Social inequality in mortality among adults and elderly in northern Sweden 1851–2013[1]

Göran Broström[2] and Sören Edvinsson[3]
Centre for Demographic and Ageing Research (CEDAR)
Umeå University, SE-90187 Umeå, Sweden

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[2]email: goran.brostrom@umu.se
[3]email: soren.edvinsson@umu.se

Abstract

A long-term perspective on the development of social inequalities in mortality in the adult and elderly population is taken in this paper. The area under investigation consists of the Skellefteå and Umeå regions in the north of Sweden, and the time period is 1851–2013.The outcome is all cause mortality and cause specific mortality for the categories cardiovascular diseases and cancers. The analysis of inequality is based on Hisclass.

The main findings are that the a consistent social gradient implying better survival for classes with more access to economic and other resources, only become evident in the later half of the 20th century, with lower classes having the highest mortality. The class patterns in mortality differed however depending on gender. Women of higher classes were comparatively favoured in most of the studied periods, while higher class men were disadvantaged when it comes to survival at least until the middle of the 20th century. The modern pattern of clear socio-economic differences appeared surprisingly late. Additional analyses based on education and income categories confirmed large inequality in mortality between different groups during the latest decades, but also demonstrated more distinct differences between categories with better survival the more income and the higher education level people have. Both cardiovascular diseases and cancers conform with the pattern already observed when it comes to all-cause mortality.

Contents

1 Introduction

For a long time, it was generally assumed that socio-economic health inequalities were high in historical societies, probably higher than in modern societies. This can be considered as a reasonable assumption since these societies were in most cases characterised by very large differences between groups and classes. Knowing that access to resources provides advantages in all ways, the health advantage of higher classes ought to be obvious. When in recent years new studies have appeared, investigating social inequality in health and mortality with micro-data, the assumed pattern has been questioned. Results from different studies have diverged, some reporting substantial differences but many have found surprisingly small socio-economic differences during the first stages of the transition (Bengtsson and van Poppel, 2011; Edvinsson and Lindkvist, 2011; Edvinsson and Broström, 2012). The appearance of the consistent pattern of inequality in survival that characterises present-day societies must have developed somewhere on the road from a high-mortality to a low-mortality regime. The complete process is however largely unknown.

A long-term perspective on the development of social inequalities in mortality in the adult and elderly population is taken in the present paper. The area under investigation consists of the Skellefteå and Umeå regions in the north of Sweden, and the time period is 1851–2013 for Skellefteå and 1901–2013 for Umeå.

This paper is a follow-up of an earlier paper (Edvinsson and Broström, 2016), presented at the ESHD Conference in Leuven, Belgium, 2016. Here we make a quick look back in time for the Skellefteå region (1851–1900), and we also consider causes of death from the early 20th century. The Lisa data (Swedish population registers) allow us to study the effect of income and education on mortality in a more direct way for the period 1990–2005, and to compare it with the results of the class-based analysis.

2 Aims and questions

The aim of the paper is to investigate the development of social differences using HISCLASS in mortality for the adult and elderly population during the mortality transition. The analyses will be performed on data from the Skellefteå and Umeå regions 1851–2013. The main questions are:

1. Has inequality in mortality between social classes increased among the adult and elderly population, primarily benefiting the highest social positions?

2. Are there any gender differences in the effect of social position?

3. Is social position equally important among the retired population as for those in working age?

4. Is there a difference between classes in mortality from cardiovascular diseases and cancers respectively?

5. Are there large differences in survival depending on level of education and income categories?

3 Previous research

For a detailed presentation we refer to Edvinsson and Broström (2016). Here is a short summary.

Several studies have shown how important access to economic and other resources are for health, but it is not clear how this has developed in history. Antonovsky (1967) and Smith (1983) suggest that social inequality in health has passed through different phases in history. According to them, social health differences were comparatively small during the pre-transitional phase when space was a strong determinant for the spread of disease. Differences then increased during the transitional phase when mortality declined and wealthy groups used their resources to gain better health. Finally, health differences decreased again in modern low-mortality settings when instead health-related behaviour became important, resulting in marginal differences. Omran (1982) state, in the third proposition in his theory of the epidemiological transition, that even if the class differential in mortality was maintained during the transition, the decline set in earlier and was faster among privileged groups.

These assumptions has however been questioned by later research. According to the present state of knowledge about the development of social health inequalities (in Sweden but also in other European countries), no consistent social hierarchy has been found before 1900 but substantial differences towards the late 20th and early 21st century. It appears as if a more consequent social health divide developed in the period in-between. This period has not been thoroughly studied on this issue, mainly because of lack of data to analyse. However, the extension of data at the Demographic Data Base, Umeå University (DDB) makes such studies possible. We are now able to analyse social differences in mortality with micro-data on a sufficiently large population and with substantial social diversity from the 20th century for the Skellefteå and Umeå regions (Westberg et al., 2016).

4 The Skellefteå and Umeå regions

Figures 2 and 1 show the study areas and their position in Sweden.

[Figure 1 about here.]

[Figure 2 about here.]

Both regions are part of the county of Västerbotten in the north of Sweden, along the coast of the Gulf of Bothnia. The Skellefteå region in Poplink consists of a selection of parishes surrounding the town of Skellefteå, founded in 1845 but with a very small population in the 19th century. The data from the period after 1960 cover the Skellefteå 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, getting their livelihood from agricultural production. The region was vulnerable for harvest failures, one living long in memory was the famine of 1867—1868 (Edvinsson and Broström, 2014). Towards the end of the century, the region became connected to the Swedish railway system, thus improving the communications and contacts with other parts of the country. During the 20th century, industrialisation took place, partly by the opening of mines in the inlands. This also led to a population increase both in the town and in the rural parts, and a much more diversified economy. Mortality was fairly low in comparison with other parts of the country and the fertility transition was late. The Skellefteå population size as defined in our data sets was 16 473 on January 1, 1850, 41 352 on January 1, 1900, 61 938 on January 1, 1950 and 76 723 at the end of the century.

The Umeå region in Poplink (from 1900 until 1950s) consists of Umeå urban and rural parish, and in the Linneus database from 1960 onwards of Umeå municipality where another three parishes are included. This region has a somewhat different character from that of Skellefteå, even though agriculture dominated the economy for a long time. Umeå town had a small population but was substantially larger than Skellefteå town during almost the whole studied period. It was the administrative centre in the county of Västerbotten and schools and military regiments were placed here. Consequently, Officials, teachers and the military were much more common in Umeå than in Skellefteå. Agriculture dominated the rural part, there were some foundries, some industries for example in forestry and small-scale production. Umeå had a much more diversified occupational structure than Skellefteå. The population size as defined in our data sets was 18 970 on January 1, 1900, 32 900 on January 1, 1950 and 103 970 when the century ended.

5 Data and variables

The data for the present study comes from two large population databases at the DDB, Umeå University. The early period is covered by the database

Poplink, the digitisation of historical parish registers for the Skellefteå and Umeå region (Westberg et al., 2016). The population in the two regions is large enough and socially diverse to enable studies of social mortality inequalities. 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. Data from the regions are accessed for the period 1901–1950s.

The other large data-set comes from the Linnaeus database (Malmberg et al., 2010). It is based on different linked population registers from 1960 to 2013 and is used within the ageing program at CEDAR, Umeå University. The study period from 1960 to 2000 are constructed from censuses every fifth year 1960–1990, with additional information on deaths from National Board of Health and Welfare. For the period 2002–2013 we use the information from the yearly population registers (LISA) together with death information from National Board of Health and Welfare. The construction of these data-sets for analysis is presented below.

Information on individuals are anonymised and the two databases are not linked between each other. This stops us from following individuals present in both databases throughout their lives, thus they are treated separately. This also makes it impossible to add information on individuals in the Linnaeus database from what we potentially could find in Poplink, for example family background or occupations earlier in life.

In the data-set analysed here, all individuals 40 years and older and ever being resident in either of the regions are included. The data file contains the variables on sex, birth date, death date, first and last date of observation and type of entrance/exit.Total number of deaths analysed are 68.244.

5.1 Presence periods

Differences in available information, both when it comes to structure and variables used for attributing social class, from the two data sets as well as within the Linnaeus data set makes necessary diverging approaches when it comes to the identification of presence periods within our regions. The Poplink data provides us with exact dates or at least year of start and exit of the presence of all individuals in our data. This is however not the case with the Linnaeus database. For the period 1960–2000 we use the presence in the censuses 1960–1990 together with the yearly population registers 1986–2000 and information on deaths from the National Board of Health and Welfare for defining the observation periods as well as their social class (see below) in our analyses. We have however no exact information on what happened in-between the censuses, for example the exact date of exit for persons that moved between two censuses. We have solved this by considering everyone as resident in our regions during the complete five-year period between censuses if the person is missing in this census. This overestimates their presence in our regions, but should not bias the results. We furthermore miss those that both moved in and moved out or vice versa between censuses. Exit dates are exact if they refer to death, and in these cases we consider them as constantly present from the last census to the death data even if the death took place in another part of Sweden.

For the last period, 2002–2013, we use the yearly population registers (also known as LISA data from Statistics Sweden), together with information on deaths from National Board of Health and Welfare. This data allows a better control of the presence periods in the studied regions.

5.2 HISCLASS

In this paper we analyse mortality differences according to social class according to the classification scheme HISCLASS. The only type of socio-economic information available both in Linnaeus and Poplink is occupations, which can be used to identify distinct social classes. Thus, analysing according to social class is apart from a scientific choice, also a practical one. Using occupational data is the only and obvious alternative if we are to make a longitudinal study of socio-economic mortality differences with consistent classification schemes (although not without some problems). There are also other problems connected with using the same classification scheme covering a long time period, but this will be approached in more detail in the discussion section. Social position is treated as a time-dependent variable.

The availability to information on occupations varies over time and between sources. The Poplink data usually provides information only on the occupation of head of households. The censuses 1960–1990 include occupational codes based on the system used in Sweden at that time, NYK (Nordisk Yrkesklassificering). The yearly population registers (LISA) do not report occupations until 2001, thus there is a window of 11 years from 1990 to 2001 where we lack information. In the censuses, we have solved this by extending the periods for which we consider the defined social class be valid. Thus, the social class in the census 1990 is considered to be kept until 2000.

The use of different data sets, forces us to apply different approaches towards defining the social position. In the Poplink data, social class is based on the occupational titles given in the parish records. These can be more or less precise. There are some problems with titles that are not precise enough to identify the size of the enterprise, or the division between skills, semi-skilled and unskilled workers. We consider however their validity to be sufficient for identification of social position. Another problem is that we in Poplink usually get the occupation only for the head of household, thus under-estimating the female working-force participation and the occupations of adult children residing with their parents (Vikström, 2010). In this study and according to the research questions in the present paper, we have chosen to categorise wife according to the position of the head of household, usually the husband/father, assuming that the family shares the same socio-economic position. This strategy makes the problem of under-recording less problematic.

Female labour is however much better covered in the Linnaeus database, both in the censuses and the population registers. Another difference is that it is much more difficult to define households in the same way as in Poplink from the Linnaeus database. Extra-marital cohabitation, connected to the Second Demographic Transition (Van de Kaa, 1987, 2003), became very common in Sweden during this period. It is also worth to notice that female labour force participation became the norm, and we can therefore argue that the occupation of the male as signifier of the social class became obsolete. We let all included persons be signified by their individual occupation for this period. Still, we need to keep in mind that the results for the different periods are not completely comparable.

Due to the construction of the time-dependent data, some records report unknown social position. This has been updated according to rules in order to optimise available information and minimise missing information. Those that still lack information on social class are not included in the analysis, something that have consequences for elderly living in the 1960s in particular, since many were already retired and thus without occupation when we first observe them in the 1960 census. The fact that Linnaeus and Poplink are separate databases stops us from updating this information from Poplink.This, together with the circumstance that many women had no occupation in the census 1960 explains the large proportion where we have not been able to determine class during that decade.

The classification scheme used here is HISCLASS (Van Leeuwen and Maas, 2011), a class-based system. The scheme uses HISCO as a basis for assigning categories. HISCO Van Leeuwen et al. (2002) (Historical International Standard Classifications of Occupations) is a classification system of historical occupations, representing a historical version of ISCO. HISCO groups occupations according to tasks and skills. HISCLASS have 12 categories, but some categories become quite small in number even when analysing these comparatively large regions and we have therefore used only the main categories, based on position on the labour market. We have therefore collapsed categories, ending up with the following four:

1. `elite`, HISCLASS 1 and 2. Higher managers and professionals.

2. `lowMan`, HISCLASS 3 and 8. Lower managers and farmers.

3. `lowWhiteC`, HISCLASS 4, 5 and 6. Lower white collar.

4. `worker`, HISCLASS 7, 9, 10, 11 and 12. Workers of different skills including farm workers.

For the Poplink data, we have used a script re-coding HISCO into HISCLASS, provided to us by Jonas Helgertz, Lund University. The procedure for occupations in the Linnaeus database is a little more complicated. The occupations in the censuses (NYK) must first be transferred to the system later in use, SSYK (which is the Swedish version of ISCO88). Thereafter the SSYK, both those transferred from the censuses and those given in the population registers 2001-2013, can be re-coded into HISCLASS.

Figure 3 shows the distribution (per cent) of exposure time over HISCLASS for our selected periods. The category of workers are fairly stable over time, while the lower white collar group was very small during the 19th century, then starting to increase during the early 20th century and increasing considerably during the period from the 1960s onwards. The group of lower managers where farmers also are included, was large until the middle of the 20th century, but has diminished considerably thereafter. This is to a large extent explained by farmers almost disappearing as an occupation in recent time. The highest classes has increased substantially, although from a very low level in the 19th century. The increase of academics in connection to the establishment of Umeå university explains much of this increase.

[Figure 3 about here.]

For the corresponding numbers, with missing values (`NA`) included, see Table 1.The proportion with missing HISCLASS was very low during the periods until 1950, between 4 and 8 % lacked information allowing determination of class. This increased considerably for the beginning of period when the other data set—the Linnaeus database—is used, in particular for the 1960s where every second person lacks HISCLASS and the 1970s with almost a third have missing information. This has to do with difficulties in the determination of class from the censuses, something we discuss below. For the most recent period, the information is complete.

[Table 1 about here.]

5.3 Marital status

Marital status is treated as a time-dependent variable in the data file. The statuses used are unmarried, married and dissolved marriages (without distinguishing between widowed and divorces). The status unmarried is often not explicitly noted in the source, which makes the status unknown in the database Poplink for people for people moving to our parishes. If no explicit status is given in the sources and partner is missing, the status has been set to unmarried in our data file.

Regarding the distribution of marital status over time, see Figure 4.

[Figure 4 about here.]

5.4 Cause of death

In the present study, we analyse mortality in the two most common disease groups in the ages we are investigating: Cardiovascular diseases and cancers. Compulsory reporting of cause of death became introduced in 1911 for all Sweden, and not only the urban part which had been the case from 1860. Classification systems have however changed. Sweden did not join ICD until 1952, but the historical causes of death in the Poplink database have been coded according to the ICD10 system. In the present study, we have identified the codes relevant for cardiovascular diseases and cancers in the ICD 8, 9 and 10.

The distribution of causes of death is shown in Figure 5. Notice the high proportion of other causes in the first two periods. This category include cases with unknown cause and unspecific causes which has implications for the cause-specific analyses. In the analyse section, we comment more on this. The total dominance of the two cause groups we are studying is apparent from the figure.

[Figure 5 about here.]

5.5 Periods for analysis

We have made separate analyses for the different periods. For the century 1851–1950 we have divided it into four periods of 25 years each. The nineteenth century period represents a mainly pre-industrial society dominated by agriculture and with restricted welfare provisions. During the years 1901–1950, industrialisation had started and the urban environments increased in population size. The modern welfare state began to develop during this time. For the period 1960 onwards, the analyses is made on decades except for the two last periods. Sweden at this time is a wealthy welfare society with low income inequality in international comparison, particularly until the 1990s. A financial crisis struck Sweden in the early 1990s, which among other things increased unemployment and changed parts of the welfare system, not being as generous as before. The start of the last period (2008–2013) coincides with the international financial crisis that also had strong impact on Swedish economy.

5.6 Income

Income is based on disposable individual income from the LISA database at Statistics Sweden, grouped into quartiles. It is only analysed from 1990 to 2005.

5.7 Education

Education is here analysed only for the period 1990 onwards. Years of education are given in 7 categories and is based on level of education according to categories in the LISA database at Statistics Sweden. It ranges from basic education (less than nine years schooling) at level 1, to high academic degree (PhD and similar) at level 7.

6 Models

The proportional hazards model in a survival analysis context is used, allowing for adjustment for civil status and rural/urban environment. Since the central explanatory variable, HISCLASS, do not follow the proportionality property, the analyses are stratified with respect to the variable, and the main results are presented graphically.

Another practical problem is the size of that data set: It contains no less than 2 432 871 records of 236 011 individuals, of which 68 244 are observed to die. This makes it very inconvenient use the nowadays so popular semi-parametric technique known as *Cox regression* (Cox, 1972; Broström, 2002). Instead we use a parametric model that allows for reduction of the data to *sufficient statistics* (Fisher, 1922). The idea is to keep all relevant covariates *categorical*, and then create a table with all possible combinations of levels of the covariates. For each such combination, the total amount of exposure and the number of deaths are calculated. We have two sexes, three civil statuses, ten periods, two urban/rural groups, four hisclasses at age 40, four hisclasses at age 60, ten age groups, and 22 cohorts, in all 422 400 possible combinations. However, in this scheme there are many structural zeroes (impossible combinations) and some random zeros, so the actual number of combinations we end up with is 24 326. The data set is thus reduced in size by 99 per cent.

The parametric model we use for the baseline hazard function is piecewise constant on five-year intervals, so we arrive at the following proportional hazards regression model:

$$h(t; \lambda, \boldsymbol{\beta}, \mathbf{x}) = \lambda(t) e^{\boldsymbol{\beta}\mathbf{x}}, \quad 40 < t \leq 90, \tag{1}$$

where

$\mathbf{x} = (x_1, \ldots, x_n)$ is a vector of covariates,

$\boldsymbol{\beta} = (\beta_1, \ldots, \beta_n)$ is the corresponding vector of regression parameters.

and

$$\lambda(t) = \alpha_i, \ 40 + 5(i-1) < t \leq 40 + 5i, \ i = 1, \ldots, 10.$$

Since all components of $\mathbf{x}$ are categorical covariates, the estimation of (1) can be performed in two ways, first by the original data set and a survival analysis routine handling a piecewise constant hazard, or second, by the reduced data set (table) and *Poisson regression.* The second way is faster than the first by a factor of size at least 100, often much more, depending on hardware, and the point is that the two ways give exactly the same results. This is because the table is a *sufficient statistic* for (1) and the original data set.

The analyses are performed in the **R** environment for statistical computing and graphics (R Core Team, 2016), especially using the package `eha` (Broström, 2012; Broström, 2016) The proportional hazards model allow us to scrutinise the differences and the development in more detail. We divide the analysis into two age groups, 40–64 and 65–89 years of age, the first age group representing people that were still mainly in the workforce, and the second those that mainly were retired. The model controls for period, marital status and whether the individual resides in the urban or rural part. There are no serious signs of deviation from proportionality assumption, except regarding HISCLASS.

We analyse both regions together but perform separate analyses for men and women and for the age groups 40–64 and 65–89. The model in the analyses include social class, sex and marital status. Each decade during the 20th century gets separate analyses, but we then combine results in order to show the development of the social patterning of mortality during the studied period. We present the results for the period 2001–2013 separately. We suggest a heterogeneity index in order to investigate a possible homogenisation of mortality between social classes.

The important explanatory variable, HISCLASS, is included in the proportional hazards models as a *stratification* variable. The main reason for this choice is that the effect of HISCLASS on survival is non-proportional, that is, it varies with age. With the reduced data set and Poisson regression, this is simply achieved by introducing an interaction term between `age` and `hisclass`. Then, the main results are presented *graphically.* There is some lack of information in the higher ages around 1960–1980 (see Table 1), because that kind of information is simply missing to a large extent.

7 Results, all causes of death

Models are fitted separately for each time period, from 1851 to 2013, with the exception of the period 1951–1960. We stratify on HISCLASS and control for the covariates `sex` and `civst`. The cumulative hazards at the end of the time period (65 if 40–64, 90 if 65–89) are the main target in our analysis: These numbers are used in the process of graphically illustrating the development over time.

7.1 Ages 40–64

We start by looking at cumulative hazards by HISCLASS over the last four time periods, in order to illustrate the process. They are adjusted for `civil status`. We present separate analyses for women and men, see Figures 6 and 7.

[Figure 6 about here.]

[Figure 7 about here.]

From Figures 6 and 7 it is obvious that the idea of proportional hazards is not reasonable. We therefore use another approach.

The "TMR", that is, the summed hazards over the age interval 40–64 is shown in Figure 8.

[Figure 8 about here.]

Figure 8 shows mortality levels during the different periods. Obviously, and not surprisingly, mortality is decreasing over time, and we can already identify some interesting social patterns in mortality which will be commented more on below. Apart from the social pattern that will be commented on below, there are a couple of observations to be made from the figure. Women have consistently better survival than men. This is a well-known phenomenon in Swedish demographic history. Male mortality has almost always been higher than female in all age groups (Willner, 1999; Sundin and Willner, 2007). We also observe a substantial decline in mortality for both sexes, resulting in smaller absolute differences between social classes. The compression that is visible for later decades is partly explained by the decreasing general mortality. It is not obvious that differences between social classes have diminished. This conclusion has been confirmed by separate analyses (results not shown). There is no clear indication of homogenisation of mortality levels between social classes.

However, we are mainly interested in illustrating the change in relative position among the HISCLASSES over time rather than the absolute levels, so we *standardize* the levels in each time period. It is illustrated in Figure 9. In the rest of the paper, we only present these relative mortality levels for the different classes.

[Figure 9 about here.]

Notice that we have not analysed the 1950s due to the fact that we only have data for some parishes at that time, consequently having no corresponding population for that decade. Furthermore, we need to be cautious when interpreting the results for the 1960s in particular, but also for the 1970s due to much missing information on HISCLASS for these decades, something that have restricted the size of the population observed. The changing economy also have consequences for the analysis, particularly when it comes to the agricultural sector. While farmers were common occupations during the first half of the 20th century, these occupations has constantly decreased in numbers thereafter. This means that the second HISCLASS group has somewhat different character during the last periods in the figures.

The social pattern of mortality among women is quite much in accordance with previous analyses from the present research group on other regions in northern Sweden and for other periods (Edvinsson and Lindkvist, 2011; Edvinsson and Broström, 2012, 2016). The highest social class usually have comparatively low mortality, while working class women have high. This is especially the case during the latest decades of the century and until 2013. We once again remind that the results from the 1960s must be interpreted with caution due to the large proportion of missing cases.

A different pattern appears among men. The groups we would expect to have the lowest mortality, if we assume that access to different resources and having a high status determines survival, instead have the highest during the nineteenth and much of the 20th century. This is also in accordance with our previous studies (Edvinsson and Lindkvist, 2011; Edvinsson and Broström, 2012, 2016). Workers on the other hand have comparatively low mortality until the 1960s. This changes however towards the end the 20th century. From the 1980s, there is a clear advantage when it comes to survival for higher managers and professionals. The expected social gradient in mortality has developed. This is also what we usually find in analyses of social health inequalities in present-day Sweden as well as in most other countries. In the regions we are studying, this is however a quite recent phenomenon.

The effect of income and education, 1990–2005

A common alternative to a class analysis is to use income or education for investigating socio-economic health differences. Comparing different approaches are furthermore valuable in order to understand why some are advantaged and others disadvantaged. For the time being, we have to restrict such a comparative analysis to the last decades.

The analysis for the period 1990–2005 is based on a separate analysis with income and education as explanatory variables and with controls of period and marital status.

The statistical significance of the covariates are shown in Table 2.

[Table 2 about here.]

The estimated effect sizes for women are shown in Figure 10.

[Figure 10 about here.]

And for men:

[Table 3 about here.]

[Figure 11 about here.]

Both education and income were strongly significant, as well as marital status as expected. Those with the two lowest education level hade the highest mortality, while those with highest level of education had by far the best survival. The differences must be considered large, and it follows almost a continuous improvement according to increasing levels. The same can be said concerning income. Higher incomes result in lower mortality. This is also what could be expected, and conforms to what we know of social health differences in present-day Sweden. Notice however that we cannot definitely establish a causal relationship between income and mortality in particular. Having low incomes may be caused by bad health.

7.2 Ages 65–89

We now turn to the elderly, i.e. those that mostly have left the workforce. Corresponding to the previous analysis, we use the value of the cumulative hazards at duration 25 (age 90), starting from age 65 as a summary measure.

The general pattern and development of mortality (not shown here) do not differ that much from the younger age group, of course representing a much higher mortality level. Mortality among women was, as expected, lower than among men. We find a clear decline in mortality, but this decline did not set in definitely until sometimes after the Second World War (results not shown here), i.e. later than for the age group 40–64 years. This corresponds to the Swedish development where we find a turning point at this time with better survival among elderly, to a large extent caused by lower mortality in cardiovascular diseases. The results for the 1960s are however uncertain as discussed above, especially for women due to the difficulty to determine HISCLASS for the majority of them.

Concerning the social pattern, the pattern is a little more difficult to interpret, compared to the younger age group (the new analyses differ somewhat from the ones in Edvinsson and Broström (2016)). For women the results are mixed. We do not find the same clear advantage for elite women during period until 1950, and neither do we find any large disadvantage for working class elderly women. In some periods, the social differences were small, and the elite even had substantially higher mortality during the early 20th century. Notice however that this group was rather small at the time. During the recent decades, the pattern is not very clear, but for the two last periods, the elite have the lowest mortality. It is however not possible to identify a clear social gradient in mortality.

For men we find indications of the same intriguing change among elderly as for the adult population 40–64 years. Mortality was in fact substantially higher among men from the elite but the disadvantage is mainly apparent during the 19th century. Differences are fairly small during the first half of the 20th century. Only during the second half of the 20th century, we find periods with much better survival for the highest social class while retired workers had fairly high mortality. But even in recent times, the pattern is not completely clear. During the last periods, we do not find a social gradient on HISCLASSES among elderly men (even in this case, the new analyses differ somewhat from the ones in Edvinsson and Broström (2016)). This is quite unexpected, since other studies have shown clear socio-economic differences in Sweden during recent decades.

[Figure 12 about here.]

The effect of income and education, 1990–2005

The fact that we find rather unclear associations between HISCLASSES and survival, makes alternative approaches to the question of socio-economic health differences interesting. As for the younger age group, we have included an analysis for the period 1990–2005 with income and education as explanatory variables.

The statistical significance of the covariates are shown in Table 4

[Table 4 about here.]

The estimated effect sizes are shown in Figure 13

[Figure 13 about here.]

And for men:

[Table 5 about here.]

[Figure 14 about here.]

These figures show clear associations both with income and education and for women as well as for men. More years of education resulted in lower mortality. For women the association with additional levels became however smaller at the higher levels, the effect is more visible at the steps above the basic levels. In a similar fashion, increased incomes is associated with improved survival both for men and for women. Apparently, education and income is better to catch up socio-economic differences compared to hisclass, at least for this period.

8 Results, cardiovascular death

We now turn to a special analysis of mortality for the two dominating causes of death among the adult and elderly population. We start with cardiovascular diseases. Many studies have shown that socio-economic conditions are strongly associated with mortality in this disease group. Belonging to working class, having less education and low income increases the mortality risks. We would therefore expect to find a clear social pattern in the present analysis.

First, a general observation is that the analysis of causes of death and their development are more difficult to interpret, partly because the number of cases are fewer but also that the quality and coverage of reported death causes differ. Thus, many deaths during the 19th century were not diagnosed at all, and there was still a substantial part of all death in the early twentieth century where death cause is designated as unknown or dying from old age, despite reporting causes of death had become mandatory. For the period 1901-1925, the proportion of deaths from cardiovascular diseases increased from 25 to 43 per cent for the age group 40 and above, but at the same time unknown cause and death of old age decreased from 28 percent to 18 per cent. Are there many cardiovascular deaths disguised there?

As before, models are fitted separately for each ten-year time period, from 1851 to 2013. We stratify on HISCLASS and use the covariates `sex` and `civst`. The cumulative hazards at the end of the time period (65 if 40–64, 90 if 65–89) are the main target in our analysis: These numbers are used in the process of graphically illustrating the development over time.

8.1 Ages 40–64

We start by looking at cumulative hazards by Hisclass over time periods. They are adjusted for `civil status`. We present separate analyses for women and men.

We will use as a summary measure the value of the cumulative hazards at age 65, given survival to age 40.

[Figure 15 about here.]

Figure 8 shows mortality levels during different periods from 1901 onwards. A couple of observations can be made. Women from the highest social class had almost consistently lower mortality from cardiovascular diseases compared to others.This is apparent even for the periods with deficient cause of death data. The pattern concerning the other groups are less clear, but if we compare the two largest groups, the workers and the lower manager/farmer group, the differences were rather small during most of the time. A new pattern has however developed from 1990 onwards. Now working class women have substantially higher cardiovascular compared to others.

For men, we find a different pattern, a pattern however that to a large extent is consistent with what we observed concerning all-cause mortality. The elite group had much higher cardiovascular diseases up until the middle of the 20th century, but instead have the lowest mortality from 1980 onwards. Working class men had a fairly low cardiovascular mortality, but in the same way as among women, the levels were fairly similar to the one of the other large group, lower manager/farmers. And in the same way as for women at this age, working class me have by far the highest mortality from this cause of death during the last decades. A social hierarchy in cardiovascular mortality seems to have developed both for men and women.

The effect of income and education, 1990–2005

We have also performed the analysis on the alternative approaches on socio-economic differences for the causes of death. It is based on a separate analysis with income and education as explanatory variables.

The statistical significance of the covariates are shown in Table 6

[Table 6 about here.]

The estimated effect sizes are shown in Figure 16

[Figure 16 about here.]

And for men:

[Table 7 about here.]

[Figure 17 about here.]

The analysis of cardiovascular mortality according to education and income conforms very well to what we find for all-cause mortality, and we will therefore not delve into detail on this issue. More education as well as higher income is advantageous both for women and men for avoiding deaths related to the circulatory system. This is also well in line with our analysis based on HISCLASS above.

8.2 Ages 65–89

In this section we focus on cardiovascular mortality among those that mostly have left the workforce, the age group 65–89 years. In accordance with the analyses for the age group 40–64, the model adjusts for `civil status` and with separate analyses for women and men. We use as a summary measure the value of the cumulative hazards at duration 25 (age 90), starting from age 65.

Concerning the social pattern, we find rather mixed results but with some similarities to the ones for the age group 40–64. For women mortality in this disease group were somewhat higher among the elite and the lower manager/farmer group than the others until only the last decades. Elderly from a working class background have not been disadvantaged for most of the 20th century. The social class pattern has changed somewhat during the last periods and more in line to what is expected. The differences are however not that large. Cardiovascular disease mortality among elderly women do not present a consistent class pattern. Also for men, we find high cardiovascular mortality during the period 1926–1950 and the 1980s for the elite, but also for lower-managers/farmers during the first half of the 20th century. As for women, we find no clear class pattern during the last periods and the differences are quite small.The diffuse pattern of class differences in cardiovascular mortality is surprising. It is therefore of interest to find out what other aspects of social differentiation tell us.

Notice that the results for the 1960s must be interpreted with caution due to much missing data on HISCLASS among the elderly.

[Figure 18 about here.]

The effect of income and education on cardiovascular death, 1990–2005

The analysis of cardiovascular mortality for the period 1990–2005 is in this section based on a separate analysis with income and education as explanatory variables. The statistical significance of the covariates are shown in Table 8 for women and Table 9 for men. It confirms that most of the variables are strongly significant except

[Table 8 about here.]

[Table 9 about here.]

The estimated effect sizes are shown in Figure 10

[Figure 19 about here.]

And for men:

[Figure 20 about here.]

The pattern is similar to what we find for all-cause mortality. The higher educational level, the lower cardiovascular mortality, and more income leads to better survival. This association is clear and consistent for women as well as for men. A minor difference between men and women is that mortality in the higher levels of education do not lead to lower mortality among women while that is the case among men.

9 Results, cancer death

While we assume clear social differences in cardiovascular diseases, this is not necessarily an obvious assumption when it comes to cancers. Different forms of cancers have very different origin and different pathways to disease and death. The social pattern of higher mortality in classes with less power and accordingly less life chances are considered to be less clear when it comes to cancers. In the present analysis we include cancer deaths 1901–2013, but with an unregistered and not analysed period between 1951–1960. There is a risk that cancer mortality is under-estimated during the first half of the 20th century, illustrated above by the large proportion of unknown or vague causes at that time. We believe however that cancers were better diagnosed than cardiovascular deaths. This is supported by the stability in proportion of cancer deaths between the two periods, 12,5 per cent 1901–1925 and 13,5 per cent for the period 1926–1950.

Models are fitted separately for each period, from 1851 to 2013. We stratify on HISCLASS and use the covariates `sex` and `civst`. The cumulative hazards at the end of the period (65 if 40–64, 90 if 65–89) are the main target in our analysis: These numbers are used in the process of graphically illustrating the development over time.

9.1 Ages 40–64

[Figure 21 about here.]

Figure 21 shows relative mortality levels according to HISCLASS during the different studied periods. The social differences were small until the middle of the 20th century, for women as well as for men. For the periods after 1980, the rather small differences remain. There is an indication of the elite having lower cancer mortality for women sexes during the last periods, but these differences are small and we do not find any clear social gradient in the risks. Thus, for this age group cancer mortality is not something that distinguishes between classes.

The effect of income and education on cancer mortality, 1990–2005

In the previous section, we concluded that there were no social inequality in cancer mortality according to hisclass. The question here is if the lacking socio-economic differentiation holds also when using education and income as categorising variables. The analysis for the period 1990–2005 is based on a separate analysis with income and education as explanatory variables.

The statistical significance of the covariates are shown in Table 10 for women and Table 11 for men. The variables of interest here are all significant.

[Table 10 about here.]

[Table 11 about here.]

The estimated effect sizes are shown in Figure 22.

[Figure 22 about here.]

And for men:

[Figure 23 about here.]

When it comes to the association with education and income, we find the similar pattern as those for all-cause mortality and cardiovascular mortality. There is a strong effect for both men and women of having more education and income. These variables seem to catch up important aspect of socio-economic differences in health and mortality.

9.2 Ages 65–89

We finally turn to cancer mortality among the elderly. In accordance with the analyses for the age group 40–64, the model adjusts for `civil status` and with separate analyses for women and men.

We use the value of the cumulative hazards at duration 25 (age 90) as a summary measure, starting from age 65.

The relation between different classes and cancer mortality fluctuates considerably both for women and men in this age group. For some periods it has to do with quite few events to analyse, particularly for the 1960s where HISCLASS has been difficult to determine for the elderly. Women of higher classes sometimes have favourable mortality, but unfavourable at other times. It seems however that the higher classes have reached lower cancer levels compared to the working class from 2001 onwards. Men from the elite had higher mortality until the 1970s, but a social gradient has appeared thereafter. Now the elite with assumed more resources have lower mortality than other groups. Elderly of workers origin on the other side have higher cancer mortality during the last decades, sometimes substantially higher than the others.The pattern is however not completely clear.

[Figure 24 about here.]

The effect of income and education on cancer death, 1990–2005

Thus, we find indications of social differences in the later decades, particularly between the elite and the workers. The alternative analysis for the last period is based on a separate analysis with income and education as explanatory variables.

The statistical significance of the covariates are shown in Table 12 for women and Table 13 for men.

[Table 12 about here.]

[Table 13 about here.]

The estimated effect sizes are shown in Figure 25

[Figure 25 about here.]

And for men:

[Figure 26 about here.]

The social inequality in cancer mortality is confirmed by the approach of analysing the effect of education and income. We find the same consistent pattern as we have found for all-cause mortality and cardiovascular mortality for this period. Higher levels of education and more income is associated with lower cancer mortality. We can therefore conclude that both education and income are strongly decisive aspects of social differentiation when it comes to mortality during the last decades.

10 Discussion

The authors of this paper have scrutinised different aspects of the social pattern of mortality in northern Sweden for quite some time, focusing on different regions, different age groups and partly different social categories. Already the earliest findings, concerning the social inequality in a rapidly growing town in an industrial district, surprised and at least at first confused the author (Edvinsson, 1992). The expected social gradient in survival, meaning that people from higher social classes always had an advantage, was in many cases, particularly among adult men, not found despite the well-documented socio-economic differences in this society. There were however large differences between men and women and for different age groups. Further studies have confirmed these findings (Edvinsson and Lindkvist, 2011; Edvinsson and Broström, 2012). These earlier studies have ended with an assumption that distinct and consistent differences to the advantage of higher classes developed somewhere during and probably quite early in the 20th century. Until now we have however not been able to investigate the continuous development on mortality differences among the adult and elderly population due to no available data. This is the first time it has been possible, and the results continue to surprise us. The consistent advantage for higher social classes do not appear until quite late in the regions we have analysed. The social pattern of female mortality are closer to what is expected, but a social gradient in male adult mortality seems to be a recent phenomenon. Furthermore, this transition and the class pattern of mortality differ depending on age group. Inequality in mortality appear clearer for the population at working age, while the differences are smaller among the elderly, a somewhat modified result from what we found in the first and preliminary analyses presented in Leuven this year (Edvinsson and Broström, 2016).

We have also added analyses of cause-specific mortality to the previous version. Mortality from cardiovascular diseases contributes to a large proportion of all deaths during the 20th century, and we are not surprised that it has a fairly similar pattern as for all-cause mortality. What is surprising is however the small class differences among the elderly. Cancer is sometimes considered less connected to social class, and we find mixed results in our analyses. There are however indications of a social gradient during the last decades in both studied age groups. Development of death causes are however problematic since the ways they have been diagnosed and the proportion with missing or vague information has changed over time.

The perhaps surprising results makes it reasonable to consider their validity and possible weaknesses in the study. There are of course uncertainties involved in all studies of this sort, something that should not be ignored. One obstacle concerns the quality of the available information in the sources. Occupational titles in historical sources are not always distinct enough to define the correct class. It can be difficult to identify the skill level in the working class population because many were often only designated as labourer. The size of the enterprise for free entrepreneurs is unknown and it may be impossible to distinguish if they are self-employed or have many employed. The class system and the position of different classes can also be discussed. Studies covering long period have the problem that occupations and classes change character - they do not represent the same thing. Nonetheless, these ambiguities and possible mis-classifications are not of that sort and magnitude that it would radically change the basic patterns observed. The social classes identified during the different periods represent distinct groups with very large differences in resources, capacities and power. A worker would not end up in the highest SOCPO level and large-scale entrepreneurs and higher officials would certainly be assigned the right level.Available data also show that the differences in income and wealth were large, often enormous.

In this paper we have analysed social inequality in health from the perspective of social classes using HISCLASS. However, there are alternative ways to analyse social inequality, and we cannot exclude that such analyses gives other results or at least would modify the image presented here. There are other alternatives then HISCLASS, representing status or class dimensions. SOCPO is another system based on hierarchic categories of social power, which we have used in a couple of previous studies. In many modern studies categorisations based on income, wealth or education are common for studies of inequality. It is possible that such categorisations are better fit to distinguish between groups in society. They represent different dimensions of inequality, and we believe that the topic discussed here would gain from analyses of different aspects of inequality. One problem is however that reliable data on income and education are rarely available in historical population databases. We can however be certain that the highest HISCLASSES level have more education and the lowest the least. We also know from the 1930 census that the economic differences were very large at that time and that occupations in higher HISCLASSES tend to have higher incomes. The groups that may diverge are those within agriculture and those having a small enterprise where we can assume that the reported income figures underestimate their economic standard.

As a test, we have however included analyses of the associations of education and income to mortality for the period 1990–2005. For women as well as for men, for both age groups and for all-cause mortality as well as cause-specific mortality we find consistent differences with higher educational level and more income leading to lower mortality. As already mentioned, the class analysis proved that it in most cases are strong differences during the last centuries, but the pattern is much clearer in the alternative ways of categorisation. This does not mean that a class analysis is worthless, rather that the different categorisations measure different things. But it certainly point to the importance to also consider other aspect of social inequality in the past. We do not know if education and income are equally important in the past and that these measures would provide us with a completely different picture, but this is something that calls for further investigation.

The results of small socio-economic gradient in the past and its late development are however in accordance with other studies (Bengtsson and van Poppel, 2011), for example by Bengtsson and Dribe (2011) in a very different setting, a couple of Scanian parishes. They found the first indications of an emerging social gradient in the 1950s.The similarities makes us more comfortable about our results.

Solar and Irwin (2010) lists three different types of intermediary social determinants of health, material circumstances, behaviours and biological factors, and finally psycho-social factors. Most studies have focused on the material circumstances. Having a better economy can give advantages in many aspects of relevance for health and mortality, for example good living conditions, access to food, medical care, better conditions at work et cetera. Even though these advantages ought to have been at hand in our studied regions, the final result was not better health for men in the most privileged groups until the later part of the 20th century. We must consider other intermediary determinants. Psycho-social factors have been frequently discussed during the most recent decades, for example by Marmot (2004). He argues that being higher in the status ladder leads to better health, regardless of where in the status ladder we look. This is also one of the arguments Wilkinson and Pickett (2009) use as an explanation why equal societies always perform better than unequal ones when it comes to health and other social conditions. In the case studied here, we do not find any indication of a status syndrome, since mortality levels was in the opposite directions to the one we would expect from these theories.

This makes us consider the possible impact of behavioural factors. Our results of the gender aspect might be of interest in this case. When it comes to gender differences, the present study confirms what we have found on the Sundsvall region. There is a clear gendered pattern when it comes to social inequality in mortality. While high HISCLASS did not have any positive impact on survival for men in the early 20th century, we find that higher social positions among women led to longer lives. Within the same households, the effect of social class seems to lead to different results. This opens up for behavioural aspects based on different gendered expectations. Alcohol has been suggested as part of the large gender differences in the 19th century (Willner, 1999; Edvinsson, 1992), and a more risk-taking life may be a component of the male mortality.

Having a high social status could be expressed in attitudes and behaviours that were harmful for health. Alcohol consumption decreased rapidly during the period late 19th century to the 1950s, thus possibly making room for an increased role of economic resources. But the old pattern in social health inequalities remained. It is however possible that the relative differences in alcohol consumption prevailed, although at a lower level. The question is however if the lower levels of alcohol consumption had any substantial negative impact on health. Swedes at that time had very low consumption levels. Alternative explanations should also be scrutinise. There may have been strong and heavy requirements of being successful for the male ëlite. Many were involved in businesses with high risks. It would be very damaging to lose the high position and they may have felt that they lived under constant threat of economic failure. There are several examples among the economic ëlite in the Sundsvall region that they had such problems (Edvinsson and Lindkvist, 2011). A possible future study involving analyses of death causes might throw some light on this issue.

Our study illustrates the importance of considering contextual factors and the restrictions of making general statements. We need to look into all aspects of social classes, not only the material ones but also what this means for behaviour, norms, way of living. Edvinsson and Lindkvist (2011) suggested that an explanation for the larger social health inequalities in the present-day world is that status and higher social position is now expressed through health and being fit and physical active, while in many historical contexts higher social status was expressed by low physical activity, obsessive eating (being fat was impressive), drinking, smoking and sometimes also taking risks.

Another question is if our results can be generalised. We have studied environments in northern Sweden without any large metropolis. Perhaps Sweden and/or this part of Sweden is a special case. The social differences may have been smaller, the involvement of government both at the national and local level may have been stronger, thus mitigating socio-economic disadvantages. These are relevant questions, which hopefully can be addressed in other and maybe comparative studies.

Finally, we argue that our results have implications for our understanding on several hot research issues. A central question concerning the mortality transition is how the enormous increase in survival could be accomplished. This is still a hot debated question. McKeown (1976) argues that the improvements up to the middle of the 20th century was first of all made possible by improved nutrition. This seems to implicate that having more resources would lead to better survival. If research shows that the most advantaged groups did not have better health and longer lives, this do not necessarily speak against McKeown's ideas but it makes the question more complex. The results are also difficult to fit into Link and Phelan (1995) hypothesis that social conditions should be seen as a fundamental cause of disease. Even if we would eliminate disadvantages such as bad living conditions, lower standard of medical care and other proximate determinants for the poor, the health disadvantage would remain. In the historical context we have analysed here, this does not get any support. This further illustrate the need for situating the analyses in their historical and geographical contexts.

In recent years, the question about the relation between health and income inequality been widely discussed. Even though our study do not address this issue directly, our results are of interest for this question as well. The development of the social inequality in mortality do not seem to fit that well into the development of income and wealth inequalities. The early 20th century, in Sweden as well as in other countries, was characterised by very large economic differences, still this did in our regions not lead to any consistent advantage for the highest social classes. After the Second World War, economic differences diminished, and was at its lowest in Sweden at about 1980, i.e. at a time when a more expected pattern of a social hierarchy in survival had appeared. The period thereafter is characterised by increasing economic differences, and this may coincide with increasing health differences as well. The long-term relation between economic inequality and health is worth further studies.

11 Conclusion

We started this paper by raising the issue of the development of social inequalities. When studying this question in history we often get surprised of its complexity. In a society characterised by large economic inequality, we would expect that this would result in corresponding mortality differences, i.e. higher social classes having an advantage. We find the appearance of a consistent social pattern in mortality, to the advantage of the higher classes, but surprisingly late in our history. It is only in the recent decades that this pattern dominates. Improved survival characterised however all HISCLASSes. We can however confirm that there are gender differences in the social pattern. While there is no clear social gradient among men, the results at least partly indicate advantages for the higher social classes for women already early in the 20th century. Females had more to gain from a high social position. Previous studies of the mortality transition have made similar observations. Among adults, gender has often been of more significant importance than social class. The reason for this difference and for the late appearance of the modern social pattern among men is still an enigma that require further studies, even though we have suggested the possible importance of behavioural factors and changes in ideals connected to different social classes. This should stimulate us to further disentangle the pathways for how social position influence health and mortality in different societies. Furthermore, we do not find any substantial differences or distinct pattern in the relation between class and the two major cause-of-death groups. Finally, we find stronger differences in the social pattern among the working-age population, while the associations were smaller or not so clear among the elderly. However, when analysing the association with education and income in the period 1990–2005 we find consistent patterns of higher income and higher education level being associated with lower mortality, indicating that these variables are better to catch socio-economic differences at least in the present-day society.

Acknowledgements

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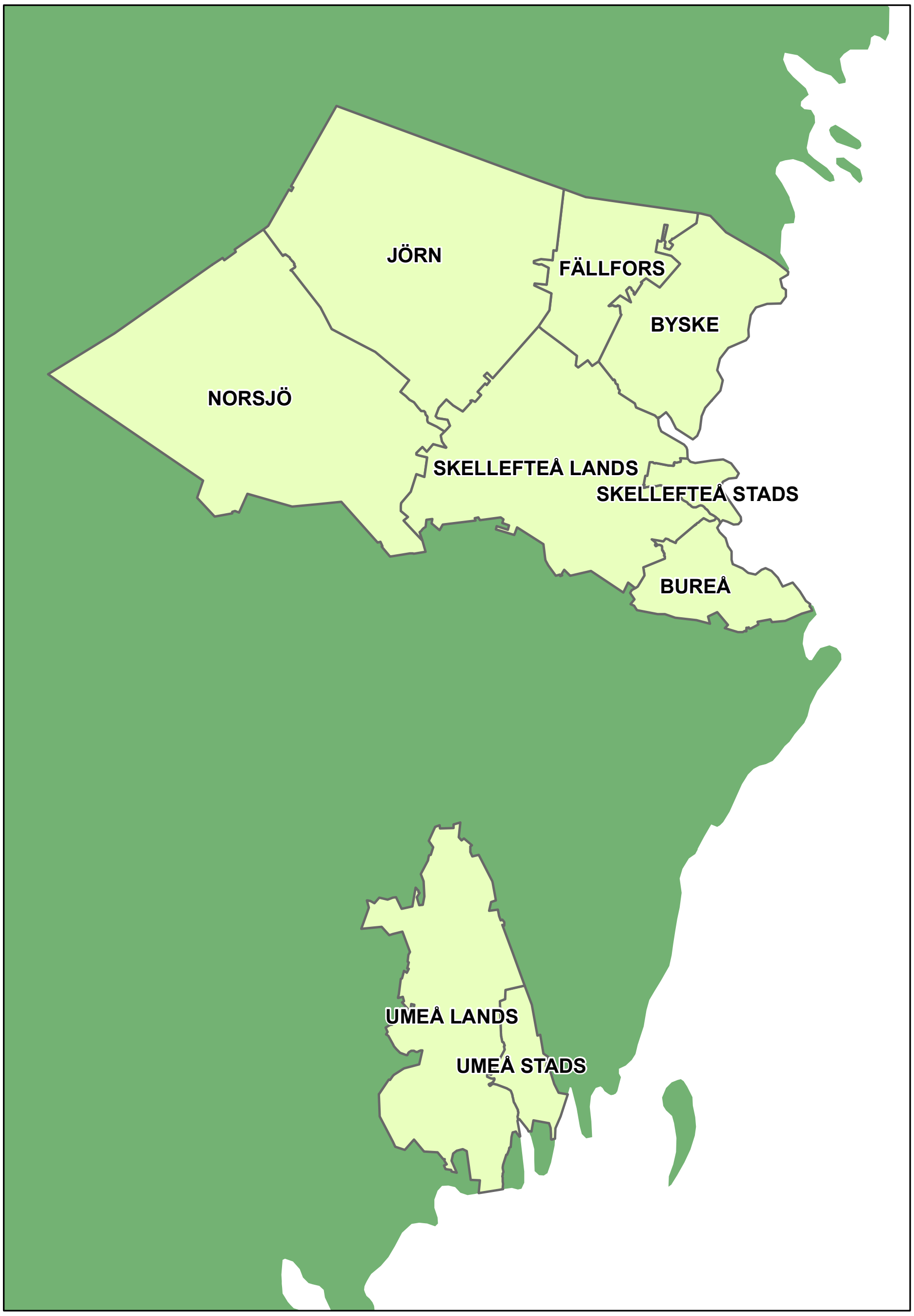


Figure 1: The Skellefteå and Umeå regions.

Figure 2: The Skellefteå and Umeå regions in Sweden.

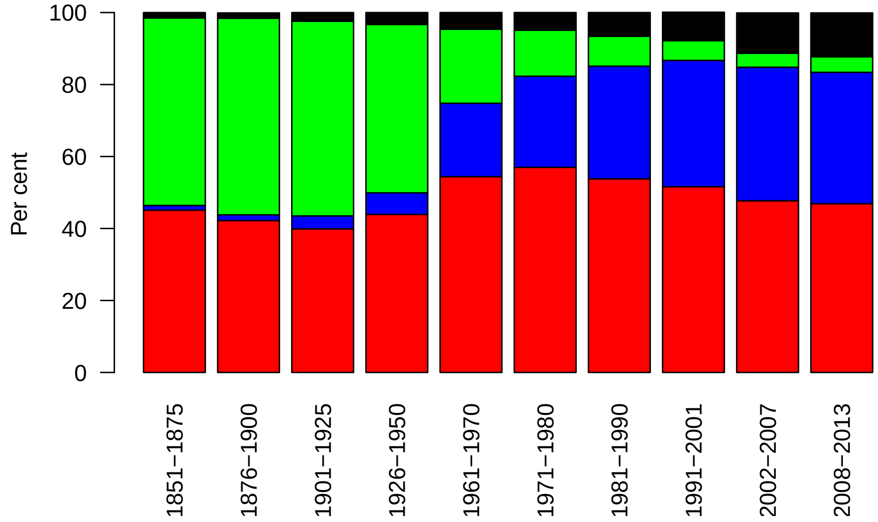


Figure 3: Exposure by hisclass (from the top: elite, farmers and lower business, lower white collar, workers) and time period

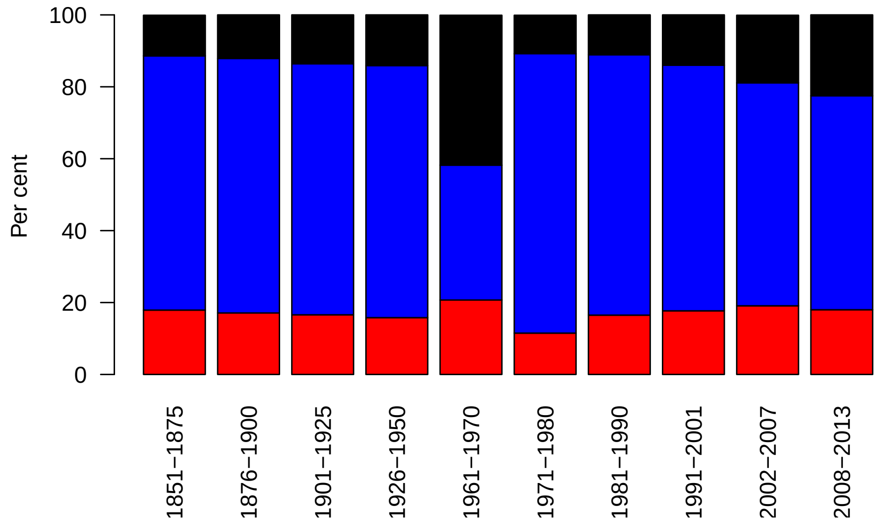


Figure 4: Exposure by civil status (from the top: previously married, married and never married) and time period

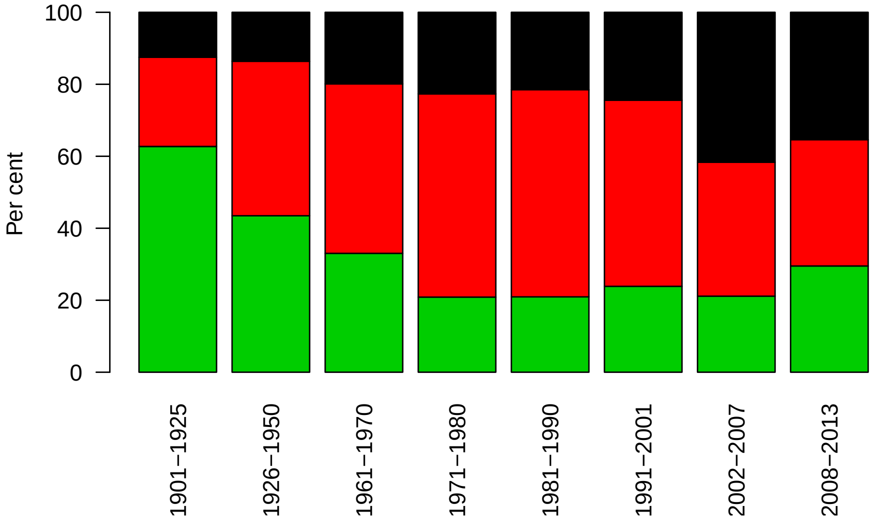


Figure 5: Causes of death by time period (top: cancer, middle: cardiovascular, bottom: other).

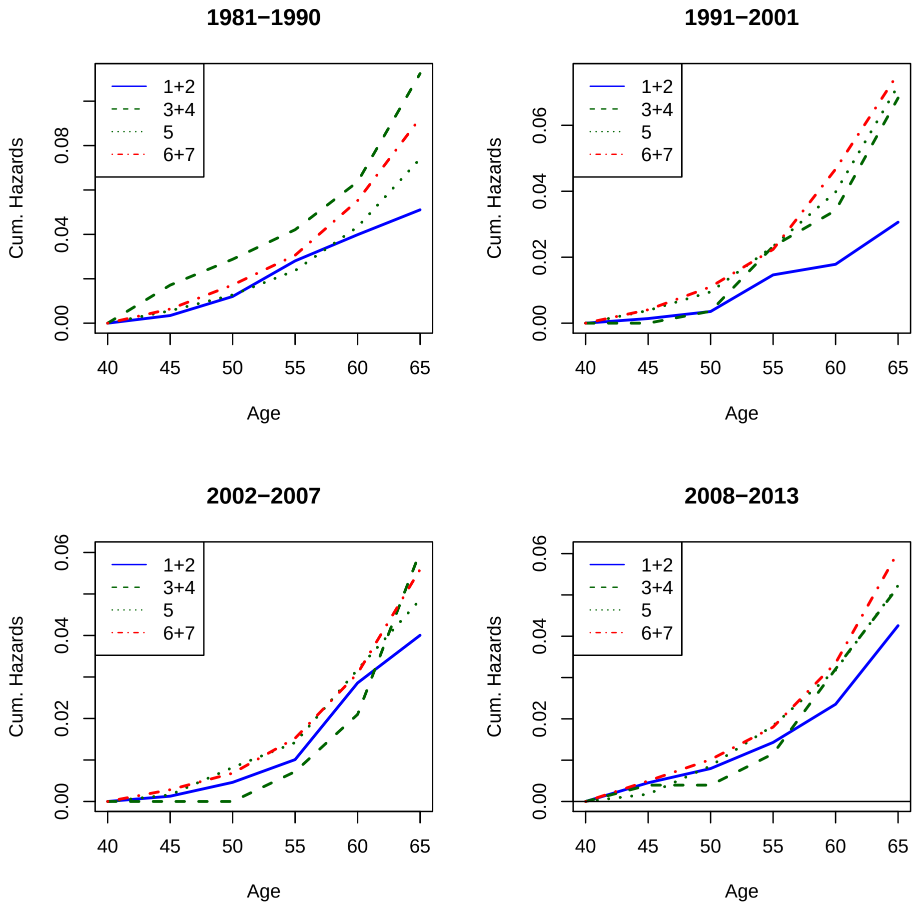


Figure 6: Cumulative hazards for HISCLASS by time period, ages 40–64, women.

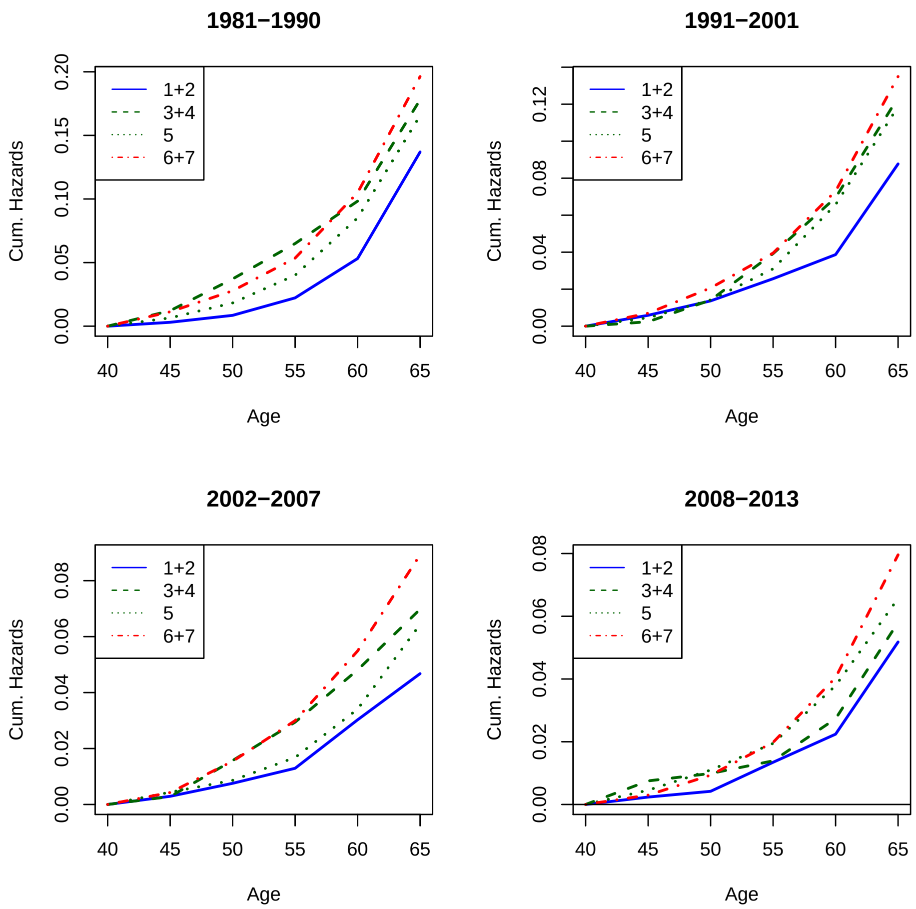


Figure 7: Cumulative hazards for HISCLASS by time period, ages 40–64, men.

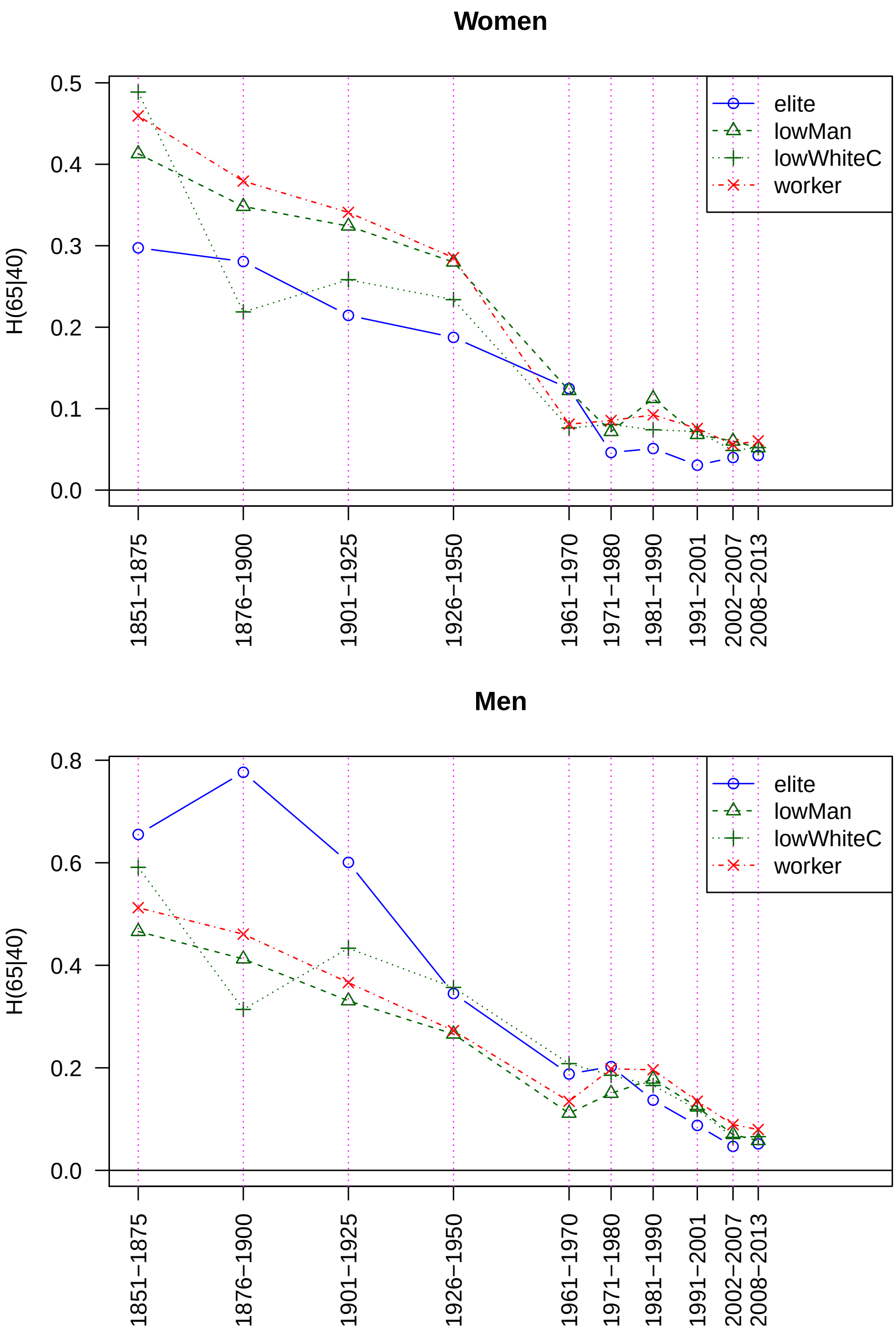


Figure 8: Total hazard of dying before age 65 for a 40 year old person by HISCLASS and decade, women (top) and men (bottom).

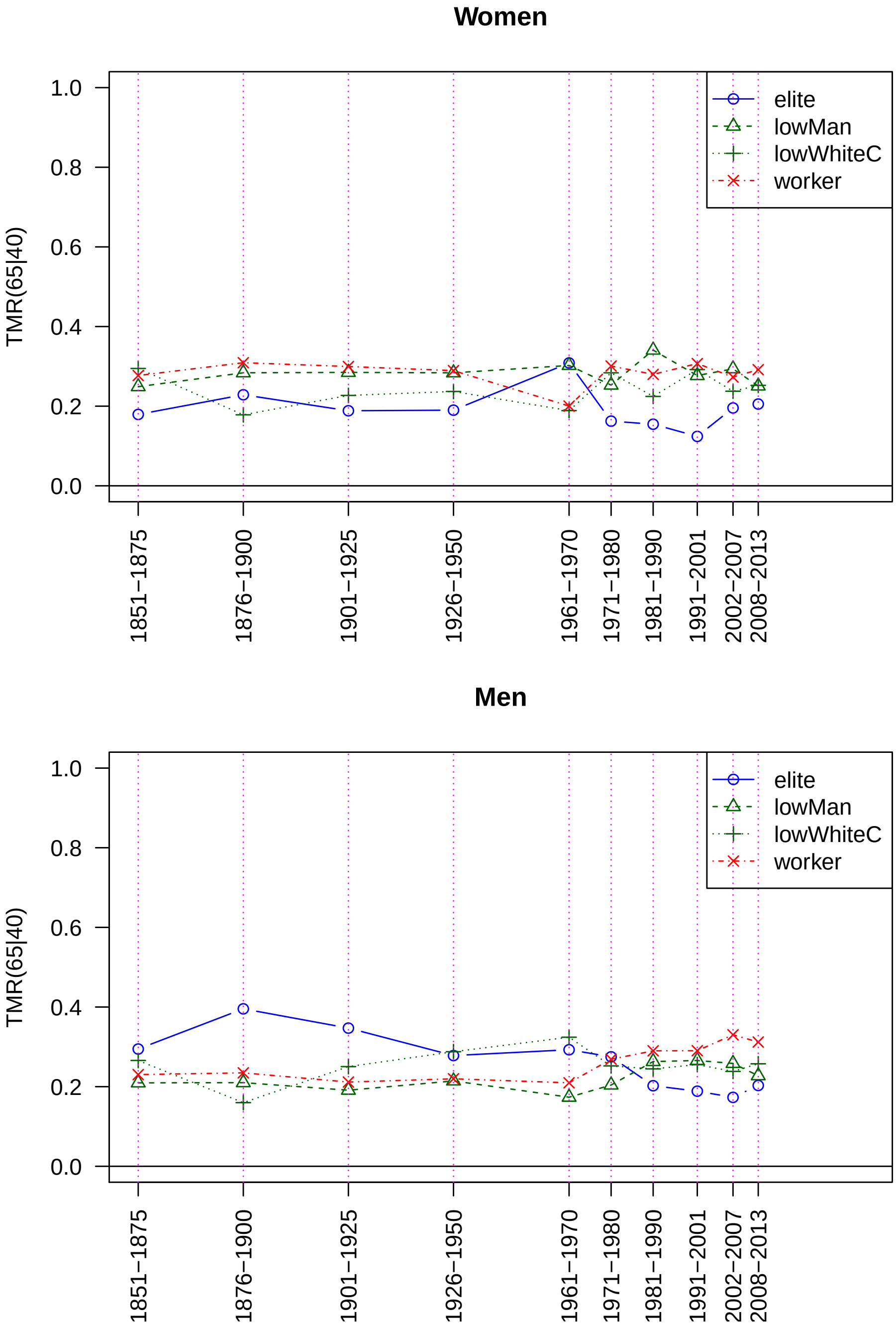


Figure 9: Total hazard of dying before age 65 for a 40 year old person standardized by HISCLASS and decade, women (top) and men (bottom).

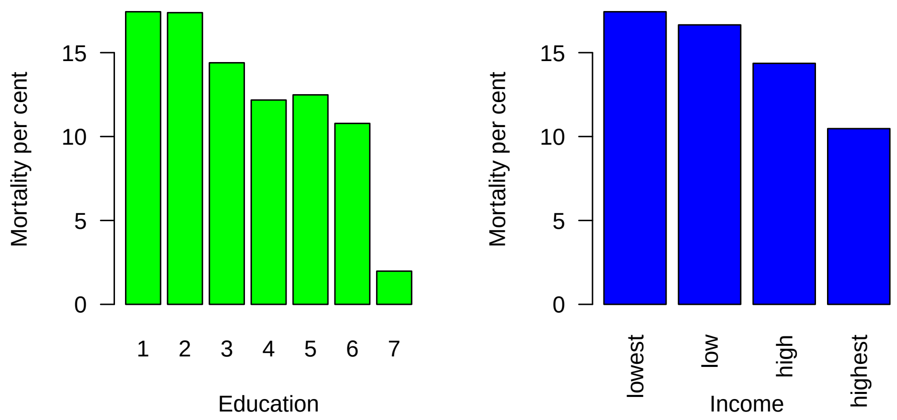
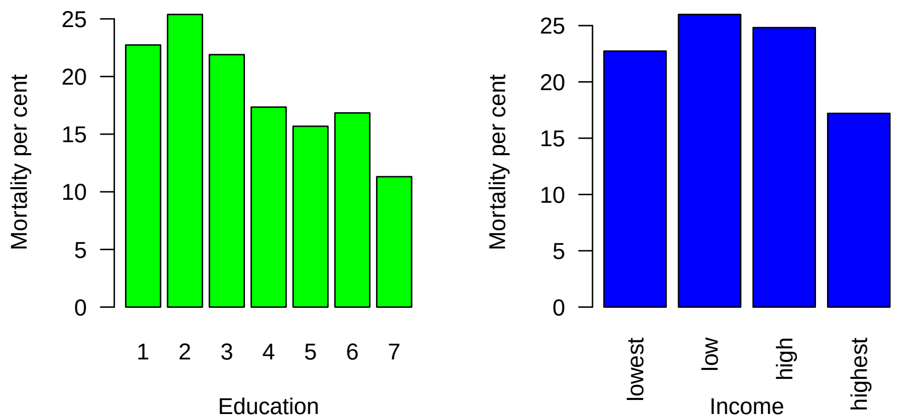


Figure 10: Effect sizes, women 40-64, 1990-2005.



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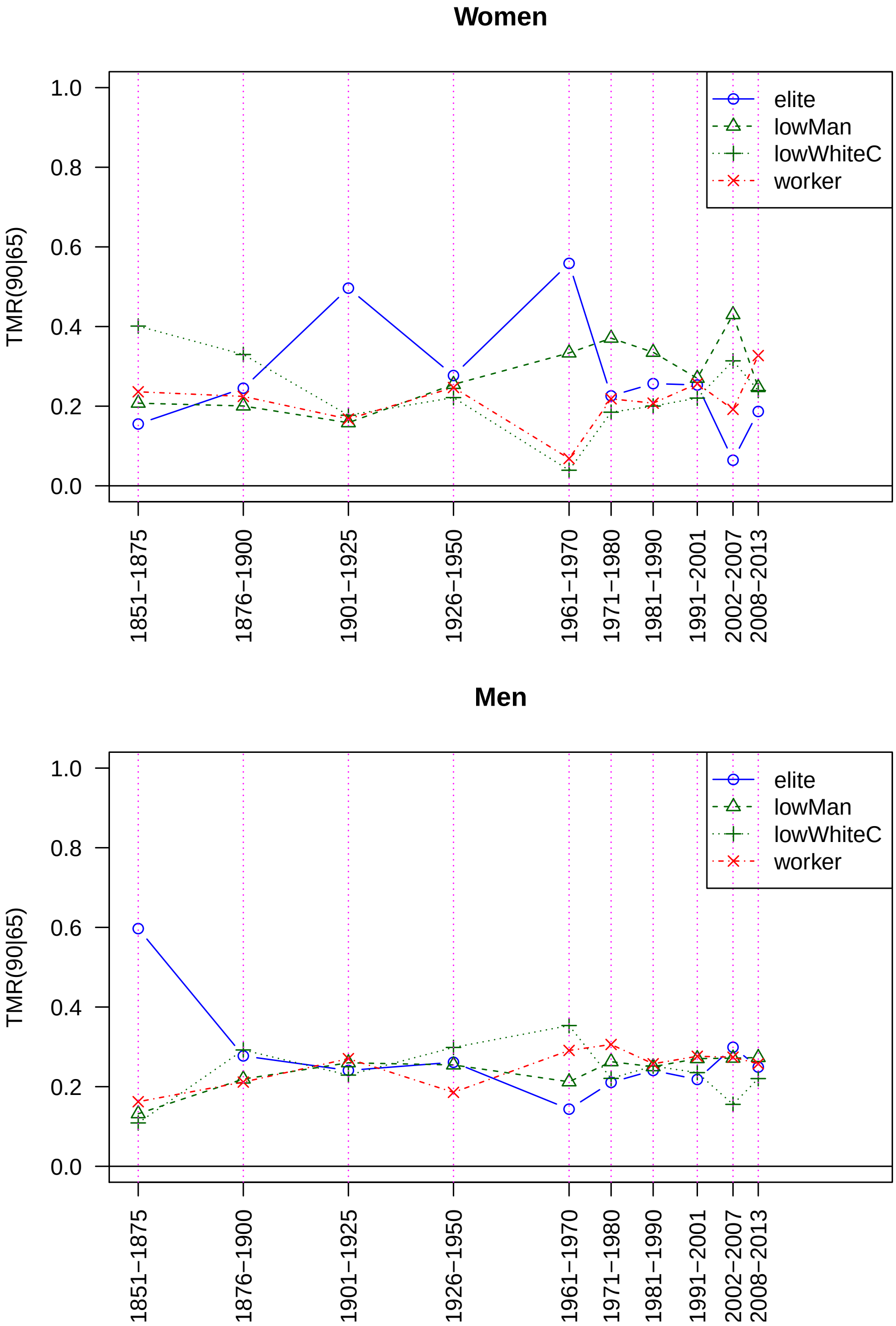

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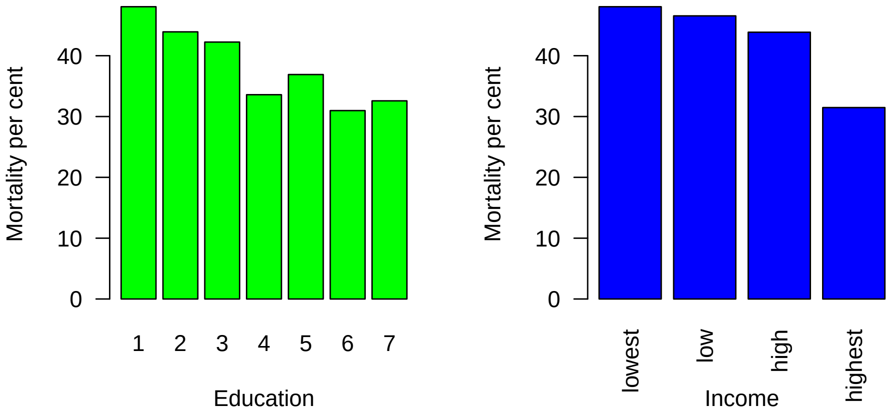

Figure 13: Effect sizes, women 65-89, 1990-2005.

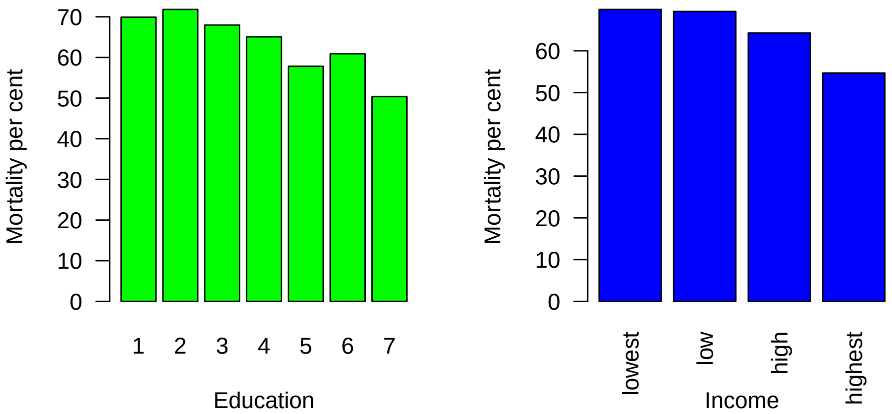

Figure 14: Effect sizes, men 65-89, 1990-2005.

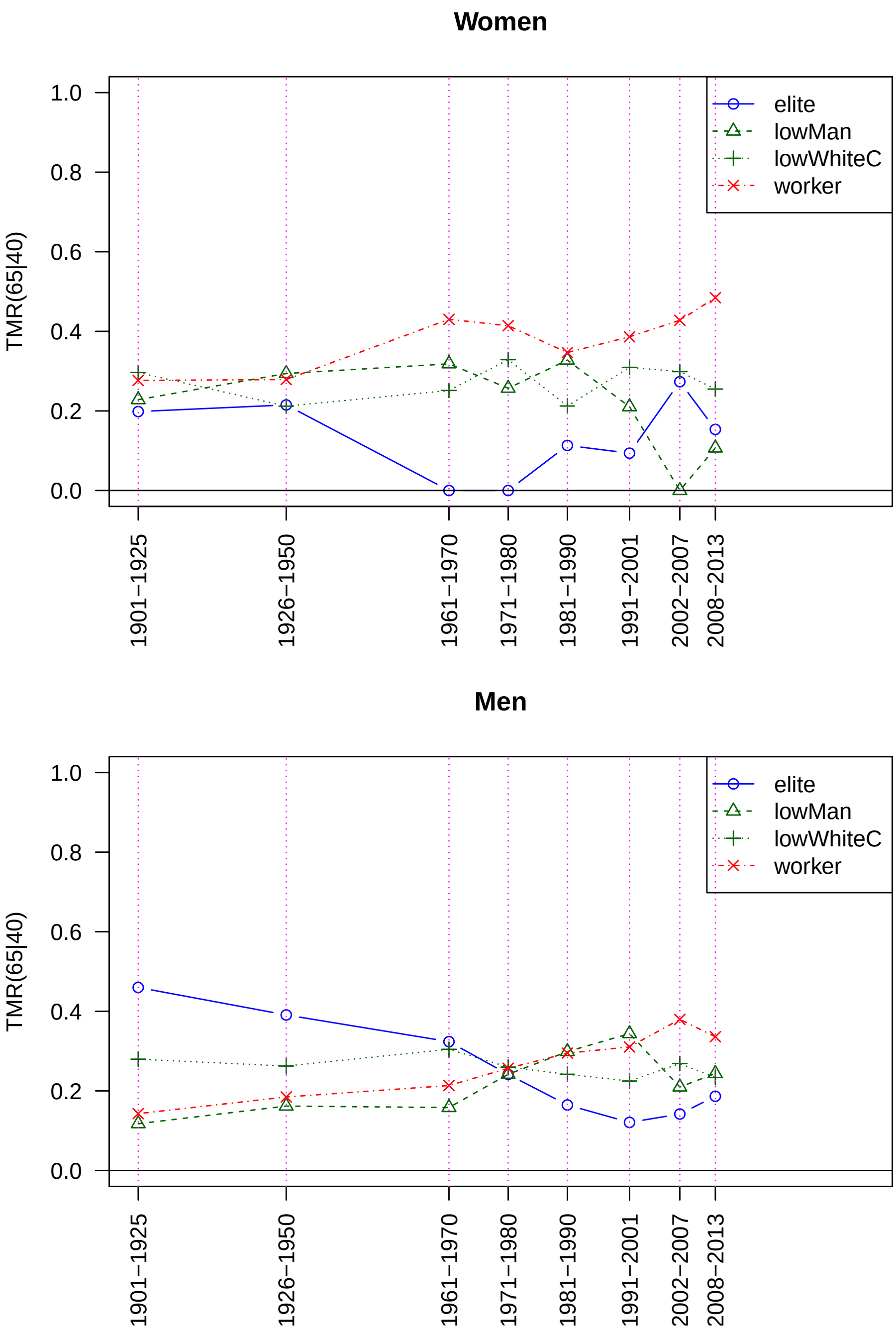

Figure 15: Total hazard of dying before age 65 for a 40 year old person standardized by HISCLASS and decade, women (top) and men (bottom), cardiovascular death.

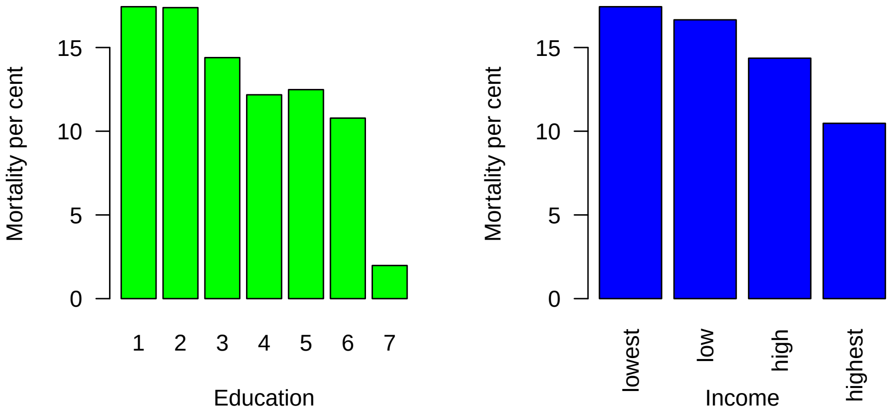

Figure 16: Effect sizes, women 40-64, 1990-2005, cardiovascular death.

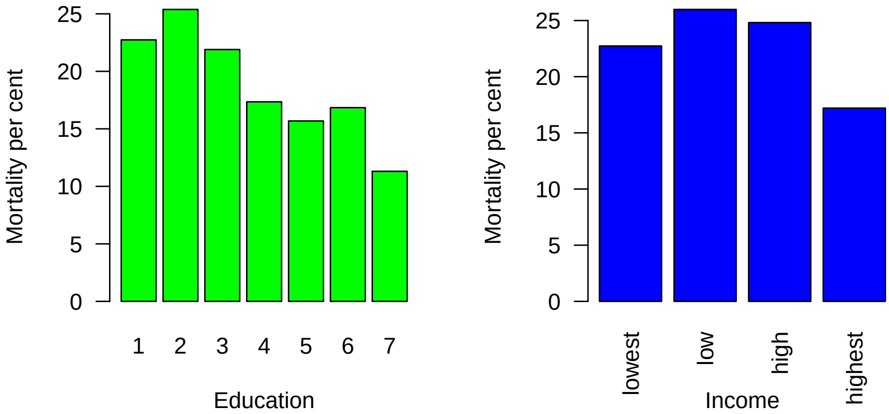

Figure 17: Effect sizes, men 40-64, 1990-2005, cardiovascular death.

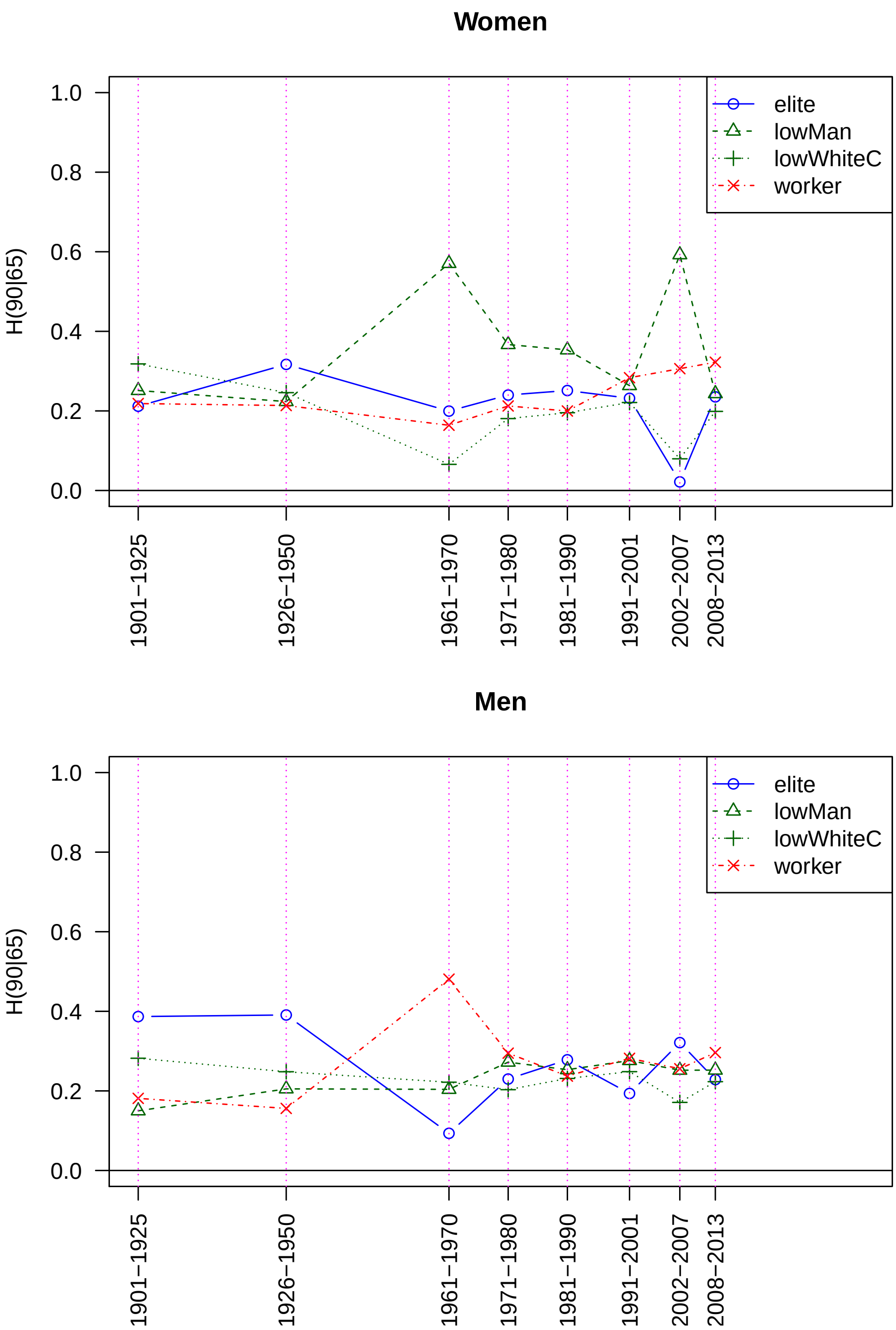

Figure 18: Total hazard of dying before age 90 for a 65 year old person standardized by HISCLASS and decade, women (top) and men (bottom), cardiovascular death.

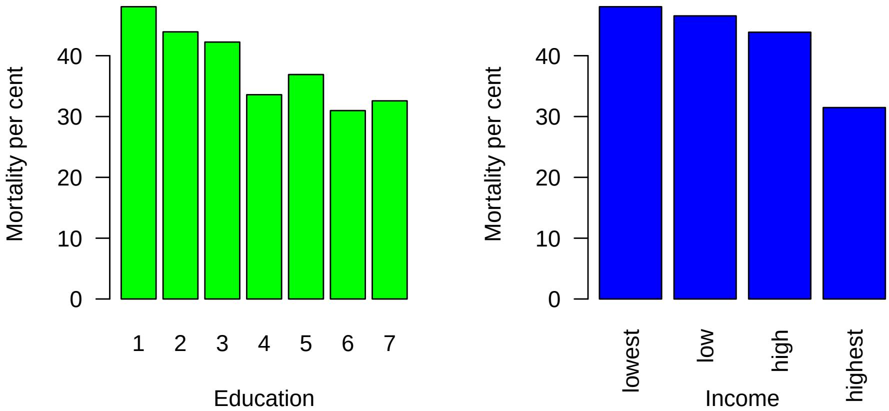

Figure 19: Effect sizes, women 65-89, 1990-2005, cardiovascular death.

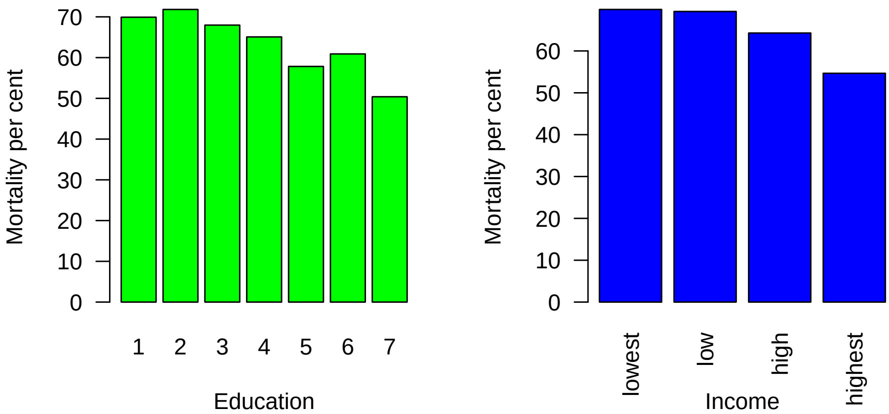

Figure 20: Effect sizes, men 65-89, 1990-2005, cardiovascular death.

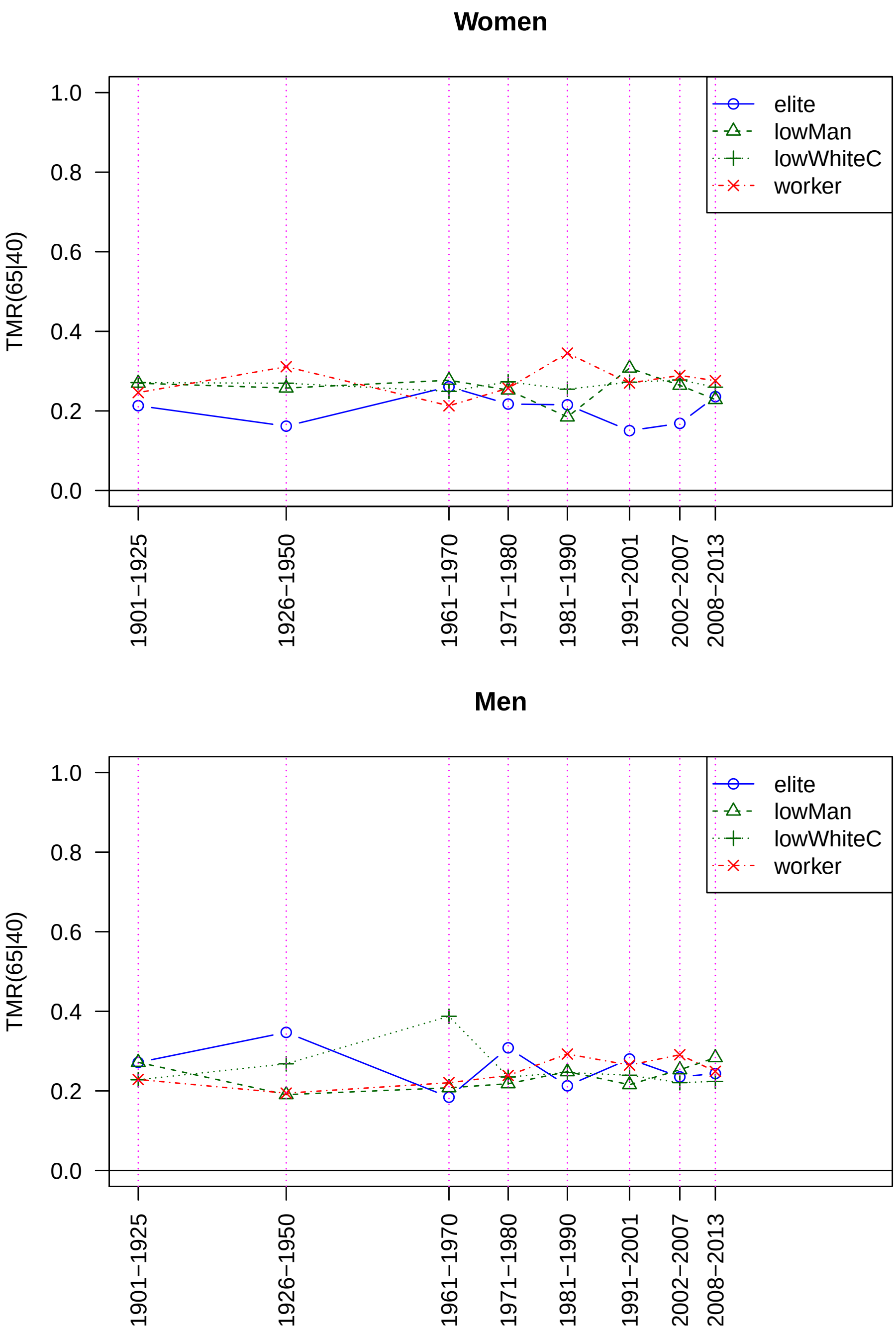

Figure 21: Total hazard of dying before age 65 for a 40 year old person standardized by HISCLASS and decade, women (top) and men (bottom), cancer death.

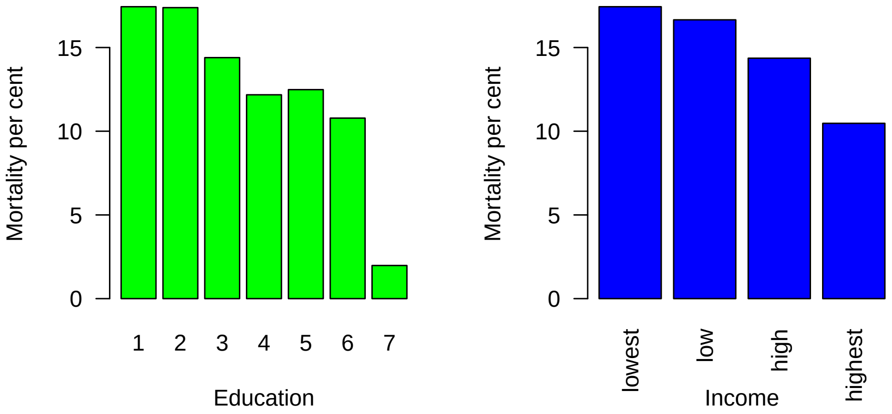

Figure 22: Effect sizes, women 40-64, 1990-2005, cancer death.

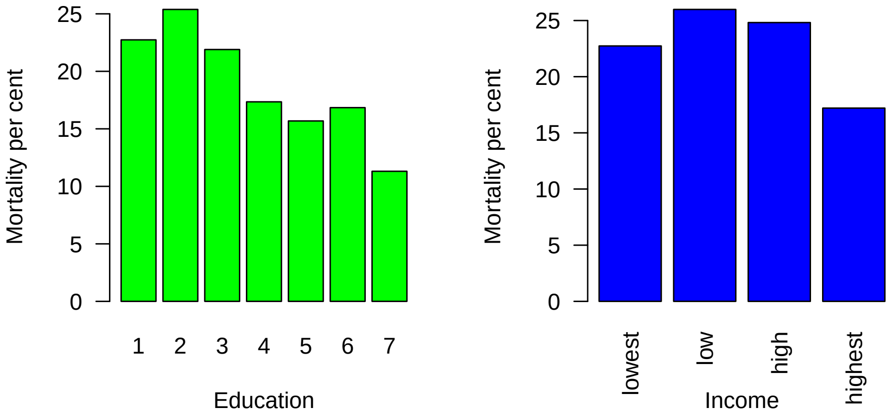

Figure 23: Effect sizes, men 40-64, 1990-2005, cancer death.

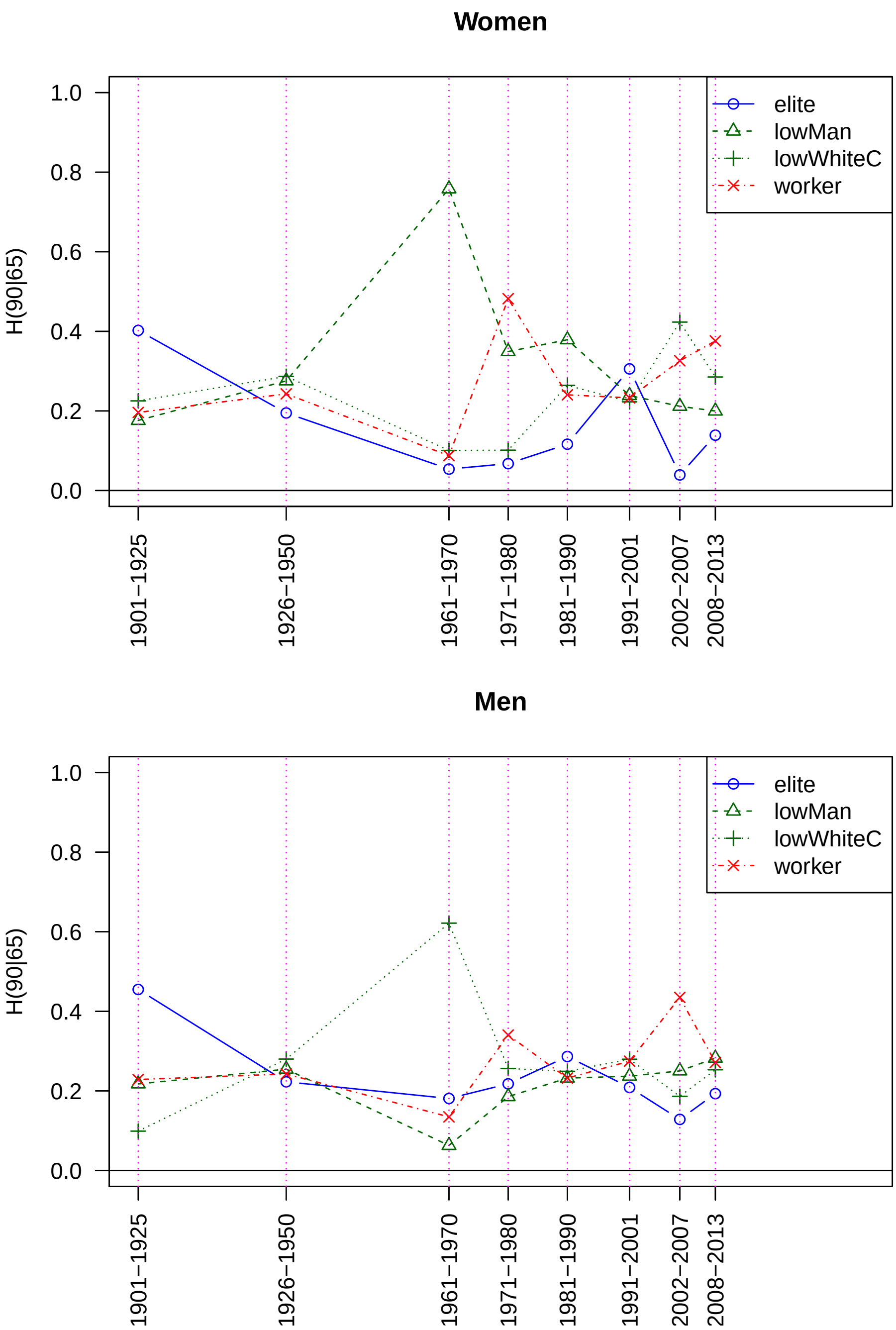

Figure 24: Total hazard of dying before age 90 for a 65 year old person standardized by HISCLASS and decade, women (top) and men (bottom), cancer death.

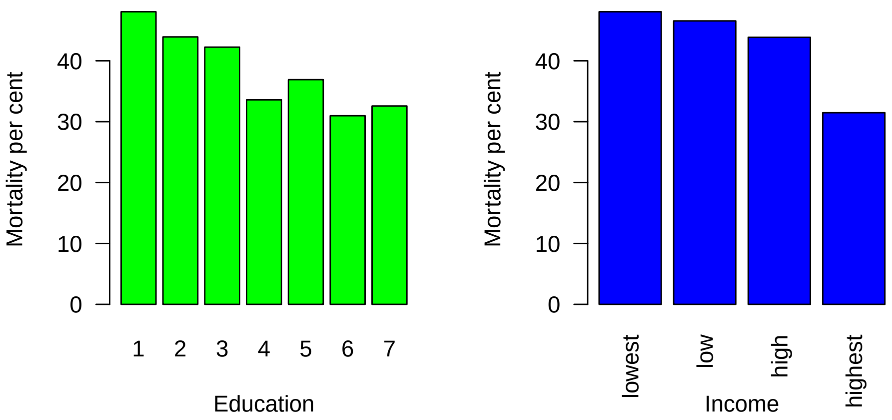

Figure 25: Effect sizes, women 65-89, 1990-2005, cancer death.

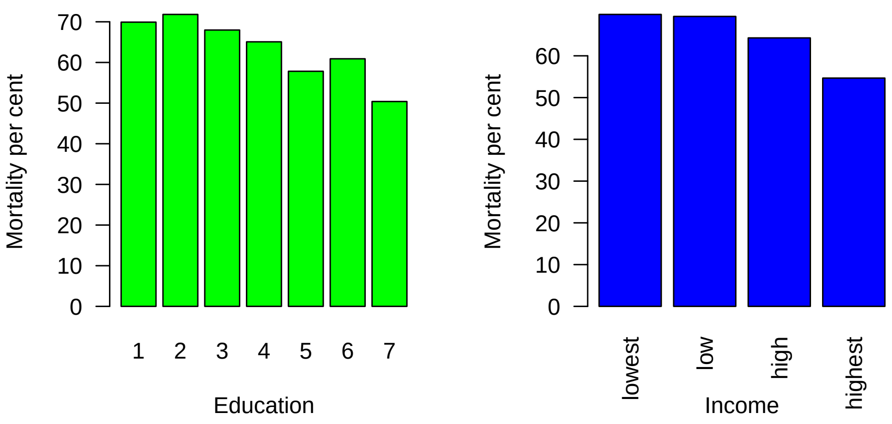

Figure 26: Effect sizes, men 65-89, 1990-2005, cancer death.

List of Tables

	elite	lowMan	lowWhiteC	worker	NA
1851-1875	2	48	1	45	4
1876-1900	2	48	2	40	8
1901-1925	3	51	4	36	6
1926-1950	4	44	6	41	4
1961-1970	2	9	11	28	49
1971-1980	4	8	20	40	29
1981-1990	6	6	28	43	17
1991-2001	7	5	30	43	14
2002-2007	15	7	35	44	0
2008-2013	15	7	34	43	0

Table 1: Hisclass by time period, per cent.

	Df	Deviance	AIC	LRT	Pr(>Chi)
<none>		2641.27	4435.92		
as.factor(age)	4	3040.96	4827.60	399.69	0.0000
urban	1	2641.71	4434.35	0.43	0.5099
period	7	2651.80	4432.45	10.53	0.1604
civst	2	2726.38	4517.03	85.11	0.0000
income	3	2680.12	4468.76	38.85	0.0000
educ	6	2677.43	4460.07	36.15	0.0000

Table 2: Effect of covariates for women 40-64, 1990-2005.

	Df	Deviance	AIC	LRT	Pr(>Chi)
<none>		3512.69	6239.93		
as.factor(age)	4	4307.07	7026.30	794.38	0.0000
urban	1	3516.09	6241.32	3.40	0.0653
period	7	3528.32	6241.55	15.62	0.0288
civst	2	3707.78	6431.01	195.09	0.0000
income	3	3577.95	6299.18	65.26	0.0000
educ	6	3566.58	6281.81	53.88	0.0000

Table 3: Effect of covariates for men 40-64, 1990-2005.

	Df	Deviance	AIC	LRT	Pr(>Chi)
<none>		1644.58	3518.27		
as.factor(age)	2	1778.63	3648.31	134.04	0.0000
urban	1	1645.99	3517.67	1.41	0.2351
period	7	1651.66	3511.35	7.08	0.4205
civst	2	1685.24	3554.93	40.66	0.0000
income	3	1685.13	3552.82	40.55	0.0000
educ	6	1673.08	3534.76	28.49	0.0001

Table 4: Effect of covariates for women 65-89, 1990-2005.

	Df	Deviance	AIC	LRT	Pr(>Chi)
<none>		2026.10	4707.72		
as.factor(age)	2	2207.76	4885.37	181.66	0.0000
urban	1	2029.98	4709.60	3.88	0.0488
period	7	2050.43	4718.04	24.33	0.0010
civst	2	2148.73	4826.35	122.63	0.0000
income	3	2075.63	4751.25	49.53	0.0000
educ	6	2047.56	4717.17	21.46	0.0015

Table 5: Effect of covariates for men 65-89, 1990-2005.

	Df	Deviance	AIC	LRT	Pr(>Chi)
<none>		2641.27	4435.92		
as.factor(age)	4	3040.96	4827.60	399.69	0.0000
urban	1	2641.71	4434.35	0.43	0.5099
period	7	2651.80	4432.45	10.53	0.1604
civst	2	2726.38	4517.03	85.11	0.0000
income	3	2680.12	4468.76	38.85	0.0000
educ	6	2677.43	4460.07	36.15	0.0000

Table 6: Effect of covariates for women 40-64, 1990-2005, cardiovascular death.

	Df	Deviance	AIC	LRT	Pr(>Chi)
<none>		3512.69	6239.93		
as.factor(age)	4	4307.07	7026.30	794.38	0.0000
urban	1	3516.09	6241.32	3.40	0.0653
period	7	3528.32	6241.55	15.62	0.0288
civst	2	3707.78	6431.01	195.09	0.0000
income	3	3577.95	6299.18	65.26	0.0000
educ	6	3566.58	6281.81	53.88	0.0000

Table 7: Effect of covariates for men 40-64, 1990-2005, cardiovascular death.

	Df	Deviance	AIC	LRT	Pr(>Chi)
<none>		1644.58	3518.27		
as.factor(age)	2	1778.63	3648.31	134.04	0.0000
urban	1	1645.99	3517.67	1.41	0.2351
period	7	1651.66	3511.35	7.08	0.4205
civst	2	1685.24	3554.93	40.66	0.0000
income	3	1685.13	3552.82	40.55	0.0000
educ	6	1673.08	3534.76	28.49	0.0001

Table 8: Effect of covariates for women 65-89, 1990-2005, cardiovascular death.

	Df	Deviance	AIC	LRT	Pr(>Chi)
<none>		2026.10	4707.72		
as.factor(age)	2	2207.76	4885.37	181.66	0.0000
urban	1	2029.98	4709.60	3.88	0.0488
period	7	2050.43	4718.04	24.33	0.0010
civst	2	2148.73	4826.35	122.63	0.0000
income	3	2075.63	4751.25	49.53	0.0000
educ	6	2047.56	4717.17	21.46	0.0015

Table 9: Effect of covariates for men 65-89, 1990-2005, cardiovascular death.

	Df	Deviance	AIC	LRT	Pr(>Chi)
<none>		2641.27	4435.92		
as.factor(age)	4	3040.96	4827.60	399.69	0.0000
urban	1	2641.71	4434.35	0.43	0.5099
period	7	2651.80	4432.45	10.53	0.1604
civst	2	2726.38	4517.03	85.11	0.0000
income	3	2680.12	4468.76	38.85	0.0000
educ	6	2677.43	4460.07	36.15	0.0000

Table 10: Effect of covariates for women 40-64, 1990-2005, cancer death.

	Df	Deviance	AIC	LRT	Pr(>Chi)
<none>		3512.69	6239.93		
as.factor(age)	4	4307.07	7026.30	794.38	0.0000
urban	1	3516.09	6241.32	3.40	0.0653
period	7	3528.32	6241.55	15.62	0.0288
civst	2	3707.78	6431.01	195.09	0.0000
income	3	3577.95	6299.18	65.26	0.0000
educ	6	3566.58	6281.81	53.88	0.0000

Table 11: Effect of covariates for men 40-64, 1990-2005, cancer death.

	Df	Deviance	AIC	LRT	Pr(>Chi)
<none>		1644.58	3518.27		
as.factor(age)	2	1778.63	3648.31	134.04	0.0000
urban	1	1645.99	3517.67	1.41	0.2351
period	7	1651.66	3511.35	7.08	0.4205
civst	2	1685.24	3554.93	40.66	0.0000
income	3	1685.13	3552.82	40.55	0.0000
educ	6	1673.08	3534.76	28.49	0.0001

Table 12: Effect of covariates for women 65-89, 1990-2005, cancer death.

	Df	Deviance	AIC	LRT	Pr(>Chi)
<none>		2026.10	4707.72		
as.factor(age)	2	2207.76	4885.37	181.66	0.0000
urban	1	2029.98	4709.60	3.88	0.0488
period	7	2050.43	4718.04	24.33	0.0010
civst	2	2148.73	4826.35	122.63	0.0000
income	3	2075.63	4751.25	49.53	0.0000
educ	6	2047.56	4717.17	21.46	0.0015

Table 13: Effect of covariates for men 65-89, 1990-2005, cancer death.