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Centre for Demographic and Ageing Research

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Is high social class always beneficial for survival? A study of northern Sweden 1801–2013[1]

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[1]Short title, "Is high social class always beneficial for survival?"

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Abstract

Focusing on two regions in northern Sweden 1801–2013, we challenge common notions of the assumed advantage in survival of belonging to a high social class. The issue is analysed according to gender and age group (adults and elderly) and in relation to the development of economic inequality. The results show that high social class is not always favourable for survival. Men in the elite category, particularly in working age, had higher mortality compared to others during a large part of the studied period; a male mortality class reversal appears at a surprisingly late date, while the social gradient among women conforms to the expected pattern. We suggest that health-related behaviour is decisive not only in later but earlier phases of the mortality transition as well. The results implicate that the association between social class and health is more complex than is assumed in many of the dominant theories in demography and epidemiology.

Keywords: Class reversal in mortality; Gender differences; Inverse probability weighting; Mortality transition; Restricted mean survival time.

1 Introduction

A major theme in demographic and epidemiological studies is the seemingly persistent effect of social class on mortality. In the present study, we challenge common notions of this by taking a long-term perspective on the development of social class inequalities in mortality in the adult and elderly population. The arguments for our statements are based on an investigation of the Skellefteå and Umeå regions in northern Sweden for the periods 1801–2013 for Skellefteå and 1901–2013 for Umeå. The main issue is analysed according to gender and age group (working age vs retired). Furthermore we place this in the context of how the inequality in mortality is associated with the development of economic inequality in society. The results are discussed in relation to the mortality transition and the social determinants of health and mortality, as well as their implications on some of the most influential hypotheses and concepts in health research. The study is unique in its long time-perspective and its utilization of historical micro-data of a sufficiently large and socially diverse population for analyses of a central issue in health research.

Based on the results, we argue that high social class is not necessarily favourable for survival. Social conditions and social position certainly have impact, but not always in the expected direction. In our case this is apparent for men during a large part of the studied period, particularly for men in working age; only at a surprisingly late date appears a male mortality class reversal, changing the relation to a substantial advantage of being in a higher social position. Mortality risks in different contexts must be understood in the intersection between class and gender. We suggest that health-related behaviour is not only important in present-day societies, but was also decisive in earlier phases of the mortality transition. The results implicate that the association between social class and health is more complex than is assumed in many of the dominant theories in demography and epidemiology.

1.1 Social class and mortality

One of the central aspects of survival is social class and access to economic and other resources. In present-day welfare societies, social position, either according to social class, education or income, is a strong determinant when it comes to health and mortality and its impact are even increasing (Kunst

et al. 2004; Mackenbach et al. 2016; Fritzell and Lundberg 2007; Brønnum-Hansen and Baadsgaard 2012; Strand et al. 2010). Link and Phelan (2002) suggest that "... social conditions have been, are and will continue to be irreducible determinants of health outcomes and therefore deserve their appellation of 'fundamental causes' of disease and death". The persistence of social inequality in mortality to the disadvantage of the lower classes is one of the main assumptions in their theory (Link and Phelan 1995; Link et al. 1998). The idea that socio-economic health inequalities were probably larger in historical societies is a reasonable assumption since these societies were often characterized by enormous class differences. Knowing that access to different kinds of resources, such as economic, social and cultural capital, provides advantages in all aspects of life, the health advantage of higher classes ought to be obvious.

However, recent studies investigating social inequality in health and mortality with micro-data have questioned the generality of the assumed pattern (Bengtsson and Poppel 2011), and solid empirical evidence about the process is lacking and studies focusing on the issue are few. One exception is the paper by Bengtsson, Dribe, and Helgertz (2020), where a study from southern Sweden for the time period 1813–2015 is presented. There is a need for additional reliable studies from different geographical and historical settings in order to better understand the role of class and socio-economic conditions in health and survival over time.

Social position affects health and mortality differently during the life course and from adulthood into old age. The differences either decrease in old age (status levelling), are constant (status maintenance), or increase (cumulative advantage) (Hoffmann 2008). Diminishing differences may be a consequence of the circumstance that biological factors become increasingly important during the ageing process and in old age, leaving less impact for social factors. The status maintenance hypothesis basically assumes continuity in the determinants of social health inequalities from adulthood to old age. The cumulative (dis)advantage hypothesis (Dannefer 2003), implies that advantages and disadvantages persist and accumulate during life in a negative spiral, rewarding some while disfavouring others.

Another aspect of the development of social inequality in mortality concerns its relation to economic inequality. Wilkinson and Pickett (2009) argue that income inequality has an independent effect on mortality, separate from the direct effect of actual access to economic resources. They find that unequal societies perform less well when it comes to health (as well as

other social conditions) than equal ones in the todays economically developed world. This has initiated a vital scholarly debate and the topic has been extensively studied (Subramanian and Kawachi 2004; Wagstaff and Van Doorslaer 2000). In recent decades, the respective association between trends of inequalities in mortality and income is weak or non-existent according to Hoffmann et al. (2016). What the association looked like in previous periods is unknown; this is of particular interest as the levels of economic inequality differed fundamentally from those of recent decades. Even if not a necessary implication, it is reasonable to assume that poorer groups were the most disadvantaged due to large levels of inequality.

2 The Skellefteå and Umeå regions

Figure 1: The Skellefteå and Umeå regions in Sweden.

During the studied period, Sweden developed from a poor agricultural society with low urbanization to a rich welfare state. The regions studied here were for a long time remote from the central parts of the country. The

Skellefteå and Umeå regions (Figure 1) are part of the county of Västerbotten in northern Sweden along the coast of the Gulf of Bothnia, where communication with the rest of Sweden was difficult until the late 19th century. The economy was dominated by agriculture, making it vulnerable to harvest failures; several severe famines occurred in the regions during the 1800s, for example after the harvest failure of 1867 (Edvinsson and Broström 2014). During the long winters, sea communication was hindered due to the Gulf of Bothnia being frozen, in some cases as late as June (Fahlgren 1956). Towards the end of the 19th century, the Swedish railway system reached this part of Sweden, facilitating contact with the rest of Sweden, improving the economy and making it possible to mitigate the effects of harvest failures.The regions became increasingly integrated in the same epidemiological pattern as the rest of Sweden.

In our dataset, before 1950 the Skellefteå region consists of a selection of parishes surrounding the town of Skellefteå, founded in 1845 but with a very small population during the 19th century. The data from the period after 1975 cover the Skellefteå, Norsjö and Malå municipalities, the same area as for the earlier period but with the addition of two more parishes. The majority of the 19th century population lived in rural villages and hamlets, making its livelihood from agricultural production. During the 20th century, industrialization took place. This also led to a population increase both in the town and the rural parts, resulting in a more diversified economy. The Skellefteå population size as defined in our data sets (all ages) was 6,142 on January 1, 1801, 43,212 on January 1, 1901, and 76,723 at the end of the 20th century.

The Umeå region in the dataset consists of Umeå urban and rural parishes 1901–1950, and from 1976 onwards of Umeå municipality, with another three parishes included. Umeå town had for a long time a small population, and was the administrative, educational and military centre of the county of Västerbotten. During the latter part of the 20th century, the establishment of Umeå University led to a rapid population increase. Agriculture dominated the rural part. Consequently the economy was more diversified than that of Skellefteå. The population size as defined in our data sets (all ages) was 19,138 on January 1, 1901 and 103,970 when the 20th century ended.

3 Data and variables

The data for the present study come from two large population databases at the Demographic Data Base (DDB),Umeå University (http://www.cedar.umu.se), which provide us with micro-data for the Skellefteå and Umeå regions in northern Sweden ("The Demographic Database, CEDAR, Umeå University" 2015). The period 1801–1950 is covered by the database Poplink (Westberg, Engberg, and Edvinsson 2016). Poplink is based on linked parish records, allowing us to reconstruct life biographies on people as long as they remained in the region. The records are linked within, but not between, the regions.

The other large data set is extracted from the Linnaeus database (Malmberg, Nilsson, and Weinehall 2010), which is based on different linked national population registers from 1960 to 2013 (censuses, LISA from Statistics Sweden and cause of death registers) and is used within the ageing programme at CEDAR, Umeå University. Due to data issues we choose to use Linnaeus data only from 1976 onwards.

Individuals are anonymized and as the two databases are not linked, they are treated as separate units. This prevents us from following individuals between the two databases throughout their lives. It also makes it impossible to add information on individuals in the Linnaeus database from what we could potentially extract from Poplink, for example family background or previous social class.

In the data set analysed here, all individuals aged 40 years and older ever having resided in either of the regions are included. The data file contains the variables social class, gender, urban/rural residence, birth date, death date, first and last date of observation and type of entrance/exit. The total number of person years is 1.59 millions leading to 39.13 thousand deaths in Poplink and 3.1 million person years leading to 60.65 thousand deaths in the Linnaeus database: see Figure 2.

3.1 Presence periods

Differences in available information in the two datasets as well as in the Linnaeus data make it necessary to apply different approaches when it comes to the identification of presence periods. The Poplink data provide us with exact dates, or at least year of start and exit of presence, allowing us to have full and continuous control over the *de jure* population. This is not

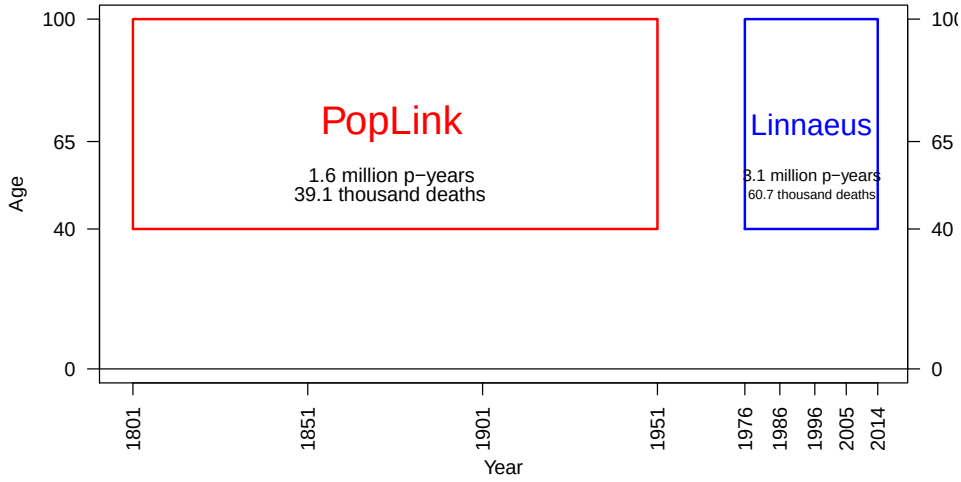

Figure 2: The sampling frame.

the case with the Linnaeus database, however. For the period 1976–2001 we use presence in the censuses 1975–1990 and information on deaths from the National Board of Health and Welfare. The populations in the Skellefteå and Umeå regions are those residing there according to the censuses. Each census constitute the baseline for which persons are followed up during the five years until the next census (e.g. the 1975 census has a follow-up from 1 November 1975 until 31 October 1980). The exception of this is the 1990 census for which the follow-up is until 31 December 2001. Thus, the deaths do not necessarily take place in our region for the Linnaeus analyses, although this is usually the case.

For the last period, from 1 January 2002 until 31 December 2013, we use the yearly population registers (LISA data) together with information on deaths from the National Board of Health and Welfare. The LISA data depict the situation at the end of the given year, so the follow-up period is from 1 January to 31 December the next year. Deaths may still occur outside the region, but less frequently than when exposure is restricted to presence in the censuses.

3.2 Social class

Mortality differences are analysed according to social class, based on a modified form of the classification scheme Hisclass (Van Leeuwen and Maas 2011). Social position during working age is defined at around age 40 but defined from the last occupation in working age for the elderly and retired population; i.e. from age 65 until death or last observation.

The availability of information on occupations varies over time and between sources. In Poplink, occupations are coded according to the original DDB coding system that has then been adapted to Hisclass. For the Linnaeus data, the occupations are available in the coding scheme HISCO (Van Leeuwen, Maas, and Miles 2002) who then are recoded into Hisclass. We consider the observed social class in a census to be valid for the full period until the next census, corresponding to our definition of presence periods. For the period 1991–2000 the social class in the 1990 census is considered to be maintained until 2001.

The two data sets represent different ways of reporting occupations. Poplink usually only provides the occupation of the head of household, thus underestimating female labour force participation as well as that of adult children residing with their parents (Vikström 2010). For the Poplink period, we have chosen to categorize wives according to the position of the head of household, usually the husband/father, assuming that the family shares the same socio-economic position. We consider this as a reasonable approach for this period.

Female labour is much better covered in the Linnaeus database, and it is difficult to define households in the same way as in Poplink. Extramarital cohabitation became common and female labour force participation developed as the norm in Sweden during this period. The husband's occupation as signifier of social class became, if not obsolete, at least less relevant. All included persons are signified by their individual occupation for this period. Although the results for the different periods are not completely comparable, the difference in approach reflects an actual change in how social class is structured.

Hisclass, the classification system used as a basis for our categorization, is a "... HISCO-based historical international social class scheme" (Van Leeuwen and Maas 2011; Van Leeuwen, Maas, and Miles 2002). The different classes in Hisclass represent distinct categories, based on whether the work is manual or non–manual, skill level, supervision, and sector. Im-

plicitly it reflects large differences in access to economic resources, status, social power, etc. We have chosen to work with a broad definition of classes, merging the original 12 social classes in Hisclass into four, representing different levels of control and access to resources vital for life chances, and an additional fifth category of unknown class:

1. `elite`, Hisclass 1 and 2. Higher managers and higher professionals.
2. `middle`, Hisclass 3, 4, 5, and 6. Lower managers, lower professionals, clerical and sales personell.
3. `worker`, Hisclass 7, 9, 10, 11 and 12. Workers including farm workers.
4. `farmer`, Hisclass 8. Farmers.
5. `none`, not given, unknown.

Figure 3 shows the distribution (per cent) of exposure times according to class for women and men (see also Figures 6, 7, and 8 for aggregated totals during the different periods in the Appendix). The farmer category was dominant until the middle of the 20th centuries but have become marginal in the latest periods, particularly among women. The category of workers is fairly stable over time. The highest class has increased substantially, albeit from a very low level in the 19th century. The increase in academics in connection to the establishment of Umeå University explains much of this increase in later time. Furthermore, we observe a rather high percentage of missing social class in the early 19th century. For men the proportion is somewhat higher in the age group 65 and above, those who were retired, but still low enough to be used in our analyses (results not shown). If we disregard the very first period, however, there were very few with occupation missing until 1950.

The proportion of missing values among women is a larger problem, however. Corresponding to what we found for men, the proportion without social position is very low until the middle of the 20th century, reflecting the way women's social position is defined. However, the frequency of missing social class is quite high during particularly the first two periods of data from the Linnaeus database—from 1976. Since female social class for this period is defined according to own occupation, the consequence of many women being outside the workforce is that the proportion of missing increases. For the later periods, the results are fairly complete.

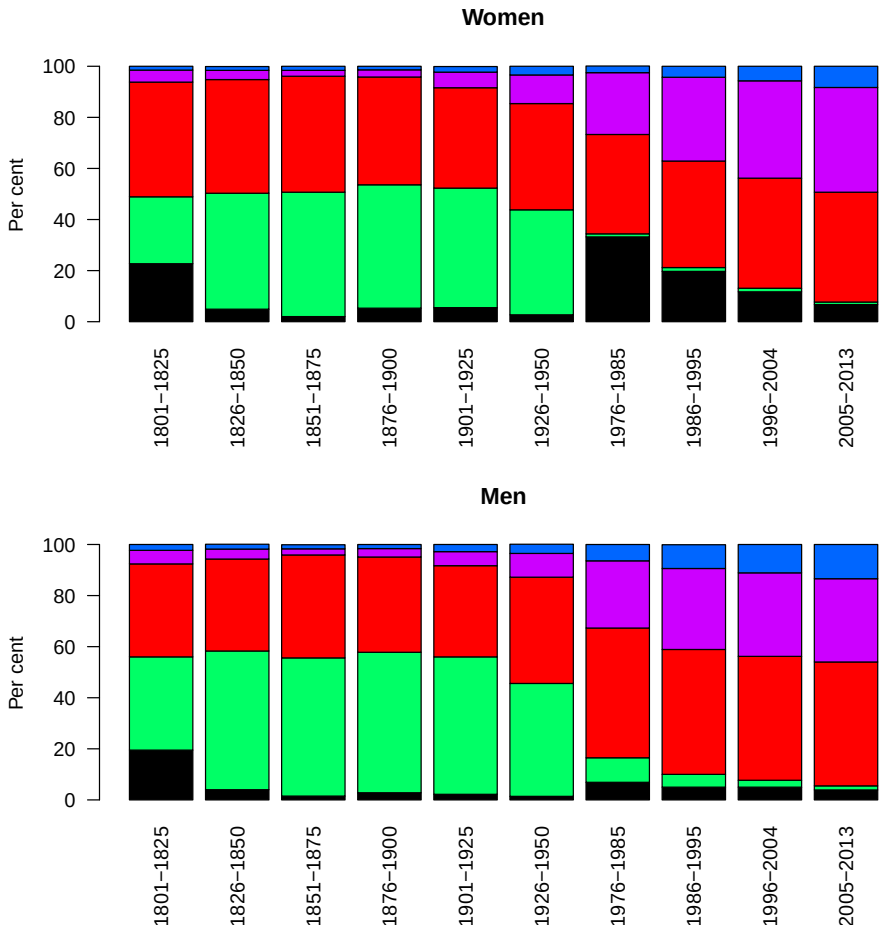

Figure 3: Relative exposure by social class(from the top: elite, middle, workers, farmers, none), time period, and sex.

3.3 Marital status

Marital status is a time-fixed covariate. The statuses used are unmarried, married and dissolved marriage (without distinguishing between widowed and divorced). If no explicit status is given in the sources and the partner is missing, the status has been set to unmarried. Note that it has not been possible to identify cohabitation.

The proportion married varies between 60 and 70 percent over time, never married between 15 and 25 percent, and previously married between 10 and 15 per cent.

3.4 Urban vs rural residence

In 19th and early 20th century Sweden (as in other countries), mortality was much higher in urban environments (Nilsson 1994; Edvinsson 1992). The unsanitary and overcrowded living conditions, as well as the risk of importing infections, made the health risks higher in towns and cities. In the present paper, the variable **urban** (values *TRUE* or *FALSE*) controls for this aspect by distinguishing between urban and rural residence for the periods after 1900, based on parish or place of residence.

3.5 Periods of analysis

We have done separate analyses for the different time periods. The period 1801–1950 is divided into six subperiods of 25 years each. The 19th century periods represent a mainly pre-industrial society dominated by agriculture and with only basic welfare provisions. During the years 1901–1950, industrialization started and the urban environments increased in population size. The modern Swedish welfare state began to develop. For the period 1976 onwards, there are separate analyses of ten-year periods. Sweden had developed into a wealthy welfare society with low income inequality. Then in the early 1990s, a financial crisis struck Sweden, which among other things increased unemployment and changed parts of
the welfare system towards being less generous. In the most recent decades income inequality has increased considerably.

4 Models and methods

The comparison of mortality in the five social classes, period by period, is done by comparing estimated survival curves, adjusted for the distribution of the confounding variables over the social classes. The adjustment is carried out by inverse probability weighting (Horvitz and Thompson 1952; Hernán and Robins 2006) in the following way: First, for each social class, the probability that an individual in the class belongs to that class is estimated by logistic regression with the confounders as explanatory variables. Second, these probabilities are inverted and used as weights in the estimation of the survival curves for each social class.

The important explanatory variable, social class, is included in the proportional hazards models as a *stratification* variable. The main reason for this choice is that the effect of social class on survival is non-proportional; that is, it varies with age. The results are presented graphically. The comments on the results are based on the figures and focus on the central variable in our study, social class. The models are fitted separately for sex and time period, from 1801 to 2013.

The social classes are compared by the *restricted mean survival time (RMST)* in the age interval (65, 99) for a person aged 65, and *RMST* in the age interval (40, 64) for a person aged 40. The *RMST* is the expected years of life in a certain time interval, given survival up to the start of that interval. See, e.g., Royston and Parmar (2011) for more detail.

The analyses are performed in the **R** environment for statistical computing and graphics (R Core Team 2020), especially using the package **eha** (Broström 2012, 2020). In the analysis, data are divided into two age groups, 40–64 and 65–99 years of age. The model controls for marital status and whether the individual resides in the urban or rural parts of the regions. Each period is analysed separately, but we then combine results in order to show the development of the social patterning of mortality during the studied period.

The disturbance effect of confounders is balanced out through weighting. In our case, `civil status` and `urban/rural` are confounders, that is, they are correlated to both our outcome, mortality, and our explanatory variable, social class. The latter association manifests itself through the facts that the marriage frequency varies by social class and certain social classes are more common in the rural area than others (we find farmers on the countryside).

5 Results

5.1 Ages 40–64

Differences in mortality in the age group 40–64 are getting very small as we move forward in time: Almost all forty-year-olds today survive beyond 65, regardless of social class. In Sweden of the year 2014, the probability of surviving age 65 for a forty-year-old man is 91 per cent (a period measure). The corresponding figure for a forty-year-old woman is 94 per cent. A relevant measure of comparison is the probability (risk) of dying before age 65 for a forty-year-old, remembering that the absolute risks are very small in the later time periods.

	Df	AIC	LRT	Pr(>Chi)
<none>		264844.13		
civst	2	265072.87	232.74	0.0000
urban	1	264842.49	0.35	0.5529
hisclass:period:sex	36	264855.30	83.17	0.0000

Table 1: ANOVA, ages 40–64.

From Table 1 it is obvious that the *statistical significance* is strong in our statistical model of the probability of dying. The most interesting feature is the three-way interaction with **sex**, **period**, and **social class**. This indicates that fundamental changes have taken place in the relationship between the variables during our study period.

Figure 4 shows the *RMST* (in years) in the age interval 40–64 during the different periods. Obviously, but not surprisingly, it increases over time for both sexes. Women have consistently better survival than men. This is well-known in Swedish demographic history (Willner 1999; Sundin and Willner 2007) as well as in other parts of the world. The substantial decline in mortality for both sexes results in smaller absolute differences between social classes in the later time periods.

The most striking and surprising result of the analysis is the different patterns for men and women, especially regarding the elite class. The social pattern of mortality among women is a great deal in accordance with previous analyses on other regions in northern Sweden and for other periods (Edvinsson and Lindkvist 2011; Edvinsson and Broström 2012). The highest social class usually has a comparatively low mortality, while working-class

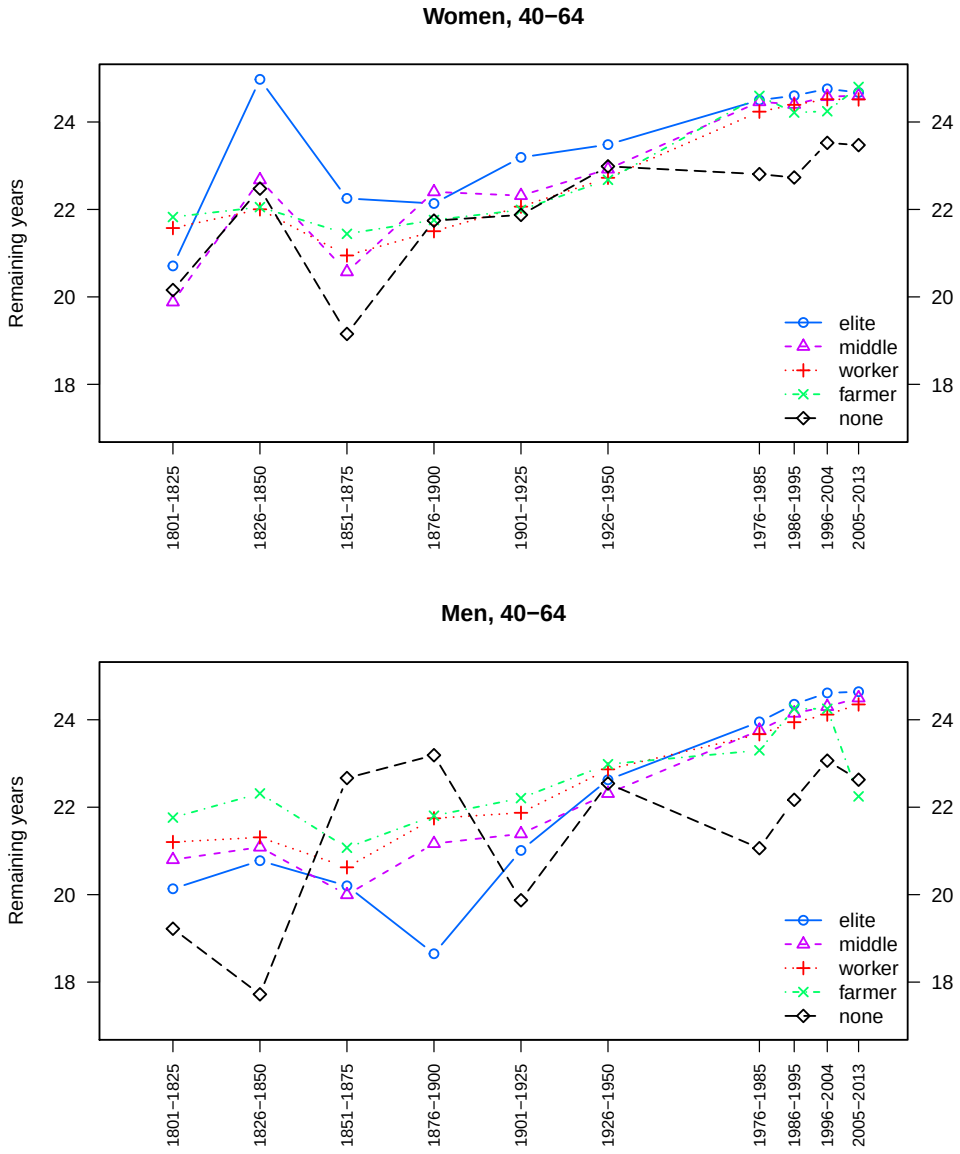

Figure 4: Restricted mean survival in ages 40-64, given survival to age 40, by period and social class.

women have high mortality, but during most periods at about the same level as the farmer and only a little higher than the middle category. However, there is no substantial change in the RMST order between classes except for the periods after 1976 (considering the very few female farmers during the latest decades). The group with unknown social class is distinguished by much lower RMST from 1976 and onwards. This might have to do with how we have defined social position for women before and after 1950. After it is based on their own occupation; lacking an occupation likely includes women who are more frail when it comes to health or are vulnerable due to social characteristics.

A completely different pattern appears among men. The groups we expect to have the highest RMST, if assuming that access to vital resources and belonging to a high social class determines survival, instead have by far the lowest RMST before 65 during the 19th century and much of the 20th. Workers, on the other hand, have comparatively high RMST until 1950, at the same level as the farmers and somewhat below the middle category. Consequently, the gender difference was extremely large for the elite group. Men had much lower RMST compared to women, basically living in the same households. In the other classes, the difference was much smaller. Men in high positions were the most vulnerable.

The relative positions change radically towards the end of the 20th century. From the 1980s, there is a clear advantage when it comes to survival for the elite. A change of the class pattern in mortality takes place, and the expected social gradient in mortality develops. This is also what we usually find in analyses of social health inequalities in present-day Sweden as well as in most other countries, results that have formed the basis for many of the contemporary epidemiological and demographic theories. In the regions we are studying, this is a quite recent phenomenon. Corresponding to what we find for women, those without a known occupation have much higher mortality than the others from the late 1970s onwards. The assumption made for women of unknown social class is probably even more relevant for men, who likely represent groups in society that are particularly vulnerable. The reason for being without notation of occupation may also vary over time.

5.2 Ages 65–99

We now turn to the elderly, those who in most cases have left the workforce. We use the *RMST* at 65 up to age 100 as the summary measure. Since the probablility of surviving 100 for a 65-year-old, the RMST is practically equal to *expected remaining life* at 65.

	Df	AIC	LRT	Pr(>Chi)
<none>		542707.33		
urban	1	542719.22	13.89	0.0002
civst	2	542871.27	167.94	0.0000
hisclass:period:sex	36	542745.56	110.23	0.0000

Table 2: ANOVA, ages 65-99.

First, looking at Table 2, it is obvious that the statistical significance regarding differences between groups over time is strong.

The general pattern and development of mortality resembles that from the younger age group, see Figure 5. Mean death age among women, as expected, was higher than among men. We find a clear increase in life expectancy, but the fastest decline did not set in definitely until sometime after the Second World War; that is, later than for the age group 40–64 years. This corresponds to the Swedish development whereby we find a turning point at this time with better survival among elderly, first for women and a couple of decades later for men.

Concerning the differences in the social pattern, it is less consistent compared to what we find for the younger age group in the earlier time periods. For women the results are mixed. We do not find the same clear advantage for elite women during the period before 1925, but neither do we find any large disadvantage for working-class elderly women at that time. In most periods the social differences were small between working class women and those in the farming and middle categories. The social differences continued to be small until the last decades of the 20th century. It is only during the four last periods (after the year 1975) that it is possible to establish the expected and consistent social gradient in mortality.

For men we find indications of the same intriguing change among elderly as for the adult male population aged 40–64 years, but with a more mixed social pattern in this age group until the last periods. There was no clear social gradient during the 19th century, a pattern that prevailed until the

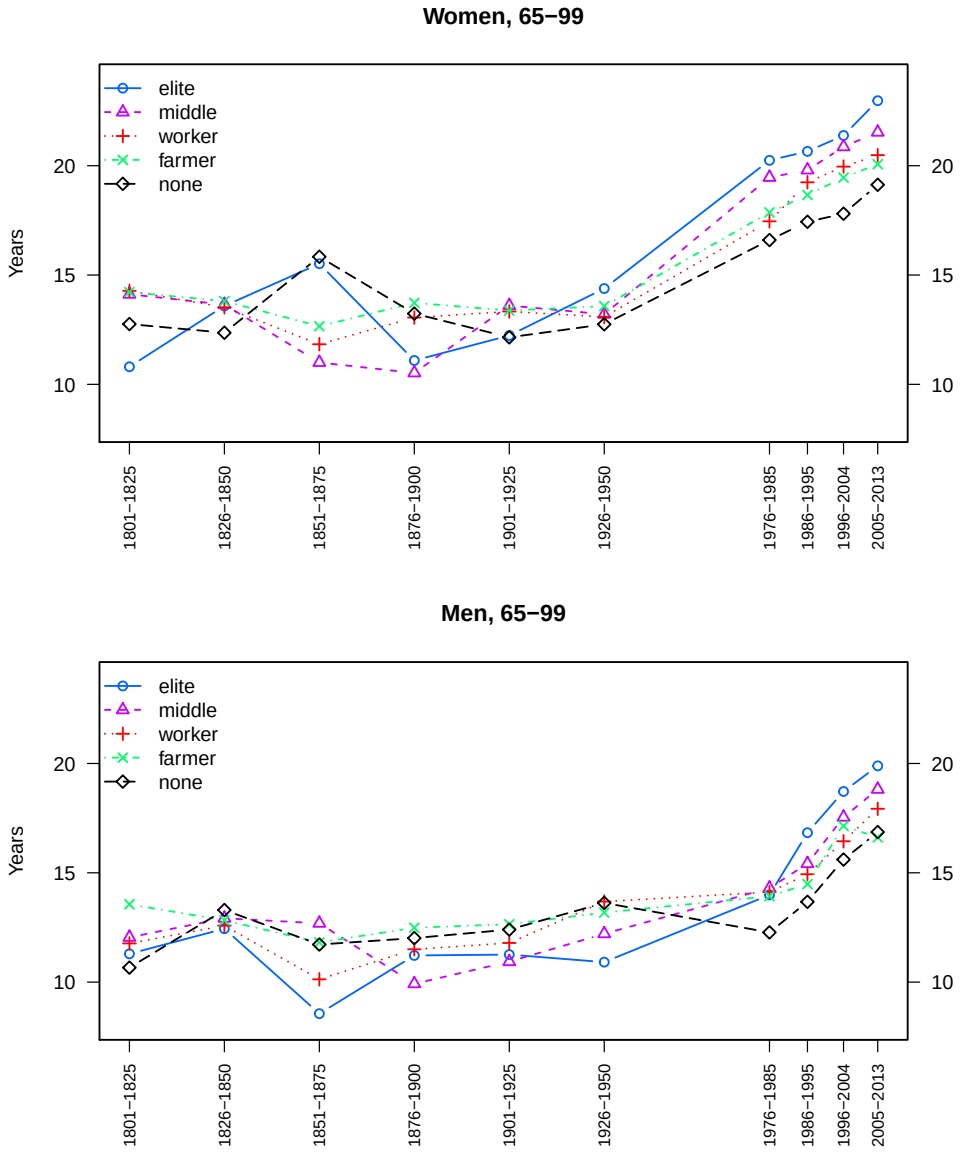

Figure 5: Restricted mean survival in ages 65-99, given survival to age 65, by social class and period.

middle of the the 20th century. Similar to what we found for men in working age, it is not until the second half of the 20th century that a distinct social gradient appears, characterised by better survival for higher social classes. The difference between the worker and the farmer group has been small in most periods.

6 Discussion

Previous studies have scrutinized different aspects of the social pattern of mortality in historical northern Sweden for some time, focusing on different regions, age groups and time periods (Edvinsson 1992, 2004; Edvinsson and Lindkvist 2011; Edvinsson and Broström 2012). When it comes to infant and child mortality during pre- and early-transitional time, the expected socio-economic differences have often, but not always, been confirmed (Edvinsson 1992, 2004; Brändström, Edvinsson, and Rogers 2002; Burström and Bernhardt 2001; Molitoris 2017).

Studies based on micro-data on adult and elderly populations in history have been rare, mainly due to lack of adequate data. The results from such studies show other patterns than that for infant and child mortality, reporting surprisingly small or even reversed class differences, for example in the 19th century Sundsvall region (Edvinsson and Lindkvist 2011; Edvinsson and Broström 2012). This raises the question of when the modern social gradient appeared, if this was something that developed in the early parts of the 20th century. The results presented here show that the consistent advantage for higher social classes does not appear until surprisingly late in the investigated regions. Instead, men in the elite category experienced the highest death risks. The basic pattern is primarily observed in the working-age population, while the differences are smaller or even non-existent in old age in accordance with the status-levelling hypothesis.

The results showing a small or even reversed socio-economic gradient in the past and its late development are in accordance with other studies (Bengtsson and Poppel 2011), for example Bengtsson and Dribe (2011) in a different setting, a couple of Scanian parishes in southern Sweden, albeit with somewhat different social categories. They find the first indications of an emerging social gradient to be a fairly recent phenomenon, in their case as late as the 1950s. This is further developed by Bengtsson, Dribe, and Helgertz (2020) who analyse social class differences in southern Sweden from the early nineteenth to the early twenty-first century. They find that the

systematic social gradient in the adult population emerges only after 1950 for women and after 1970 for men. Their results are very much in line with what we find for northern Sweden. There are some other studies indicating a similar pattern. A study of mortality and social class in Sweden during the period 1960–1968 found that self-employed men and non-manual male workers in fact had higher mortality than manual workers in total as well as in cardiovascular mortality (Vågerö and Norell 1989). A recent study by Dribe and Eriksson (2018) on the social pattern of mortality, based on 1880–1910 census data linked to death registers, shows that the unexpected pattern found in the present study is not unique, but rather seems to have characterised all parts of the country.

Compared to previous studies, the present one shows a much clearer survival disadvantage of the elite, and not only the lack of social gradient.These findings are contrary to what is usually assumed. The studies usually referred to when discussing the historically large social inequalities in health are mainly based on data from England and Wales (Antonovsky 1967; Woods and Williams 1995; Pamuk 1985). We know less about how general these results are, but apparently the Swedish context differed from the English and Welsh ones.

It is reasonable to consider the validity and possible weaknesses of our study. Some of the limitations have been addressed in the presentation of the variables: the fact that social class of women was defined according to household until 1950 but was defined individually from 1976, different definitions of presence during the same two periods and some differences in parishes included at different periods. However, these differences are neither of the magnitude nor of the character that the main conclusions are affected. Most women end up in the same category as their husbands and using presence based strictly on living in the regions or a definition based on baseline with a short follow-up can only marginally change the results, especially since most people in our age groups remained in the same region at follow-up.

One obstacle concerns the quality of available information. Occupational titles in historical sources are not always sufficiently distinct to define the correct class. Studies covering long periods face the problem that occupations and classes change character—they do not represent the same thing over time. We have chosen to work with a few broad groups. Nevertheless, these ambiguities and possible mis-classifications cannot radically change the basic patterns observed. The social classes identified during the different periods represent distinct groups when it comes to resources, capacities,

and power.

An intriguing aspect of this study is the lack of association between level of economic inequality and social differences in mortality. Even though our study does not directly address the hypothesis posed by Wilkinson and Pickett (2009) and thus cannot falsify it, our results are relevant for this question as well. In the 19th and early 20th century, like other countries, Sweden was characterised by enormous economic differences; still, in our regions this did not lead to any consistent advantage for the highest social class. After the Second World War, economic differences began diminishing, and were at their lowest in Sweden around 1980; i.e. at a time when the expected pattern of a social hierarchy in survival appeared. The period thereafter is characterized by increasing economic differences, coinciding with increasing health differences (Roine and Waldenström 2008, 2009). We do not have access to the exact development of income inequality in our regions, but there is no reason to believe that it has not followed the general development of first diminishing and later increasing inequality, but maybe at somewhat lower levels of inequality. The long-term relationship between economic inequality and health is still a puzzle requiring further studies.

The WHO Commission on Social Determinants of Health framework provides a holistic model on how socio-economic position influences health. Social class works through intermediate determinants (material circumstances, behaviours, biological factors and psycho-social factors) related to exposure and vulnerability (Solar and Irwin 2010). People are situated within socio-economic and political contexts, as well as prevailing societal value systems. In an overview of explanations of the persistence of health inequalities (primarily focusing on high-income countries with extensive welfare arrangements), Mackenbach (2012) identifies a couple of theories, emphasizing different mechanisms and circumstances such as psycho-social pathways, material conditions, cultural capital, etc. However, most of these explanations are based on the assumption that higher social classes are always advantaged when it comes to health and mortality.

We believe our results have implications on several issues concerning our understanding of the demographic and epidemiologic development and seems to be in conflict with many of the dominating theories in present-day health research. McKeown (1976) argues that improved nutrition has been the main determinant of the increase in life expectancy in recent centuries. This ought to imply that people with less adequate resources are the most vulnerable in the earlier phases of the mortality transition. The results presented here

prove that the most wealthy and privileged groups were not able to avoid the most common health risks in historical societies.

While the McKeown thesis has been refuted by several scholars (Szreter 1988, @colgrove02), it has played and is still playing a central role within epidemiology and social medicine. One of these leading theories is the hypothesis by Link and Phelan (1995) stating that social conditions are fundamental causes of disease and not only expressions of specific disadvantages connected to social position. The criticism of the arguments by McKeown forced them to address following question: "If Colgrove is right about the McKeown thesis, social epidemiology is left with a gaping hole in its explanatory repertoire and a challenge to a cherished principle about the importance of social factors of health" (Link and Phelan 2002).

Others emphasize psycho-social factors, for example Marmot (2004), who argues that higher status leads to better health regardless of where on the status ladder the individual is situated. Psychosocial factors are also suggested by Wilkinson and Pickett (2009) as an explanation for why equal societies perform better than unequal ones. In the long-term perspective provided here, neither of these theories fits the historical observations; their validity is mainly apparent for the most recent decades. To be fair, however, our study does not explicitly test for the possible impact of different material or psycho-social mechanisms. These factors could still be (and probably are) valid and influence the social pattern of mortality. What our study establishes is that there is no necessary eternal social gradient favouring higher social classes. Our results do however point to the important role of social position. The lacking social hierarchy may be caused by other socially determined mechanisms having a stronger impact on the pattern. We might have to consider the possibility of socially countervailing mechanisms (Lutfey and Freese 2005).

The historical perspective shows the complexity of how health and mortality are socially constructed, and illustrates the need to contextualize our analyses. We must thus consider other and potentially more important explanations than the pure advantage of being in a high social position, reflecting that the embodiment can be materialized in different ways. In the following we discuss three possible pathways—the life course perspective, social stress, and class- and gender-based lifestyles. Concerning the life course perspective, exposure to diseases and other negative experiences in childhood can influence one's health later in life. Up until the early 20th century, being exposed to an urban environment had far higher health con-

sequences than living in rural Sweden. There is a possibility that the elite group to a greater extent had spent their childhood in the more harmful urban environments, and that this might have influenced their health and survival in adulthood. It seems improbable, however, that differences in residential background explain the observed pattern. The second pathway relates to the health risks of belonging to a certain social class. We usually assume that health risks are higher in social classes with less access to resources, as discussed earlier in this article. It is possible, however, that men in high positions had a stressful life, for example entrepreneurs facing the risk of losing an advantageous position. Business could fail which meant a substantial loss of prestige and social network. Suicides certainly occurred among the elite, but it is difficult to verify the extent of social stress in this and other social classes.

Social stress can also be expressed in unhealthy lifestyles, the third pathway we discuss. Harmful behaviours can be connected to certain expectations associated with being a man of high status. Our results regarding the gender aspect are important in this respect. As several researchers have pointed out, demographic research has often ignored power relations and different roles within families (Watkins 1993; Mackinnon 1995; Janssens 2007). Historical Sweden was strongly gender-segregated, discriminating against women and giving them less space for action. In our study, we do not find the lack of power to have negative health consequences for women. Within the same households, the effect of social class leads to different results, high social position being beneficial for women but not for men. Instead, we might consider the role of behaviours based on distinct gendered and class expectations. Having a high social status is sometimes expressed in attitudes, norms and way of living that are potentially harmful to one's health. Edvinsson and Lindkvist (2011), finding similar results in another environment, suggest that an explanation for the large social health inequalities in present-day society is that high status is expressed through health, being fit and physically active, while in many historical contexts higher social status (for men) was expressed in low physical activity, obsessive eating, drinking and smoking and being more inclined to take risks. Alcohol has been suggested to be part of the large gender differences in the 19th century (Willner 1999; Edvinsson 1992), and a more risk-taking lifestyle may be an important component of male mortality (Courtenay 2000; Razzell and Spence 2006; Jaadla, Puur, and Rahu 2017). Different historical contexts promote different ways to spend economic resources.

In the today's high-income world including Sweden, smoking and drinking

contribute to a substantial part of socio-economic health differences (Martikainen et al. 2014; Sydén and Landberg 2016). Our study suggests a possible impact in historical Sweden as well. If this interpretation is correct, the hypothesis by Antonovsky (1967), on an increasing role of health-related behaviour in the modern low-mortality regime while economic and material conditions determined the social mortality pattern during the early phases of the mortality transition, can be questioned. Instead, health-related inequality might be equally strong earlier in history but expressed in a completely different way. To corroborate this claim, we need to find evidence on the social differentiation of consumption patterns and behaviours in history. Unfortunately, such data are rarely available before the 1960s. At best, we have circumstantial and anecdotal evidence. However, such evidence does support the idea of less health-beneficial lifestyles among elite men (Edvinsson and Lindkvist (2011)).

Overweight, obesity and physical inactivity were probably more common in higher social classes. Vågerö and Norell (1989) find a higher total as well as cardiovascular mortality among self-employed men and non-manual male workers, which they suggest can be explained by the higher tobacco consumption among men in these groups. The social pattern among women was the reverse, however, in line with the present study. There is no solid information on smoking in different social classes before the 1960s in Sweden, but there are international studies indicating a higher prevalence and consumption of tobacco in higher classes during the early phases of the tobacco epidemic, for example illustrated by the fact that smoking was initially more prevalent among physicians. There was also a clear association between higher incomes and tobacco consumption (Lopez, Collishaw, and Piha 1994).

The same lack of statistical evidence characterizes knowledge about alcohol consumption in different social classes in Sweden before 1960, but with some exceptions. Access to alcohol was much easier for the wealthy during the period of strong alcohol restriction in 1915-1955 and the purchase of alcoholic beverages was substantially higher among those with the highest incomes. There was also an overrepresentation of alcohol-related deaths in the higher social classes in the 1960s: Norström and Romelsjö (1998) suggest that during the last decades of the 20th century, there was an equalization and even a reversal of alcohol consumption between social strata, with higher levels among manual labourers but also with an increasingly skewed consumption distribution, indicating more high consumers in this category. A similar reversal has been observed in England and Wales during the 20th century

when it comes to cirrhosis mortality, possibly reflecting a change in consumption patterns. Mortality from this disease was substantially higher in the managerial and professional classes in 1921, being reversed in 1991 with the highest mortality in the lowest class (Crombie and Precious 2010). It could be discussed whether these indications of changes in health-related behaviour are sufficiently significant to explain the present findings; we believe they are certainly at least an important part of the story.

7 Conclusion

We set our task as analysing social differences in mortality from a long-term perspective. Until recently it has not been possible to investigate the truly long-term development of mortality differences among adult and elderly populations. Still, the prevailing idea in many parts of the scholarly society is that strong socio-economic differences in health and mortality have always existed and were possibly even stronger in historical societies due to large class differences. The present study is one of the few with such a long time perspective, investigating the development from the early 19th century until the present, utilizing micro-data of high quality on a population of considerable size and social diversification. The results will likely surprise most readers; they partly surprised us as well. The consistent advantage of belonging to the elite has not always existed, and the modern pattern of social divide in health appeared much later than expected in the regions we studied. A male mortality class reversal has taken place. Apparently high social class is not always beneficial for survival.

However, there were large differences in the pattern between men and women as well as between different age groups. Class as well as gender must be considered. The social pattern of female mortality is in line with what was expected, but a social gradient in male adult mortality is a recent phenomenon. It is an interesting paradox that both the class and gender aspects in the analysis show that those with more power and resources were in fact less successful in the high-mortality society when it comes to survival. Furthermore, inequality in mortality appears clearer for the working-age population, while the differences are smaller among the elderly.

An important question is whether our results can be found in other similar historical contexts. We have studied environments in northern Sweden with no large metropolitan areas. Perhaps Sweden or this part of Sweden is a special case. The involvement of government at both the national and

local levels may have been stronger, thus mitigating socio-economic disadvantages, but this is doubtful concerning the 19th century. The level of income inequality was certainly lower in our regions than in other parts of the country but it was still substantially higher in 1930 than towards the end of the 20th century. The results from the recent study of Scania (Bengtsson, Dribe, and Helgertz 2020) are, however, in line with the results from the present study.

It is difficult to explain the observed differences, and we can only offer tentative hypotheses. We have discussed the possible role of behavioural influences on mortality in different historical contexts, suggesting that such aspects are not only important in the modern epidemiological regime but might have been decisive in earlier phases of the epidemiologic transition as well. The results indicate that we should consider the role of gender and class expectations of behaviour. Studies of these aspects and their role in health and mortality in different times and places require further development. A possible way to proceed is to analyse the development of causes of death, and how they are distributed in different social classes. In particular, we should focus on causes that indicate risk behaviours.

Finally, we have analysed social inequality in health from the perspective of social class. However, there are alternative ways to analyse social inequality, representing other dimensions, and we cannot exclude the possibility that such analyses might give other results or modify the conclusions suggested here. In many modern studies categorizations based on income, wealth, or education are common when examining inequality. It would be interesting to compare the results from this study with alternative measures, but reliable data on income and education are unfortunately rarely available in historical population databases stretching back as far as in this article.

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Appendix

The exposure times and numbers of deaths by time period, sex, and age group are shown in the following figures, together with their corresponding death rates. The distribution over hisclasses by time and sex was shown in Figure 3.

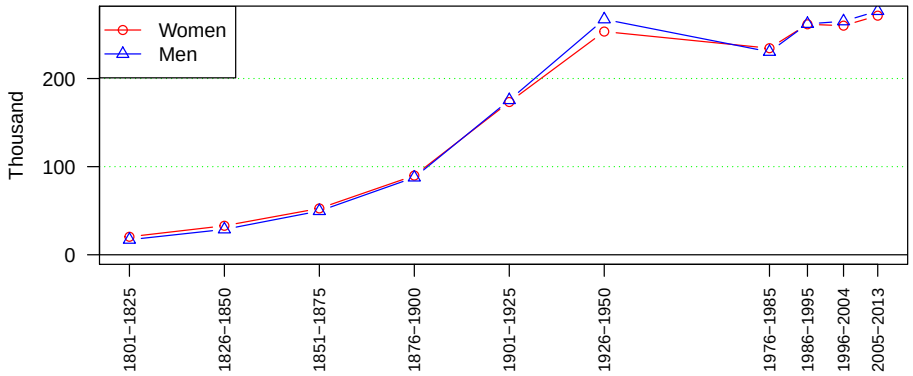

Figure 6: Person years by period and sex, ages 40-64.

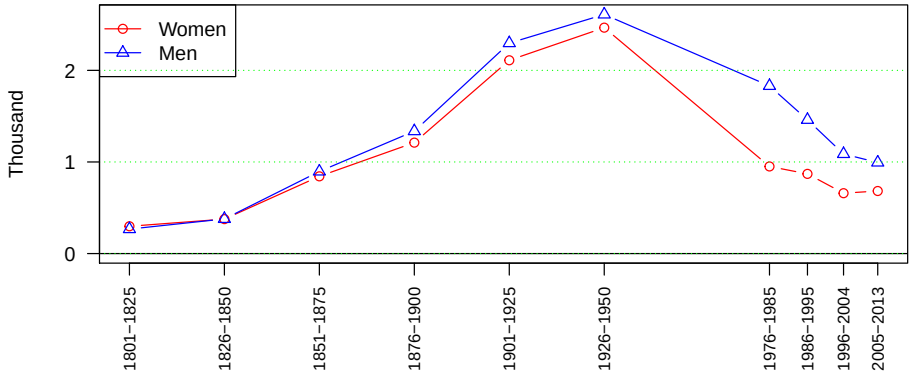

Figure 7: Number of deaths by period and sex, ages 40-64.

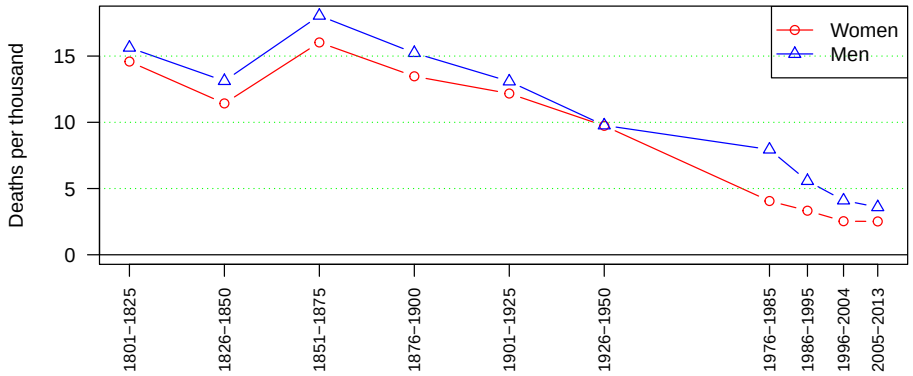

Figure 8: Crude death rates by period and sex, ages 40-64.

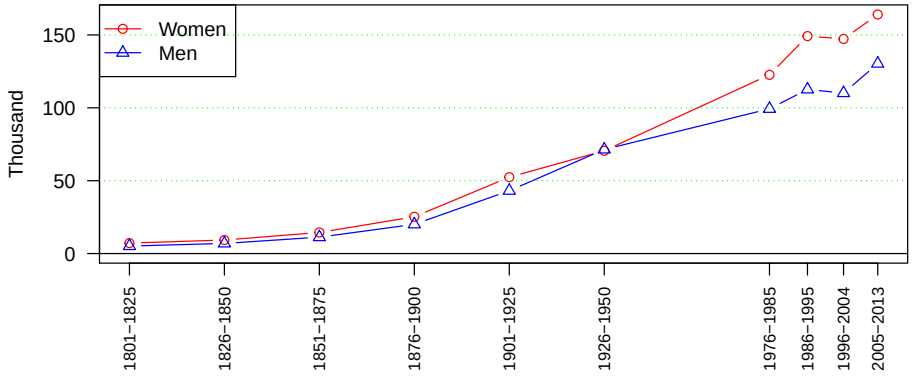

Figure 9: Person years by period and sex, ages 65-99.

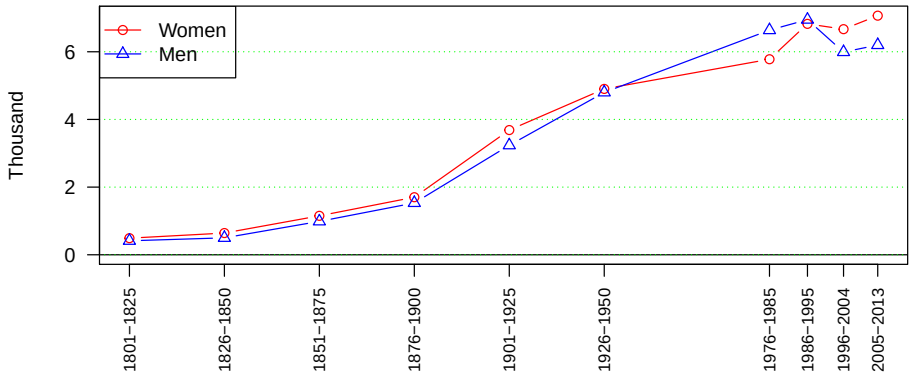

Figure 10: Number of deaths by period and sex, ages 65-99.

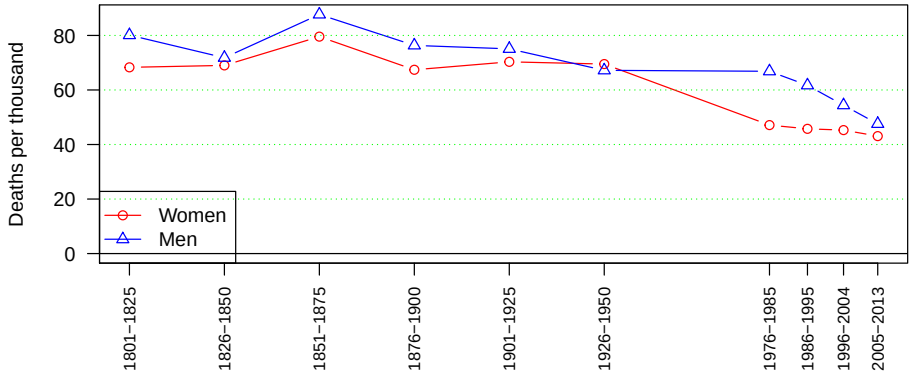

Figure 11: Crude death rates by period and sex, ages 65-99.