

When did the Health Gradient Emerge? Income, Social Class, and Mortality in Sweden, 1813-2011

Tommy Bengtsson, Martin Dribe, and Jonas Helgertz
Centre for Economic Demography
Department of Economic History
Lund University

Abstract

There is a strong mortality gradient by socioeconomic status in most of today's developed countries, which has spurred both scientific and policy interest. Despite its importance, we still do not have a full understanding of the causes of this gradient, nor about when it emerged. In this paper we study socioeconomic differences in adult mortality for men and women in Sweden over an almost 200-year period, using unique individual level register data. Our main findings show a late emergence of the mortality gradient, regardless of whether socioeconomic status is measured by occupational status, class, or income. We only find a consistent socioeconomic gradient after 1970, even though some socioeconomic mortality differences can also be observed somewhat earlier. Moreover, the mortality differentials emerge slightly earlier for women than for men. These results suggest that today's socioeconomic mortality gradient is far from a universal phenomenon.

Acknowledgement

This study is part of the research program “The Rise and Fall of the Industrial City: Landskrona Population Study”, funded by the Bank of Sweden Tercentenary Foundation (PI: Martin Dribe). We thank participants at the IUSSP seminar “Linking Past to Present: Long-Term Perspectives on Micro-Level Demographic Processes” Reitaku University, Kashiwa, Japan, 9-10 December 2016, and at the Population Association of America, April 2017.



This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement No 676060

DISCLAIMER: The results published in this working paper reflect only the author(s)'s view and the Research Executive Agency is not responsible for any use that may be made of the information they contain.

Introduction

There is overwhelming evidence of a strong socioeconomic gradient in adult mortality in today's developed countries, regardless of whether socioeconomic status is measured by education, social class, or income. The gradient is stronger among men than among women, and has grown stronger in the recent past. (e.g. Elo 2009; Mackenbach et al. 1997; Marmot et al. 1991; Torssander and Eriksson 2010; Cutler et al. 2012; De Gelder et al. 2017; Chetty et al. 2016). There is less evidence regarding the causes of this gradient, with explanations ranging from it being due to differences in access to health care, life styles, psychosocial factors or conditions and events earlier in the life course (Elo 2009; House et al. 1988; Kuh and Ben-Shlomo 2004; Marmot 2004; Smith 1999). It has also been argued that the degree of income inequality in a society is an important determinant of health and mortality through lower levels of trust and social capital (Kawachi et al. 1997; Wilkinson and Pickett 2010); an argument that, however, has been met with skepticism (e.g., Deaton 2003; see also O'Donnell et al. 2015). Due to a lack of empirical research, it is unclear when these socioeconomic differences in mortality emerged or if they have, in fact, always existed. Indeed, several researchers analyzing contemporary mortality differentials seem to assume that they were as large, or even larger, in the past (e.g. Elo 2009; Smith 1999). This is, however, at odds with some findings that indicate that mortality differentials were small in the past, at least among adults, as many leading causes of death were highly communicable and not treatable (Smith 1983; Livi-Bacci 1991; Bengtsson and Dribe 2011).

In this paper, we study the historical roots of the health gradient by looking at socioeconomic differences in male and female adult mortality during the nineteenth and twentieth centuries. We study mortality differences in the ages 30-90 by occupation (manual/non-manual), social class and income, using longitudinal individual-level data. Such a long-term analysis of the relationship between socioeconomic status and mortality

exploiting data on both income and occupation has never been undertaken before. The long-term perspective gives a rare opportunity to assess when the large socioeconomic differences in health and mortality that we observe today actually emerged, which also gives insights into the mechanisms through which socioeconomic status relate to health and mortality.

We study the period 1813-2011, which is sub-divided into six sub-periods corresponding to different stages of Sweden's economic history. We estimate models including the three different dimensions of socioeconomic status both separately and jointly, and for men and women separately. Our main findings show a late emergence of the socioeconomic gradient in mortality, regardless of which indicator that is used. We only find a consistent socioeconomic gradient after 1970, even though some mortality differences can be observed somewhat earlier 1950. Moreover, the mortality differentials emerge slightly earlier for women than for men. These results strongly suggest that today's inequality and health and mortality is far from a universal phenomenon. In the next two sections, we review some of the previous research in the field, followed by a presentation of context, data and methods, before we turn to our empirical results.

Socioeconomic status and health

All contemporary developed societies show marked differences in adult health and mortality between socioeconomic groups. Whether measured by income, education or social class (usually based on occupation), socioeconomic status is positively associated with health and negatively associated with (all-cause) mortality (see, e.g., Elo 2009; Mackenbach et al. 2003; Smith 1999, 2004; Cutler et al. 2012; De Gelder et al. 2017). Michael Marmot calls this phenomenon "the Status Syndrome" (Marmot 2004). To the question where we find a social gradient in health, he answers "pretty well everywhere" (Marmot 2004:16).

Socioeconomic status is a multifaceted concept, usually used to concatenate different measures relating to social and economic attainment. Education, income, or occupation-based measurements of social class are most often used to measure socioeconomic status. Indeed, a vast body of empirical research on contemporary developed countries has established a strong and robust relationship between aforementioned measures of socioeconomic status and health. High education has been found to be associated with lower adult mortality in Britain (Kunst and Mackenbach 1994; Mackenbach et al. 2003;), the United States (Cutler et al. 2012; Hayward et al. 2015; Kunst and Mackenbach 1994; Masters et al. 2012), continental Europe (Kunst and Mackenbach 1994), and Scandinavia (Vågerö and Norell 1989; Otterblad Olausson 1991; Bronnum-Hansen and Braadsgaard 2007; Shkolnikov et al. 2012; Steingrimsdottir et al. 2012; Torssander and Erikson 2010; Kravdal 2017).

Similarly, occupational rank has been found to be related to adult mortality. For example, in the Whitehall studies of British civil servants, a clear health gradient was found in terms of status position (Marmot et al. 1991). In Britain, as well as in Sweden, there also appears to be a clear social class gradient in mortality, in which higher social class is associated with lower mortality overall (Vågerö and Norell 1989; Otterblad Olausson 1991; Burström et al. 2005; Marmot 2004: 27; Torssander and Erikson 2010). A mortality gradient has also been identified for income, wealth or poverty (e.g. Elo 2009; Hederos et al. 2017; Smith 1999; Torssander and Erikson 2010; Chetty et al. 2016). Higher income and/or more wealth is consistently related to lower mortality, even though the strength of the relationship depends on age and is also often muted when controlling for education.

The reasons behind these health and mortality differentials by socioeconomic status have been debated in the literature, but there seems to be some agreement on a number of important factors contributing to the explanation. *Life style factors* (smoking, diet, exercise, alcohol consumption) are often mentioned as an important reason why low socioeconomic

status is related to worse health and higher mortality. The reason is that low status is associated with higher smoking prevalence, higher alcohol consumption, greater inactivity, and higher obesity rates (Vågerö and Norell 1989; Elo 2009; Smith 1999; Adler and Stewart 2010; Marmot 2004; Cavelaars et al. 2000; Norström and Romelsjö 1999). Clearly, however, differences in this kind of individual health-related behavior is only part of the story, as differences remain when controlling for this kind of health behavior.

Access to health care is often thought to be important as well, especially in contexts lacking universal provision of health care at low costs (Adler and Stewart 2010), but also in countries where health care is universal, or close to universal (Van Doorslaer et al. 2000). The latter could be related to underutilization of health services by lower socioeconomic status groups (Steingrimsdottir et al. 2012). This might also explain why there is no strong evidence that increased provision of health care actually reduces the health gradient (Smith 1999). In any case, simply providing more universal health care does not appear to be enough to eliminate the health gradient in contemporary societies (Adler and Stewart 2010).

The *efficiency of the health care* provided might indirectly contribute to the socioeconomic health gradient. The reason is that the success of treatment of patients depends on life styles, which often have a socioeconomic gradient. Smokers, for example, face increased risks of complications, including wound healing and pulmonary disorders, after any type of surgery. Several treatments are for this reason less efficient on smokers than non-smokers (Mills et al. 2011).

Environmental factors could potentially contribute to explain the socioeconomic health gradient if different socioeconomic groups live in markedly different environments. Exposure to air and water pollution and toxic waste is often not randomly distributed by socioeconomic status, but it still remains unclear how much this factor actually contributes to the health

gradients observed all over the Western world. Most likely, it is not a major factor (Adler and Stewart 2010).

In his research on British civil servants, and later on other contexts as well, Marmot has stressed the role of *psychosocial factors* in accounting for the health gradient (e.g., Marmot 2004). Controlling for other risk factors already mentioned does not completely remove the health gradient, even though it is significantly reduced. Net of such factors, the individual's socioeconomic status is linked to the degree of control they possess over their life situation. A lack of such control, most frequently experienced among individuals belonging to low socioeconomic status groups, leads to stress, which negatively affects health through different physiological mechanisms (blood pressure, susceptibility to infection, clogging of blood vessels, etc.). It is not only exposure to stress by itself that is important, but also the ability to cope with stress. Especially the combination of high stress exposure and low levels of coping lead to negative health effects (Adler and Stewart 2010). Long-term exposure to stress will excise a high toll on bodily functions through a frequent use of various physiological coping mechanisms, creating what is often referred to as "allostatic load" (Smith 1999; Adler and Stewart 2010). Lower socioeconomic positions are often associated with a lower degree of control over their work and hence higher work-related stress. It has also been argued that they suffer from weaker social networks and other resources used to cope with stress.

Finally, it has been noted that associations between socioeconomic status and health in adulthood may have their origin much earlier in life (Smith 1999; Elo 2009). We know from extensive research that *conditions early in life* (e.g., in the fetal stage and during infancy) have long-lasting impacts on health and other outcomes (e.g. Barker 1998; Case and Paxson 2008; Elo and Preston 1992; Fogel 2004; Finch and Crimmins 2004; Quaranta 2013). Low nutrition and exposure to disease during early life can affect organ development and hence the onset of chronic disease in adulthood, as well as cognitive ability, heights etc. This in turn could affect

both health and socioeconomic attainment and thereby explain some of the association between socioeconomic status and health in adulthood that we observe (e.g. Chandra and Vogl 2010; Cutler et al. 2012). At least indirectly, this is also related to another major issue in the vast literature on socioeconomic health differentials: *causality*.

While many assume, and theorize, that low socioeconomic status has a causal effect on health and mortality for the reasons just discussed, others have pointed out a causal effect from health to socioeconomic status exists as well (e.g. Deaton 2003; Smith 1999, 2004; Almond 2006; Bleakley 2007; Chandra and Vogl 2010; Cutler et al. 2012; Montez and Friedman 2014; O'Donnell et al. 2015). Although this seems very reasonable, there are studies using different quasi-experimental designs demonstrating a causal effect of education on health and mortality (e.g., Lleras-Muney 2005; Spasojevic 2010). A recent study using data of 50,000 Swedish twins estimated a three year longer life expectancy at age 60 for those with high levels of schooling (13 years or more) compared to those with low levels of schooling (less than 10 years) (Lundborg et al. 2016). Other studies have found causal effects of income on health using different empirical designs (e.g. Lindahl 2005; see also Kawachi et al. 2010). There are, however, also a number of quasi-experimental studies, using different identification strategies, finding no, or very small, causal effects of sudden income or wealth increases on various adult health outcomes, including mortality (e.g., Meer et al. 2003; Snyder and Evans 2006; Erixon 2014; Cesarini et al. 2016; see also O'Donnell et al. 2015 for a review).

When did the health gradient emerge?

Having established the existence of a strong health gradient by various measures of socioeconomic status, the question is when did it appear? Looking at the last 30 to 40 years, there is vast evidence that the socioeconomic health differentials actually have widened

(Bronnum-Hansen and Baadsgaard 2007; Shkolnikov et al. 2012; Mackenbach et al. 2003; Kunst et al. 2004; Burström et al. 2005; Hederos et al. 2017; Steingrimsdottir et al. 2012; De Gelder et al 2017). This development appears to be connected to a faster mortality decline in higher socioeconomic groups compared to lower-status groups, especially in terms of a range of preventable diseases, such as different forms of smoking-related cancers and cardiovascular disease (Mackenbach et al. 2015; Hederos 2017). This points to life-style factors becoming more important in explaining the health gradient in more recent years.

We know much less about mortality differentials by socioeconomic status before the 1960s, due to the lack of data providing a sufficient degree of detail. Many seem to assume that differences were even greater in the past, before universal health care and modern medical technology, when communicable diseases were more important for mortality and when nutrition and inadequate sanitation affected mortality to a much greater extent than today (e.g. Smith 2009). In a review of the literature, Elo (2009) also argues that mortality and health vary by socioeconomic status in all societies where it has been systematically studied and, while pathways may vary by context, the inequalities as such are “enduring”. The empirical support for these claims are, however, rather weak. Even though there are some studies actually studying socioeconomic differences in adult mortality before the 1940s, they usually cover short periods and small geographical areas (see Bengtsson and van Poppel 2011).

An example of a study indicating the important role of poverty for health and mortality at a specific point in time is the study of mortality differentials between taxpayers and non-taxpayers in Providence, Rhode Island in 1865 by Chapin (1924). He finds higher overall mortality as well as higher mortality in several important causes of death, such as pulmonary tuberculosis, heart disease and respiratory diseases among the non-taxpayers. Interestingly, he finds only small differences for contagious diseases. Similarly, Blum et al. (1990) find

substantial socioeconomic differences in remaining life expectancy at age 40 in a study of marriage certificates in Paris in the 1860s, which also include information on age at death of deceased parents of the bride and groom. More recent research, for the United States, has, however, suggested very modest mortality differences by educational attainment for cohorts born during the end of the 1800s and early 1900s (Masters et al. 2012). Likewise, other studies of different historical contexts have not found much social differences in adult mortality for men, or for both sexes combined, before the modern period (Smith 1983; Bengtsson and Dribe 2011; Edvinsson and Lindkvist 2011; Edvinsson and Broström 2012). Some studies, investigating gender differences in the mortality gradient by socioeconomic status, have found a mortality advantage for higher-status women, but not for higher-status men around the turn of the twentieth century (Dribe and Eriksson 2018; Jaadla et al. 2017).

The ambiguous results from previous research have also led to contradictory views in the literature about the long-term development of socioeconomic differentials in adult mortality; that the socioeconomic gradient in mortality has widened, narrowed, or stayed constant since the early phases of the mortality transition (see Bengtsson and van Poppel 2011). The fact that public health measures, as well as subsidized health care, reached an increasing share of the population during the course of the twentieth century is an argument in favor of *the convergence view*, which argues that socioeconomic mortality differentials have narrowed over time. Economic resources are also more evenly distributed today than they were in the past, partly because of transfers between individuals through the tax system, which strengthen the convergence hypothesis even further. Empirical support for this hypothesis has come mainly from urban contexts covering rather short periods of time (Antonovsky 1967), with the possible exception of Pamuk (1985), who finds that the social gradient in mortality in Britain declined from the 1920s to the 1950s and then started to increase again.

The convergence view has been challenged, the argument being that socioeconomic inequalities in mortality basically have remained more or less constant over the last 200 years (Link and Phelan 1996). The claim of *the constancy view*, or “fundamental causes” theory (FCT) as it has been labelled, is that while the specific mechanisms varied over time, the upper classes were always able to avoid premature deaths since they had better access to resources (Link and Phelan 1996). A recent version of the FCT attempts to take aspects of both the demographic transition and the epidemiological transition theories into account (Clouston et al. 2016). The argument is that as mortality declines new diseases come to dominate overall mortality, but mortality differentials from all diseases go through basically the same four phases.

Early on, diseases are largely non-preventable because of a lack of knowledge on causal agents and treatment. In this stage of “natural mortality” socioeconomic differences in mortality from the disease are usually small, and they can even be in favor of lower socioeconomic status groups. In the following stage, social differences arise, mainly because of new knowledge on how to prevent disease. Such knowledge is diffusing in society, and typically, the high-status groups are quicker to acquire new information and change their behavior. To the extent that new treatments and methods of diagnosis become available higher status groups will also be better able to protect themselves. This produces inequalities, as the mortality of the high-status groups starts to decline, while that of the low-status groups remains high. With a lag, mortality from the disease among the lower socioeconomic status groups also starts to decline, and after a while, the rate of improvement is faster among the low status groups and inequalities are reduced. This is a result of health-beneficial innovations becoming more universally accessible and evenly distributed throughout the population.

In the final phase, the mortality-reducing innovation becomes universally available, maximizing its impact on mortality for all groups. No more gains can be made, and in some

cases the disease is virtually eliminated (e.g. cholera or tuberculosis). In other cases, however, a small disadvantage for low-status groups remains also in this stage, due to differences in behavior or lack of resources to bring mortality all the way down. The crucial point is that this pattern is repeated disease by disease, and in all stages, except before the start of the transition, high socioeconomic status groups have an advantage when looking at overall mortality. In this sense, socioeconomic status is a fundamental cause, even though the precise mechanisms might be different for each disease.

Historical demographers, who argue that mortality in different social strata has diverged over the past 150 years (Smith 1983), have also challenged the convergence view. Socioeconomic mortality differentials were small in the past, or possibly even reversed, because mortality was mainly due to communicable, often highly virulent, diseases. Due to the nature of the predominant diseases, the upper classes were possibly even more exposed, and due to the lack of effective treatment, they may have suffered even more than the rest of the population. It has also been pointed out that in the past, regional differences in mortality were often much larger than socioeconomic differences (Smith 1983; Reid 1997; Woods et al. 1993; Garrett et al 2001; van Poppel et al. 2005; Edvinsson and Lindkvist 2011). First, mortality was much higher in urban areas; the expression urban penalty has often been used to describe it. Second, differences were often large between rural areas as well. Whether these differences are due to population density, communication networks, sanitation, access to safe water, organization of poor relief and health care, breast-feeding practices or differences in agricultural productivity is unclear. Geographic differences seem, however, to have declined during the late nineteenth and early twentieth century. This holds true for the difference between rural and urban areas, as well as within urban areas (Fogel 2004; Woods et al. 1993). Thus, it is necessary to consider regional factors when studying socioeconomic differences in

mortality. In this study, we focus on a confined geographic area to avoid any confounding influence of regional factors.

Context and Data

We use data from the Scanian Economic-Demographic Database (SEDD). These data consist of individual-level longitudinal information from five rural and semi-urban parishes and a port town in Southern Sweden, Landskrona (Bengtsson et al. 2017). The database is one of very few that can follow individuals across multiple generations from preindustrial times up to the present, and with detailed information on occupation and income, as well as on different demographic outcomes. The area is not a representative sample of Sweden in a statistical sense, but it reflects conditions shared by most similar areas during the time studied (see Dribe et al. 2015). We study the period 1813-2011, which is broken down into six sub-periods. The first sub-period (1813-1864) corresponds to the preindustrial or early industrial phase, when adult mortality was at pre-transitional levels. Between 1865 and 1904, Sweden experienced the industrial breakthrough and adult mortality started to decline. The period 1905-1949 was characterized by continued industrialization and urbanization, as well as an initial expansion of welfare institutions, such as income compensation during sickness and for work injuries, pensions, and housing allowances. While the pension program that was introduced in 1913 was the first in the world to be universal, the benefits corresponded to only 15 percent of workers' income (Edebalk 1996). It was not until 1948, when a new pension system was introduced, that a retiree could be expected to live on their pension. Until then, elderly had to rely on savings, their children, poor relief or continue to work (Edebalk and Olsson 2011). The period 1950-1967 also saw rapid economic growth and further development of essential functions of Swedish society. Turning to the final period, the beginning of the 1970s again saw an expansion of the welfare state, covering almost all

aspects of childcare to old age care, and from income compensation to health care.

Meanwhile, levels of education increased and manual work declined in importance, synonymous with overall upward social mobility (Dribe et al. 2015).

We have information about occupation annually (1813-1968 and 2001-2011) or during census years (1970, 1975, 1980, 1985, and 1990), as well as on individual income attainment from 1903 onwards. Another important characteristic is that migration to and out of the study area is comprehensively recorded, meaning that the population at risk is well-defined. The period investigated is one of continuously increasing life expectancy. During the twentieth century life expectancy at birth in Sweden rose from 52 to 77 years for men, and 55 to 82 years for women. Mortality rates for men in ages 30-34 years fell from 6 to under 1 per thousand between 1900 and 1997, and from 57 to 34 per thousand in ages 70-74 years. For women mortality in ages 30-34 declined from 6 to 0.4 per thousand, and in ages 70-74 from 50 to 19 per thousand over the same period (Statistics Sweden 1999: Table 5.3) As life expectancy increased, disease patterns also changed, from a predominance of infectious diseases to chronic diseases such as cardiovascular disease and cancer (Preston 1976).

For the port town of Landskrona, data is included from 1950 onwards, which means that for the period 1813-1949 we only have data for the five parishes. Information is provided from continuous population registers (a household-based register where information at the individual level is continuously updated), with information on demographic events, including migration to and from households for all individuals in the selected parishes. Birth and death registers have been used to adjust for possible under-recording of events in the population registers.

From 1968, individual-level information covering the entire country is available in various administrative registers at Statistics Sweden and the National Board of Health and Welfare. Data from these registers have been linked to the historical sample, which has

allowed an extension of the database along several dimensions. First, individuals who ever lived in the five parishes prior to 1968 and who were still alive in that year but lived elsewhere in the country were followed until 2011, or until death or emigration. Additionally, spouses, parents, grandparents, children and siblings of individuals belonging to the original population were added to the database if they were alive and living in Sweden sometime after 1967. All individuals added to the sample population were similarly followed until 2011, death, or emigration from Sweden.

The main analysis focuses on men and women residing in the five parishes and Landskrona, whereas sensitivity analyses are conducted comparing this population to the five parishes alone and the whole population ever lives in the five parishes or Landskrona regardless of where they live in Sweden afterwards (1968-2011).

We measure socioeconomic status based on the individual's and their spouse's income and occupation. Prior to 1968, information about occupation is obtained from several sources: demographic events, population registers, as well as annual data from the poll-tax registers and income registers. After 1968, we rely on occupational information provided by the quinquennial censuses (1970-1990) and from the annual occupation registers from 2001 onwards. For the period before 1968, occupational notations are coded in an internationally comparable coding scheme for historical occupations (HISCO) (Van Leeuwen et al. 2002). Occupations after 1968 were originally coded by Statistics Sweden in the NYK/SSYK classification, and were then recoded into HISCO after first being converted to ISCO-88 and then to ISCO-68 (Hendrickx 2002).¹ As a result, all observations on occupation are coded in HISCO.

¹ We have used the recoding files created by Erik Bihagen, available at <http://www2.sofi.su.se/~ebi/>. We have reversed the HISCO to ISCO-68 code, created by Ineke Maas and available from the website <http://hisco.antenna.nl/>.

Using the standardized occupational observations, these are subsequently coded into HISCLASS, a 12-category occupational classification scheme based on skill level, degree of supervision, whether manual or non-manual, and whether urban or rural: 1) higher managers; 2) higher professionals; 3) lower managers; 4) lower professionals; clerical and sales personnel; 5) lower clerical and sales personnel; 6) foremen; 7) medium-skilled workers; 8) farmers and fishermen; 9) lower-skilled workers; 10) lower-skilled farm workers; 11) unskilled workers; and 12) unskilled farm workers (Van Leeuwen and Maas 2011). In the analysis, the variable is used in two different ways. Firstly, occupational status is divided into two categories: manual workers (HISCLASS 6-12) and non-manual workers (HISCLASS 1-5). Secondly, we use an aggregation with six different classes: higher managers and professionals (HISCLASS 1-2), lower white-collar workers (HISCLASS 3-5), medium-skilled workers (HISCLASS 6-7), lower-skilled workers (HISCLASS 9-10), unskilled workers (HISCLASS 11-12), and farmers (HISCLASS 8). In all analyses, we also include individuals without a registered occupation (NA). Except for farmers, who are a bit problematic to fit into the class scheme over such a long period of time, other classes broadly reflect a status hierarchy from lowest status (unskilled workers) to highest status (higher managers and professionals). Some individuals have no occupations registered at all, but are only registered as son, daughter, widow, etc.

A unique feature of the data is that they include annual income at the individual level from 1903 onwards. The 1902 tax reform mandated all individuals with income or wealth over a certain limit to file a tax return. Based on these returns, as well as assessments made by a taxation board, annual attained and taxable income was recorded. Naturally, these registers also reflect the changes taking place in the tax code as the tax system developed. As we study a period of more than 100 years, these changes in tax legislation were substantial, making it challenging to identify how much all individuals earned from different income sources. For

example, besides the income thresholds, determining whether an individual had to file a tax return, Sweden practiced joint taxation of married spouses until 1971. In the period 1903-1946, there are no currently married women in the registers with an income noted and in cases when wives earned income it was added to the husband's income, essentially making it a family income. From 1947 to 1953, the incomes of married men and women are reported separately while the taxes paid are reported together, whereas from 1954 onwards both income and taxes are reported separately.

There were also thresholds under which people did not have to report income. These thresholds were almost constant over time in absolute terms, which means that an increasingly larger share of adults were listed in the income registers due to income growth. Moreover, especially in the early period, many farmers and other people drawing their income from estates reported no or very low income in their tax returns. However, based on the taxed value of the farm and other similar information the taxation board assessed an income also for these individuals ("taxable income"). There are also cases when apparently wealthy people, such as noble landowners, reported very low income but were assessed considerable sums by the tax committee, which is explained by the procedure to add a fraction of the wealth when calculating the taxable income ($1/60$ until 1938 and $1/100$ between 1939 and 1948, see Roine and Waldenström 2008). Individuals exempted from taxation have been given zero incomes.

Before 1968, income is the total income from labor, capital, self-employment and estates. From 1968 onwards, we include income from labor, self-employment, and various benefits relating to previous labor (pensions, parental leave benefits, unemployment benefits, etc.). These income definitions are not completely consistent over time, but as we focus on the association between income and mortality by sub-period, these changes should not influence the patterns observed.

Income is used as a time-varying variable for people under age 60. To reduce the impact of short-term variations in income, the earnings are measured as the average of the three preceding years. For the elderly (60-89), we use the income just before age 60 as a measure of income also after age 60 unless the actual income in retirement is higher than before retirement (which sometimes happened in the early years when the pension system was introduced and gradually developed).

We examine the relationship between socioeconomic status and mortality for both men and women. As has already mentioned, the share of women with gainful employment was very low well into the twentieth century. For married women own status is not likely to be a valid indicator of their actual living standard or social position. Consequently, in the main analysis we use the highest-status position in the couple to indicate occupational status and class, and total couple income. In the sensitivity analysis, we show that the results are practically identical when looking at individual occupation and income. Income is included in quintiles, calculated by gender and period (same periods as in the analysis).

Descriptive statistics

Table 1 displays the descriptive statistics of the sample, separately by gender. Looking first at class and occupation (the highest status in the family), there are quite dramatic changes, which are explained by fundamental structural changes taking place as Sweden transformed from a poor agricultural society into a modern welfare state. In the first period, 1813-1864, which was before the industrial breakthrough, about a third of working-age men were in households where the highest attained status was that of a farmer, and about another third unskilled workers (mainly working on farms, not shown in table 1). Around 2 percent belonged to the class of higher managers and professionals. In total, this implied that about 6 percent worked in non-manual occupations and 88 percent in manual occupations, leaving 5

percent without a classified occupation. The distribution for females looks very similar, but with a higher proportion without a registered occupation. This higher proportion missing occupation is accounted for by the unmarried women without an occupation.

Over time, the proportion in non-manual occupations increased to reach over 30 percent in the period 1950-1967, and approaching 50 percent in the final two periods after 1968. From the subdivision into classes, it is clear that increasing proportions in the group lower white-collar workers explains most of this increase in the non-manual group. Among the manual workers, there was a dramatic drop among farmers and unskilled workers, and instead an increased proportion of skilled workers. Again, the development over time is very similar for females.

Table 1 here

Within each sex, the group of individuals who are missing an occupational observation is quite heterogeneous over time. As indicated before, the consistently higher share among women in the periods before 1968 is due to a much lower labor force participation. Due to the information over time coming from different sources, before 1968 it contains people without an occupation (permanently unemployed), and after 1967 the group is made up more of people without a registered occupation in the censuses (1970-1990) or in the occupation registry (2001-2011). The latter is based on information that employers sent to Statistics Sweden, and thus only includes the currently employed, thereby excluding all unemployed as well as those outside the labor force. Due to the increasing importance of higher education, a noticeable proportion of the working-age population are also outside the labor market because they are studying. These differences are important to keep in mind when interpreting the results for this group.

Turning to income, the quintiles are calculated by period and gender. In the period 1905-1949 there is a high proportion (35 and 39 percent for men and women, respectively) in

the lowest-income group, which is explained by a high proportion of households without a registered income. Over time, taxation was expanded to also require reporting from the lower income segments, which explains the shrinking proportion of individuals with no registered income (1949-1967: 27 percent; 1968-1989: 4 percent; 1990-2011: 7 percent). In addition, work related benefits, such as unemployment benefits, sickness compensation and parental leave, are included in total income for much of the final period.

The proportion of people originating outside the county (Malmöhus county/Skåne county) increased from around 10 percent in the first periods to almost 30 percent in 1968-1989. The increase reflects the growing importance of long-range migration as Sweden developed. Thereafter, the share of migrants declined somewhat, partly due to administrative county boundary changes during the late 1990s.² In the final period, about 20 percent of the population was born outside Sweden, showing the change from being a country of emigration to a country of immigration. There are also pronounced differences over time in the distribution of the population across parishes. The parishes remaining rural throughout the period (Hög, Halmstad, Sireköpinge) declined dramatically while Kävlinge increased as it transformed from a rural village to a semi-urban municipality. In the final period, the industrial city of Landskrona dominates the sample.

Table 2 displays a cross tabulation of the exposure time between class and income quintiles. It shows a wide earnings distribution by class, especially in the early periods. Also in the highest class there were many individuals with no, or very low income. As already discussed, partly this is related to the registration of different kinds of income, such as income from property, but partly it also could also reflect low earnings due to bad health, or low labor supply for other reasons. It is also worth noting that some individuals reporting incomes, even

² The present county, Scania (Skåne) was created when Malmöhus county and Kristianstad country were merged in 1997.

high incomes, have no occupation assigned because they are listed as sons, daughters, widows, etc.

Table 2 here

Methods

To estimate the association between socioeconomic status and mortality while controlling for age and other possible determinants, we estimate Cox proportional hazards models:

$$\ln h_i(a) = \ln h_0(a) + \beta x_i$$

$h_i(a)$ is the hazard of death for an individual i at duration (age) a , $h_0(a)$ is the baseline hazard, i.e. the hazard function for an individual having the value zero on all covariates, and β is the vector of parameters for the individual covariates (x_i). The dataset is structured into episodes where individuals are followed from age 30 to 90, and where episodes are censored when time-varying covariates change value or when an individual move out of the area.³ Models include a full set of control variables, namely a linear birth year trend, civil status, migration status and parish of residence. Migration status is a proxy for the strength of social networks in the parish of residence, which could be important for mortality risks in these age groups. Socioeconomic status is a time-varying covariate in the age group 30-59. For the elderly, we use the highest observed occupational status and income in the age 50-60, a time in life at which most people have reached their peak in terms of socioeconomic position. The reason is that the occupation records of the elderly could be a rather misleading indicator of social and economic resources because of retirement. As previously mentioned, the only exception to this rule is when individuals have a higher income after age 60, where current income is used

³ For the period 1813-1968 we use a STATA program by Luciana Quaranta to create the episodes from IDS-type data (see Quaranta 2016), while for the period after 1968 episodes were created from the national registers.

instead. We are interested in understanding both how each measurement of SES (occupational status/earnings) influences mortality risk separately and jointly. Therefore, models are estimated with each respective measurement of SES as well as with the two operationalizations of occupational status together with earnings.

Cox models rely on the assumption of proportional hazards over the duration period. Formal tests (based on the scaled Schoenfeldt residuals, 'estat phtest' in STATA) shows significant non-proportionality in the income variable, especially in the first three periods, while there are no major violations for occupation and class (see Table A1). Cumulative hazards plotted over the full duration by income quintile (graphs not shown), reveal a problem mainly in ages over 80 in the period 1950-1967, where the hazard curves cross. Apart from this, there are no major violations from the proportional hazards assumption.

Main results

Table 3 shows estimates of the association between the different measures of family SES, based on the highest-status occupation and total couple income. The results come from separate models for each indicator using the main sample. Looking first at the final period (1990-2011) there is a clear mortality gradient for all three indicators, and for both men and women. Men in manual-worker couples have a doubled mortality risks compared to non-manual workers, and women in this group have about 60 percent higher mortality. Also for class there is a clear gradient going from higher managers with the lowest mortality to the unskilled workers having the highest, when only considering the employed. The non-employed have the highest mortality. Farmers, which is a very small group in this period (about 1.5 percent of total exposure), are a bit outside the gradient with mortality levels similar to the highest class. For men, the gradient is very clear also in-between the highest and lowest groups, while for women it is difficult to distinguish the manual workers of different

skill levels. Turning to income (mean over the last three years), there is a perfect gradient for men, with the lowest mortality for the top quintile, and then 20 percent higher mortality risks for the next quintile (60-80), an additional 20 percent for the next quintile (40-60), 10 percent more for the next quintile (20-40), and finally an additional 30 percent in the lowest quintile. Between the highest and lowest quintiles, the mortality difference is about 80 percent, which is more than between the unskilled workers and the higher managers. For women, the percentiles 20-60 are quite similar, and the difference between the top and the bottom is about 55 percent, somewhat less than for men. Largely, these results confirm previous research for a variety of contemporary contexts, as was discussed in the introduction and it confirms a somewhat weaker gradient for women than for men. This is reassuring because it shows that our regional sample produces the same results as previously obtained for Sweden as a whole, as well as for many other Western countries in the post-1990 period. Moreover, our results validate the use of the historical class scheme also for contemporary times, and strengthen the case for comparability of our results over time.

Table 3 here

Turning now to the patterns in earlier periods, something resembling the modern class gradient is not visible before 1970. There are some social differences also earlier, but nothing close to a consistent socioeconomic gradient in mortality. For men, it is not until the final period that we find any statistically significant differences in mortality between manual and non-manual workers, but the highest class (higher managers and professionals) had lower mortality also in the period 1968-1989, and the non-employed had much higher mortality. However, there are only small differences between the lower white-collar workers and the unskilled workers. Earlier in the twentieth century as well as in the nineteenth century, it appears as if higher status, if anything, was associated with higher, and not lower, mortality. A recent study found similar results for entire Sweden looking at the cohorts born 1841-1880,

and connected the higher mortality of the white-collar men to adverse life style, such as tobacco smoking, bad diet, and high alcohol consumption (Dribe and Eriksson 2018).

Looking at couple income, the poorest had higher mortality already in the period 1905-1949, when there are no differences at all by occupation or class. This seemingly contradictory pattern could be a result of people in bad health having lower income, regardless of their occupation. We saw previously in table 2 that there was substantial variation in income within classes, which could be connected to health. It was also clear that the variation was largest in the early periods, before there was a fully developed social insurance system. Hence, while there were no class or occupational differences in mortality, adverse health conditions may have increased the chances of ending up in the lowest income group for all classes, which could explain the strong mortality penalty in this group.

The patterns for women are quite similar, but the mortality gradient seems to emerge somewhat earlier than for men. Even if the differentials are not large, and often not statistically significant, there are indications of emerging differentials already in the late nineteenth century. Again, this is consistent with results for the entire country for the cohorts 1841-1880 as reported by Dribe and Eriksson (2018). A possible interpretation of the gender differences is that the adverse life style factors that were most likely important for the high mortality of high-status men, did not affect women in these groups as much because they were much less likely to smoke, and also had a lower alcohol consumption. Similar to men, the poorest group had higher mortality already in 1905-1949, most likely for similar reasons.

Having established a quite consistent pattern between various measurements of SES and mortality, for men as well as for women, we now proceed to investigate to what extent these measurements of SES affect the outcome jointly. While income and class are correlated, investigating their joint influence on mortality allows for a better understanding of whether the observed relationship primarily is due to access to financial resources or to other

characteristics such as educational attainment, working conditions, etc. Moreover, as was clear from table 2 previously, the overlap between class and income was actually not as large as one might expect, especially not in the first half of the twentieth century.

Table 4 displays results from models including both class and income at the same time. The sample and variable definitions are the same as in table 3, and the same control variables are included in the models. The income estimates are highly similar to the previous ones showing that the income differentials are highly independent of class differences (in the period 1950-68 the income gradient is somewhat stronger in the controlled model). Mortality differences by class, on the other hand, are more sensitive to income controls. While the overall patterns are not that different between the two sets of models, the associations are muted in the controlled model, indicating the income captures some of the class differentials in mortality.

Table 4 here

Sensitivity analysis

The main results are based on family-level indicators of occupation, social class and income of the population residing in a quite small geographic area (Landskrona and the five rural/semi-urban parishes). In this section, we test the robustness of the main findings using different study populations, different measures of class and income, and different age groups. All results are presented in appendix Table A2.

Panel 1 shows hazard ratios from models including both occupation (manual/non-manual) and income at the same time (i.e. similar to the models with class and income in table 4). For men, they are largely similar to those estimated separately, suggesting that it was not until after 1990 that a difference between manual and non-manual workers emerged. The estimates for the first two periods (until 1967) show even more strongly than before that men

in non-manual occupations experienced higher, rather than lower, mortality risks compared to manual workers. The income differences become more consistent already in the period 1950-1967, just as when controlling for class. For women, the simultaneous inclusion of both occupation and income does not change the previous conclusions from the separate estimations.

Next, we define socioeconomic status based on the individual's own occupation and income, rather than for the couple (Panel 2). Overall, the results are highly similar to the main results and confirm the emergence of mortality differentials by occupation only from about 1970, while there are differences by income also in the preceding period. Clearly, it does not matter a great deal if we measure class and income for individuals or couples. Panel 3 shows results using couple income during the previous year rather than as a three-year average. The estimates are very similar to the main results, showing that our conclusions are not dependent on how we measure income. One difference is for men in the period 1950-1969, who show a more consistent income gradient than when averaging income over three years.

As the port city of Landskrona completely dominates the sample in the final three periods (about 80 percent of all exposure) it is relevant to look at estimations excluding the town to see if the patterns are different in the largely rural area. As is evident from Panel 4, the patterns are quite similar in terms of both income and class. Overall, the main difference seems to be for men in the 1968-1989 period, where the more rural areas have a delayed onset of the SES-mortality gradient, particularly evident for class differences.

In Panel 5, we look at the population residing all over Sweden, thus either themselves originating in the five parishes and Landskrona, or whose parents or grandparents came from the area. This population we can only study in the national registers after 1968, and hence we can only include the two final periods. Naturally, the population is much bigger when including people in the entire country. The total time at risk in the two periods is more than 12

million person years for men and women compared to 1.4 million in the main sample used in Table 3 (the number of deaths is about 120,000 compared to 19,000 in the main sample). The first thing to note is the close similarity in the results for this population and our main analysis in Table 3. This is reassuring as it shows that the sample including the rural areas and Landskrona seems highly representative of the country as a whole. It is also important to note that we can reproduce the mortality gradient in the final period that have been shown in other studies using similar data, but with somewhat different selection criteria class schemes and variable definitions (e.g. Torssander and Erikson 2010).

Panels 6 and 7 show separate models for age groups 30-59 and 60-89. Overall, the mortality differentials are much larger in the younger age group, which is consistent with previous research (e.g., Bengtsson and Dribe 2011; Dribe and Eriksson 2018). Looking only at the married population in panel 8, the patterns are highly similar to the main results. Finally, results for income in the first period are robust to restricting the period to 1911-49 (instead of 1905-49), which shows that the initial changes in income registration do not affect the conclusions at all.

Conclusions

Our analysis of mortality differentials by socioeconomic status has produced a number of interesting findings. First, today's socioeconomic gradient in health and mortality is of a relatively recent origin. It is not until the after around 1970 that we find a consistent mortality penalty for individuals of lower socioeconomic status, almost regardless of model specification. The results also suggest a difference between men and women regarding the onset of the mortality gradient, where a social class and, particularly, income disadvantage for women can be traced back until 1950. However, when controlling for social class, or when focusing on income the previous year and not the last three years, we find similar income

patterns for men. It also appears that men in the highly selected group of non-manual workers, constituting less than 10 percent of the population, actually faced a mortality disadvantage compared to manual workers and men without a registered occupation during the early phases of the mortality transition. This might have been related to less healthy life styles or possibly greater exposure to disease due to more extensive migration.

Another finding is that mortality differentials by income emerge earlier than for occupation. Already in the first half of the twentieth century, men and women with in households with an income below the tax threshold have much higher mortality than those with an income over the threshold, while there is not much difference across different income groups exceeding the threshold. Over the twentieth century, this difference develops into a more or less linear gradient where lower earnings are related to higher mortality. This is a gradual process, and it is not until the period after 1970 that the modern gradient is fully developed. For class and occupational status, in particular while simultaneously accounting for the influence of income, equally strong mortality differentials never emerge. Overall, the results are not very sensitive to the inclusion of both class and income simultaneously.

In conclusion, these findings point to a rather late emergence of the inequality in health and mortality that is so much in focus in today's debate. It is not until the post-WWII period that it really became apparent, and it is only in the last 40 years that a full gradient has emerged. Thus, the socioeconomic gradient in mortality emerged in a period that is often labelled as the golden age of the Swedish economy, with rapidly increasing real wages, close to full employment, and an expansion and improvement of the health care system. Rather than being connected to the first phase of the epidemiological transition, when infectious disease mortality became more dependent on nutrition, a clear mortality gradient by socioeconomic status emerged when the economic standards of living increased tremendously, and when health care services, urban living conditions, and knowledge about disease prevention all

improved at a fast rate. This was also a period when the welfare state became fully developed with basic income security, education and health care for all, regardless of income or employment status.

The late emergence of the full health gradient points to health-related behaviors (e.g. smoking, alcohol consumption, diet and physical inactivity) and possibly psychosocial factors as important determinants. It is unlikely that early life factors created the large socioeconomic gradient we witness today. A study using the same data as in this analysis, found only weak effects of parental socioeconomic status on adult mortality. Men and women in ages 50-95, born to parents of lower socioeconomic status, had 8-12 percent higher mortality than those born to parents of higher status (Bengtsson and Quaranta 2017). For the period 1905-49, when especially those with earnings below the tax threshold had higher mortality but there were small or no differences in the rest of the population, economic well-being related to nutrition or housing quality may possibly have been more important for adult mortality than in later periods. However, in this period the results are more likely to have been driven by reversed causality, where bad health negatively affected the likelihood of having a job and a living wage.

References

- Adler, N. E. and Stewart, J. 2010. Health disparities across the lifespan: meaning, methods, and mechanisms. *Annals of the New York Academy of Sciences* 1186: 5-23.
- Almond, D. (2006). Is the 1918 Influenza pandemic over? Long-term effects of *in utero* Influenza exposure in the post-1940 U.S. population. *Journal of Political Economy* 114: 672-712.
- Antonovsky, A. 1967. Social class, life expectancy and overall mortality. *The Milbank Memorial Fund Quarterly* 45: 31–73.
- Barker, D. J. P. 1998. *Mothers, Babies, and Health in Later Life*. London: Churchill Livingstone.
- Bengtsson, T. and Dribe, M. 2011. The late emergence of socioeconomic mortality differentials: A micro-level study of adult mortality in southern Sweden 1815–1968. *Explorations in Economic History* 48: 389–400.
- Bengtsson, T., Dribe, M., Quaranta, L, and Svensson, P. 2017. *The Scanian Economic Demographic Database. Version 5.1* (Machine-readable database). Lund: Lund University, Centre for Economic Demography.
- Bengtsson, T. and van Poppel, F. 2011. Socioeconomic inequalities in death from past to present: An introduction. *Explorations in Economic History* 48: 343–356.
- Bengtsson, T. and Quaranta, L. 2017. Where you live, or who you are? The role of childhood for adult health, southern Sweden, 1900-2013. Unpublished paper.
- Bleakley, H. 2007. Disease and development: Evidence from Hookworm eradication in the American South. *Quarterly Journal of Economics* 122: 73-117.
- Blum, A., Houdaille, J., and Lamouche, M. 1990. Mortality differentials in France during the late 18th and early 19th centuries. *Population: An English Selection* 2: 163-185.

- Bronnum-Hansen, H. and Baadsgaard, M. 2007. Increasing social inequality in life expectancy in Denmark. *European Journal of Public Health* 17: 585-586.
- Burström, K., Johanneson, M., and Diderichsen, F. 2005. Increasing socio-economic inequalities in life expectancy and QALYs in Sweden 1980-1997. *Health Economics* 14: 831-850.
- Case, A. and Paxson C. 2008. Stature and status: Height, ability, and labor market outcomes. *Journal of Political Economy* 116: 499-532.
- Cavelaars, A. E. J. T. M., et al. 2000. Educational differences in smoking: international comparison. *British Medical Journal* 320: 1102-1107.
- Cesarini, D., Lindqvist, E., Östling, R., and Wallace, B. 2016. Wealth, health, and child development: Evidence from administrative data on Swedish lottery players. *Quarterly Journal of Economics* 131:687-738.
- Chandra, A. and Vogl, T. S. 2010. Rising up with shoe leather? A comment on Fair Society, Healthy Lives (The Marmot Review). *Social Science and Medicine* 71: 1227-1230.
- Chapin, C. V. 1924. Deaths among taxpayers and non-taxpayers, income tax, Providence, 1865. *American Journal of Public Health* 14: 647-651.
- Chetty, R., Stepner, M., Abraham, S., Lin, S., Scuderi, B., Turner, N., Bergeron, A., Cutler, D. 2016. The association between income and life expectancy in the United States, 2001-2014. *JAMA* 315(16):1750-1766.
- Clouston, A.P. et al. 2016. A social history of disease: contextualizing the rise and fall of social inequalities in cause-specific mortality. *Demography* 53: 1631-1656.
- Cutler, D. M., Lleras-Muney, A., and Vogl, T. 2012. Socioeconomic status and health: Dimensions and mechanisms. In: Gleid, M. and Smith P. C. (eds.), *The Oxford Handbook of Health Economics*. Oxford: Oxford University Press, pp. 124-163.

- Deaton, A. 2003. Health, inequality, and economic development. *Journal of Economic Literature* 41: 113-158.
- De Gelder, R., Menvielle, G., Costa, G., Kovács, K., Pekka Martikainen, P., Strand, B. H., and Mackenbach, J. P. 2017. Long-term trends of inequalities in mortality in 6 European countries. *International Journal of Public Health* 62:127–141
- Dribe, M. and Eriksson, B. 2018. Socioeconomic status and adult life expectancy in early 20th-century Sweden: evidence from full-count micro census data. *Lund Papers in Economic Demography 2018:1*. Centre for Economic Demography, Lund University.
- Dribe, M., Helgertz, J., and Van de Putte, B. 2015. Did social mobility increase during the industrialization process? A micro-level study of a transforming community in southern Sweden 1828–1968. *Research in Social Stratification and Mobility* 41: 25–39.
- Edebalk, P. G. 1996. *Välfärdsstaten träder fram. Svensk socialförsäkring 1884-1955*. Lund: Arkiv.
- Edebalk, P. G. and Olsson, M. 2011. Fattigvård, skatter och åldringsfrågan 1874 – 1913. Ett bidrag till framväxten av den svenska välfärdsstaten. *Meddelande från Socialhögskolan*, 2011:1. Lund: Socialhögskolan.
- Edvinsson, S., and Lindkvist, M. 2011. Wealth and health in 19th Century Sweden. A study of social differences in adult mortality in the Sundsvall region. *Explorations in Economic History* 48: 376-388.
- Edvinsson, S. and Broström, G. 2012. Old age, health, and social inequality: Exploring the social patterns of mortality in 19th century northern Sweden. *Demographic Research* 26(23): 633-660.
- Elo, I. 2009. Social class differentials in health and mortality: Patterns and explanations in comparative perspective. *Annual Review of Sociology* 35: 553-572.

- Elo, I. and Preston, S. R. 1992. Effects of early-life conditions on adult mortality: a review. *Population Index* 58: 186-212.
- Erixon, O. 2014. Health responses to a wealth shock: Evidence from a Swedish tax reform. *IFN Working Paper* No. 1011. Stockholm: Research Institute of Industrial Economics.
- Finch, C. E., and Crimmins, E. M. 2004. Inflammatory exposure and historical changes in human life-spans. *Science* 305(5691):1736-1739.
- Fogel, R. W. 2004. *The Escape from Hunger and Premature Death, 1700-2100: Europe, America, and the Third World*. Cambridge: Cambridge University Press.
- Garrett, E., et al. 2001. *Changing Family Size in England and Wales: Place, Class and Demography, 1891-1911*. Cambridge: Cambridge University Press.
- Hayward, M. D. Hummer, R. A., and Sasson, I. 2015. Trends and group differences in the association between educational attainment and U.S. adult mortality: Implications for understanding education's causal influence. *Social Science and Medicine* 127: 8-18.
- Hederos, K., Jäntti, M., Lindahl, L., & Torssander, J. 2017. Trends in life expectancy by income and the role of specific causes of death. *Economica*, published online 28 Feb. 2017.
- Hendrickx, J. 2002. ISCO: Stata Module to Recode 4 digit ISCO-68 Occupational Codes, Statistical Software Components S425801. Boston College, Department of Economics.
- House, J. S. et al. 1988. Social relationships and health. *Science* 214: 540-545.
- Jaadla, H., Puur, A., and Rahu, K. 2017. Socioeconomic and cultural differentials in mortality in a late 19th century urban setting: A linked records study from Tartu, Estonia, 1897–1900. *Demographic Research* 36(1): 1–40
- Kawachi, I. et al. 1997. Social capital, income inequality, and mortality. *American Journal of Public Health* 87: 1491-1498.

- Kawachi, I., Adler, N. E., and Dow, W. H. 2010. Money, schooling, and health: Mechanisms and causal evidence. *Annals of the New York Academy of Sciences* 1186: 56-68.
- Kravdal, O. 2017. Large and growing social inequality in mortality in Norway: The combined importance of marital status and own and spouse's education. *Population and Development Review* 43: 645-665.
- Kuh, D. and Ben-Shlomo, Y. 2004. *A Life Course Approach to Chronic Disease Epidemiology*. Oxford.
- Kunst, A. E. and Mackenbach, J. P. 1994. The size of mortality differences associated with educational level in nine industrialized countries. *American Journal of Public Health* 84: 932-937.
- Kunst, A. E. et al. 2004. Monitoring trends in socioeconomic inequalities in mortality: Experiences from a European Project. *Demographic Research Special Collection 2*: 229-254.
- Lindahl, M. 2005. Estimating the effect of income on health and mortality using lottery prizes as an exogenous source of variation in income. *Journal of Human Resources* 40: 144-168.
- Link, B. G. and Phelan, J. C. 1996. Understanding sociodemographic differences in health - the role of fundamental social causes. *American Journal of Public Health* 86: 471-473.
- Livi-Bacci, M. 1991. *Population and Nutrition: An Essay on European Demographic History*. Cambridge: Cambridge University Press.
- Lundborg, P., Lyttkens, C-H., and Nystedt, P. 2016. The effect of schooling on mortality: new evidence from 50,000 Swedish twins. *Demography* 53: 1135-1168.
- Mackenbach, J. P. et al. 1997. Socioeconomic inequalities in morbidity and mortality in Western Europe. *Lancet* 349: 1655-1659.

- Mackenbach, J. P. et al. 2003. Widening socioeconomic inequalities in mortality in six Western European countries. *International Journal of Epidemiology* 32: 830-837.
- Mackenbach, J. P. et al. 2015. Variations in the relation between education and cause-specific mortality in 19 European populations: A test of the "fundamental causes" theory of social inequalities in health. *Social Science and Medicine* 127: 51-62.
- Marmot, M. G., et al. 1991. Health inequalities among British civil servants: The Whitehall II Study. *Lancet* 337: 1387-1393.
- Marmot, M. 2004. *The Status Syndrome: How Social Standing Affects Our Health and Longevity*. London: Bloomsbury Press.
- Masters, R. K., Hummer, R. A., and Powers, D. A. 2012. Educational differences in U.S. adult mortality: a cohort perspective. *American Sociological Review* 77: 548-572.
- Meer, J., Miller, D. L., and Rosen, H. S. 2003. Exploring the health-wealth nexus. *Journal of Health Economics* 22: 713-730.
- Mills, E., Eyawo, O., Lockhart, I., Kelly, S., Wu, P., Ebbert, J. O. 2011. Smoking cessation reduces postoperative complications: A systematic review and meta-analysis. *The American Journal of Medicine* 124: 144-154.
- Montez, J. K. and Friedman, E. M. 2015. Educational attainment and adult health: Under what conditions is the association causal? *Social Science and Medicine* 127: 1-7.
- Norström, T., and Romesljö, A. 1999. Social class, drinking and alcohol-related mortality. *Journal of Substance Abuse* 10(4): 385-395.
- O'Donnell, O., Van Doorslaer, E., and Van Ourti, T. 2015. Health and inequality. In: Atkinson, A. B. and Bourguignon, F. (eds.) *Handbook of Income Distribution. Volume 2B*. Amsterdam: Elsevier, pp. 1419-1533.
- Otterblad Olausson, P. 1991. Mortality among the elderly in Sweden by social class. *Social Science and Medicine* 32: 437-440.

- Quaranta, L. 2013. *Scarred for Life. How conditions in early life affect socioeconomic status, reproduction and mortality in Southern Sweden, 1813-1968*. Lund: Lund University Media-Tryck.
- Quaranta, L. 2016. STATA programs for using the Intermediate Data Structure (IDS) to construct files for statistical analysis. *Historical Life Course Studies* 3: 2-19.
- Pamuk, E. R. 1985. Social class inequality in mortality from 1921 to 1972 in England and Wales. *Population Studies* 39: 17-31.
- Preston, S. H. 1976. *Mortality Patterns in National Populations. With Special Reference to Recorded Causes of Death*. New York: Academic Press.
- Reid, A. 1997. Locality or class? Spatial and social differentials in infant and child mortality in England and Wales, 1895-1911. In: Corsini, C., Viazzo, P-P. (Eds.), *The Decline of Infant and Child Mortality: The European Experience*. Dordrecht: Martinus Nijhoff Publishers, pp. 129-154.
- Roine, J. and Waldenström, D. 2008. The evolution of top incomes in an egalitarian society: Sweden, 1903-2004. *Journal of Public Economics* 92:366-387.
- Shkolnikov, V. M. et al. 2012. Increasing absolute mortality disparities by education in Finland, Norway and Sweden, 1971-2000. *Journal of Epidemiology and Community Health* 66: 372-378.
- Smith, D. S. 1983. Differential mortality in the United States before 1900. *Journal of Interdisciplinary History* 13: 735-759.
- Smith, J. P. 1999. Healthy bodies and thick wallets: the dual relation between health and economic status. *Journal of Economic Perspectives* 13: 145-166.
- Smith, J. P. 2004. Unraveling the SES-health connection. *Population and Development Review* 30 Suppl.: 108-132.

- Snyder, S. E. and Evans, W. N. 2006. The effect of income on mortality: Evidence from the social security notch. *Review of Economics and Statistics* 88:482-495.
- Spasojevic, J. (2010). Effects of education on adult health in Sweden: Results from a natural experiment. *Contributions to Economic Analysis* 290: 179-199.
- Statistics Sweden 1999. Befolkningsutvecklingen under 250 år. Historisk statistik för Sverige. *Demografiska rapporter 1999:2*. Stockholm: SCB.
- Steingrimsdottir, O. A. et al. 2012. Trends in life expectancy by education in Norway 1961-2009. *European Journal of Epidemiology* 27: 163-171.
- Torssander, J. and Erikson, R. 2010. Stratification and mortality-a comparison of education, class, status, and income. *European Sociological Review* 26: 465-474.
- Vågerö, D. and Norell, S. E. 1989. Mortality and social class in Sweden. Exploring a new epidemiological tool. *Scandinavian Journal of Social Medicine* 17: 49-58.
- Van Doorslaer, E. et al. 2000. Equity in the delivery of health care in Europe and the US. *Journal of Health Economics* 19: 553-583.
- Van Leeuwen, M. H. D. and Maas, I. 2011. *HISCLASS. A Historical International Social Class Scheme*. Leuven: Leuven University Press.
- Van Leeuwen, M. H. D., Maas, I., and Miles, A. 2002. *HISCO: Historical International Standard Classification of Occupations*. Van Leeuwen, Marco H. D. and Ineke Maas. 2011. *HISCLASS. A Historical International Social Class Scheme*. Leuven: Leuven University Press.
- Van Poppel, F., Jonker, M., and Mandemakers, K. 2005. Differential infant and child mortality in three Dutch regions, 1812-1909. *Economic History Review* 58: 272-309.
- Wilkinson, R.G. and Pickett, K.E. 2010. *The Spirit Level. Why Greater Equality Makes Societies Stronger*. New York: Bloomsbury Press.

Woods, R., Williams, N., and Galley, C. 1993. Infant mortality in England 1550-1950.

Problems in identification of long-term trends and geographical and social variations.

In: Corsini, C.A., Viazzo, P-P. (Eds.), *The Decline of Infant Mortality in Europe 1800-1950. Four National Case Studies*. Florence: UNICEF, pp. 35-50.