Socioeconomic inequalities in premature mortality in France: have they widened in recent decades?

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Abstract

An increase in social inequalities in premature mortality has been observed in the last decades in various European countries. In France large inequalities have been reported for several years, but the changes over time have been only partially examined.

The study was based on the analysis of a large longitudinal data set. Four periods of seven years following a census were compared. Deaths in the period (21003 deaths for men, 9418 for women) were recorded and studied according to the socioeconomic status (SES) at the census. Relative index of Inequality (RII) were calculated in order to quantify the magnitude of inequalities among those employed, and also in the entire population, with specific categories for those inactive. The Results showed that the magnitude of inequalities remained rather stable over time for men and women working at the time of the census. However, for the entire population, a strong increase in the magnitude of social inequalities was observed. For men the RIIs increased from 3.53 in the first period to 6.54 in the most recent period. For women the corresponding figures were 1.94 and 3.88. The increase was observed also for specific causes of deaths: cancer and cardiovascular diseases for both sexes, and external causes for men. In spite of a global decrease of the mortality over the period, the absolute differences between the top and the bottom of the socioeconomic scale did not change.

The results highlight the importance of temporal changes in mortality associated with an increase of unemployment, changes in the labour market, and consequences in selective exclusion from work. The classification of those not working is an important point to consider in the study of social inequalities.

Keywords : mortality, inequality, social, employment.

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Several reports document an increase in social inequalities in premature mortality in recent years in various European countries (Mackenbach & al.,2003; Donkin, Goldblatt & Lynch, 2002; Marang-Van de Mheen, Davey Smith, Hart & Gunnings-Schepers, 1998; Davey Smith, Dorling, Mitchell & Shaw, 2002). In France, large inequalities have been reported for several decades (Mackenbach et al.,1997; Kunst, 1997; Lang, Fassin, Grandjean, Kaminski & Leclerc, 2002; Leclerc, Lert & Fabien, 1990). Standardized mortality ratios (SMRs) for men according to socioeconomic status (SES) have been published for several periods (Mesrine, 1999), and other analyses have focused on those looking for work (Mesrine, 2000). The changes over time have been described for various socioeconomic groups (Monteil & Robert-Bobée, 2005), and for the elderly (Cambois, 2004). However, these analyses describe only partly changes over time, especially because the size of socioeconomic groups, that is, the distribution of SES, in France has changed substantially since 1968. Unemployment had also increased.

Several studies stress the role of occupational status for mortality; in addition to social position based on present or past occupation, being employed or not may have effects on mortality (Mesrine, 2000). Relations between employment and health can be viewed also in the other direction: in the last decades the role of health selection process towards inactivity may have increased in several countries (Virtanen & coll, 2003; Lissau & coll, 2001; Cardano, Costa & Demaria, 2004; Sermet & Khlat, 2004; Bartley & Ferrie, 2001).

The objective of this study was to describe mortality over time in France, with a specific interest for those inactive, using methods that take into account mortality in this group, and also the size of the socioeconomic groups (Regidor, 2004). We compared the magnitude of socioeconomic inequalities, separately for men and women aged 30-64 years, for four different periods, from 1968 to the end of 1996.

Methods

Permanent Demographic Sample

These data come from a longitudinal national dataset kept by INSEE (the French census and statistics bureau). It is known as the EDP (Echantillon Démographique Permanent, or permanent demographic sample) and it currently contains approximately 1 million persons (roughly 1% of the population) randomly selected according to their date of birth (4 days during the year). Inclusion occurs by birth, by marriage (for foreigners with the appropriate birthday if they marry a French national and live in France with them), or at a census, especially for immigrants (Rouault, 1994; Heran, 1998). Once included, a person remains part of the sample until death. INSEE follows EDP subjects over time, collecting for each of them social, demographic, and occupational information from different census schedules and from vital and civil status forms. This information allows an assessment of their SES at the time of censuses. This dataset is similar to the Longitudinal Study in the United Kingdom, and to other longitudinal studies in Europe; a list of the main publications relating to the EDP can be found on the website of the Longitudinal Study (http://www.cls.ioe.ac.uk/Ls/lshomepage.htlm).

Cause-specific mortality

Information about causes of deaths came from the INSERM department in charge of coding the causes of deaths. Causes of deaths could be retrieved for 98% of deaths. Causes were classified according to the WHO guidelines, ICD-8 or ICD-9 depending on the period. Four large groups of causes of death were taken into account in the study: cancer, cardiovascular, external causes, and other causes. However, due to small number of deaths in some categories for women, death by external causes was studied only for men.

Socioeconomic status

SES at the time of the census was recorded according to the French occupation and socio-professional categories (PCS, "profession et catégorie socio-professionnelle"), the standard classification for assessment of SES in France (Chenu, 2000). Seven categories were used: professionals and managers, farmers, the self-employed (except farmers), intermediate white-collar workers, office and sales personnel, skilled manual workers, unskilled workers.

Those not working at the time of the census were classified in one of the three following categories: retired or early retired, job-seekers, and other inactive (including housewives). In France, those unable to work due to health reasons are in the category "other inactive". They are not classified as "retired" since health retirement is not an administrative category.

Measure of inequality, relative Index of Inequality

The initial analyses for each period were based on Standardised Mortality Ratios (SMRs) and Cox models with age as the time variable in order to control for age, and SES as a qualitative variable.

Relative index of inequality (RIIs) were calculated in order to obtain quantitative global estimates of the magnitude of inequalities in mortality.

This index is a regression based summary measure widely used in research into social inequalities (Marang-van de Mheen & al., 1999; Davey-Smith & al., 2002; Mackenback & kunst, 1997; Singh-Manoux, 2005; Khang, 2004). It is calculated by ranking socioeconomic categories on a scale from the highest (0) to the lowest (1). Each category covers a range on the scale proportional to its population size and is given a value on the scale corresponding to the midpoint of its range (an example is given in figure 1). These data are fitted by a regression model (here, a Cox model) that yields mortality estimates for the entire social distribution. The estimates for the two extremes are used to calculate the RII, which is interpreted as the ratio of the mortality of the most disadvantaged to the most advantaged.

With figure 1 as an example, the RII gives an estimate of the ratio between mortality at the abscissa “1” and mortality at the abscissa “0”. The value given by the model may be slightly different from the ratio between the two extreme categories, because it takes into account the size of the groups and the whole distribution of deaths.

Calculating RIIs allowed to take into account the number of subjects in each category, and the changes in the distribution of SES between periods. The magnitude of inequalities could be compared between periods, and the hypothesis of stability over time could be tested.

Socioeconomic categories were ranked according to mortality rates in the models, although that meant different rankings for different periods.

Comparisons over time

The main part of the analysis was the comparison of four sub-cohorts. The baseline for each was a different census, 1968, 1975, 1982 and 1990, with a follow-up of seven years. Each sub-cohort comprised men and women in the EDP aged 30-64 years at the relevant census.

Deaths in the follow-up period were recorded and studied according to SES at the census. Foreigners and those not born in France were excluded because of the incompleteness of the information on their vital status, especially for foreigners who died abroad. A total of 30421 deaths were included in the study, 21003 for men and 9418 for women. Table 1 reports the number of subjects and deaths in the cohorts. Table 2 describes changes over the period in the percentage of active and inactive, with details for those not in the labour force.

The initial analyses suggested that the relation between relative socioeconomic position and mortality was not linear but closer to exponential, especially if job-seekers and those not in the labour force were included. For that reason, the next analyses used Cox rather than linear models, with SES as a quantitative variable.

Mortality in each 7-year period was calculated for each sub-cohort and each sex according to the SES defined at the census. The RII was calculated for each period. Three sets of analyses were performed for total mortality:

Comparison 1 – Analyses restricted to those employed at the census, SES in seven categories.

Comparison 2 – Analyses of the entire sample, based on work status at the census, in nine categories: seven SES categories for those working, plus two additional categories: retired; job-seeking or out of the labour force (combined for men because in the first periods very few men were in these two categories).

Comparison 3 – Analysis of the entire sample, based on all available information: previous SES for those retired and seeking work, present SES for those currently working. Eight categories were compared: seven SES, plus "other unoccupied" for those who could not be classified into a SES category.

For cause-specific mortality, comparisons were based on the situation at the census, described above as "comparison 2".

To test the hypothesis that socioeconomic inequalities had increased, and to take into account the decrease in mortality over time, we analyzed total mortality for the entire 1968-1996 period with two Cox models, one for each sex. The mortality risk of a subject was estimated by the model, taking into account age, period (four period variables), and work status at the census as a quantitative variable (relative situation, from 0 to 1, as in the previous models for "comparison 2"). The model gave an estimate of the mortality for an "average" subject in each period, and an estimate of the effect of the socioeconomic situation. The inequality estimate was a single RII, corresponding to the hypothesis that the RII did not change between periods.

In order to test the alternative hypothesis that the RII had increased, this model was compared to a model with an interaction term, which gave different RIIs for different periods.

In addition, slightly different models were used to estimate the change in the magnitude of the RII corresponding to an increase of one calendar year.

These models enabled us to estimate not only ratios or RIIs, which are relative measures, but also differences. The magnitude of mortality differences between the periods was calculated (Mackenback & Kunst, 1997; Bostrom & Rosen, 2003). Details on the method are given in the appendix.

Results

Mortality according to SES

For men the SES rankings according to mortality were stable over time. Of those working at the census, the scale ranged from professionals and managers to unskilled workers. The main change was among those classified as retired, job-seeking, or otherwise not in the labour force, as illustrated in figure 1 for the two extreme periods. Around 1970 these categories accounted for approximately 11% of all men (table 2); their mortality rate was high: with the professionals and managers as the reference, their standardised mortality ratios were between 300 and 400. In 1990 22% of the male population belonged to these categories, and the mortality in these subgroups had increased in comparison with professionals and managers.

The mortality for unskilled workers compared to professionals and managers did not change much between periods. However, the size of the groups changed over time: in 1968 the male population was composed of 7% professionals and managers and 17% unskilled workers; in 1990 these percentages were 13% and 7%, respectively.

For women (figure 2) SES rankings were less stable; these rankings were based, however, on relatively small numbers in some groups. For example, in the first period there were only 22 deaths among 1339 skilled workers. Among job-seekers, the numbers of deaths were smaller yet, leading to imprecise results for this category. However, globally, mortality was high for

those not employed at the time of the census (job-seeking, retired, or other inactive), when age was controlled for. The mortality ratios in these categories, with professional and managers as the reference, were smaller than for men. Over this thirty-year period, the percentage of women out of the labour force decreased dramatically (table 2 and figure 2). The mortality in this group was higher than that of the comparable general population for all four periods, but the gap between them and the professionals and managers increased with time, since the SMR rose from 180 to 230.

Magnitude of inequalities in the four periods, total mortality

As Table 3 shows, the magnitude of inequalities, as quantified by the RII, remained rather stable over time among men employed at the time of the census. However, results based on the situation at the census (employment status) for the entire male population indicated an increase of inequalities from 1968 through 1996. Using the third comparison option (entire sample, last or present SES), the RII was 2.79 for the first period and 2.79, 2.47 and 3.85 thereafter.

The magnitude of inequalities among women was smaller. As for men, comparisons restricted to the employed were stable over the three decades, but inequality increased when the entire population was considered and classified according to the situation at the census. The third option for comparisons yielded an RII of 1.66 for the first period and 1.58, 3.67 and 2.99 for those that followed.

Inequalities by cause-specific mortality

The RIIs according to the situation at the census ("comparison 2") were also calculated for specific causes of deaths: cancer and cardiovascular diseases for both sexes, external causes (only for men), and for other causes. Results are shown in table 4. In both sexes, the largest contribution to total mortality was due to cancer. Comparisons of the RIIs between periods

indicated that inequalities had increased over time for the main causes of death. Inequalities were very large for "other causes of deaths", with an increase over time except between the third and the fourth period for women.

Global changes from 1968 through 1996

Table 5 presents the changes over the entire period, according to the Cox models, for the entire population, classified by their situation at the census ("comparison 2"). Estimates given for the four periods are for a person with the average SES; they indicate that age-standardized mortality decreased during this period, especially for women. In this model the RII is shown for the first period; for the other periods, this figure must be multiplied by the corresponding interaction term. All the interaction terms (except 1975 for women) were significant, which means that socioeconomic inequalities (as defined and measured in the model) increased significantly. A time gradient was observed for men; for women, however, the increase took place primarily between the second and the third period. A slightly different model estimated that the RII was multiplied by 1.017 each year (95% CI 1.010 to 1.023) for men, and by 1.018 (95% CI 1.008 to 1.027) for women.

Figure 3 illustrates the changes in the period according to the models in Table 5. The reference (100) corresponds to an average SES in the 1968-1974 period; the mortality rate for an average SES decreased over time, as it did for those at the top of the socioeconomic scale. At the bottom, however, mortality for men in the last period was not much better than during the first and remained much worse than that of those at the top of the social scale twenty years earlier.

The magnitude of inequalities in terms of differences were calculated with these models (see details on the method in the appendix). For men in the first period the estimate for mortality at the top of the social scale was 50.4, with as reference (100) mortality for the average SES; it was 198.4 at the bottom of the social scale. Hence the estimate of the absolute difference

between the top and the bottom of the social scale was 148. The absolute difference for the most recent period was 147.5. For women, the absolute differences were 80.4 for the first period and 77.5 for the most recent period. These comparisons indicate that although mortality decreased over the period, the level of absolute inequalities remained quite stable.

Discussion

This study was able to compare several periods rather precisely, although the paucity of women's deaths in some categories is a limitation. An advantage of census data is the quality of the data and especially the quality of the coding for SES. The exhaustiveness of deaths in this sample was checked by comparing the mortality rates to the published mortality data and could be considered good. The main reason for comparing to the published mortality rates was that we had excluded foreigners and those not born in France. The impact of this decision is probably limited, which is consistent with previous results on mortality of immigrants in France (Brahimi, 1980).

The method, mainly based on RII comparisons, overcomes the difficulties due to changes in the distribution of SES categories over time. It could also provide global measures with different options for classifying those not working at the census. The method is similar to that used in a relatively recent paper (Marang-van de Mheen, 1998) and also to that used by Pamuk as early as 1985 to analyze trends in England and Wales from 1921 through 1972 (Pamuk, 1985; Wagstaff, Paci & Van Doorslaer, 1991). One difference is that Pamuk used a linear model, whereas multiplicative models are more widely used now.

The results given by the models are consistent with findings from graphical descriptive approaches. The SES rankings were based on the mortality data rather than on an independent opinion about ranking, which might be debatable (Wagstaff & al., 1991). We considered that the rankings could change over time. In any case, the consequences of this choice were

minimal: for men, the rankings were identical for all four periods; for women the RIIs would have been slightly smaller had the groups been ranked a priori. For most of the results, the SES ranking included several categories of inactive, classified as unemployed or retired irrespective of their previous occupation. This methodological choice has limitations, especially for interpreting the results in terms of social inequalities. However, we consider that it is well adapted to describe temporal changes which can be related to employment policies. With the models describing global changes from 1968 through 1996 it was possible to test the hypothesis that inequalities had increased in the period, and to quantify the magnitude of the increase.

Socioeconomic inequalities remain large in France, especially for men. In addition to inequalities within the working population, inequalities associated with employment status have increased. Inactivity, in France as in other countries, remains one of the major correlates of poor health (Virtanen, Luikkonen, Vahtera, Kivimäki & Koskencuo, 2003; Sermet & Khlat, 2004). The observed differences are both health and social inequalities, since the income level of most of those inactive in this age group is rather low. In a context of increasing unemployment, two mechanisms may explain the changes observed here: increased health selection and effects of long-term unemployment such as a low income for a long period (Mesrine, 2000; Sermet and Khlat, 2004). More precise analyses and specific models would be needed in order to quantify the mortality risk associated with different pathways towards unemployment and inactivity (Cambois, 2004; Ribet et al, 2003).

One might wonder whether the increase, or a part of it, is a consequence of changes in the classifications or changes in the legislation that lead to clearer identification of the disadvantaged or those with severe health problems. However, the only major legislative change over this period was that the legal age at retirement became 60 years in 1982. While it is plausible that those with health problems who could retire took the opportunity to do so,

this health selection effect is not specific to the years around 1982. Age at retirement in France varies according to occupation and depends on individual factors including number of years worked. Most people have some latitude (within a margin of several years) about their age at retirement, and health reasons can play a role in their decision.

It is highly plausible that health selection in employment has increased over the period, playing a role in exclusion from the labour market and early retirement, but we found no data here to support that hypothesis. Nonetheless, inequalities among those working (who are supposed to be more healthy overall) did not decrease in the period. Similar questions about Denmark in the period 1987-1994 led to the hypothesis that health-related exclusion from the labour market had increased, thereby reducing social class differences among the employed in Denmark (Lissau I, Rasmussen NK, Moss Hesse N & Hesse, 2001). Occupational mobility out of the labour market seems to increase class inequalities, however results on this topic are scarce (Cardano, Costa & Demaria, 2004).

The results highlight the importance of the methodological aspects of comparisons between periods, especially, the classification of those not working and the ways to quantify inequalities. In this study the magnitude of inequalities was clearly sensitive to how those not in the labour force were classified (as specific categories, or according to their previous category, or excluded from the comparisons). The models used here are well adapted to describe changes over time and provide a useful addition to purely descriptive approaches.

Inequalities were more pronounced for men, consistent with findings from other studies. Quantifying social inequalities among women appears to be complex (Mustard & Etches, 2003; Sacker A, Firth D, Fitzpatrick R, Lynch K & Bartley, 2000). The magnitude of the differences between the sexes may be sensitive to the choice of the inequality measure. Our first objective here was not to compare men and women, but periods.

An increase of inequalities was observed both for cancer and cardiovascular diseases, and also for external causes for men, which suggests that there is not one single explanation to the changes over this period in terms of proximal risk factors. The magnitude of inequalities by causes of death depends on the country; changes over time for a given country reflect changes in the social distribution of risk factors (Mackenbach, 2003; Khang, Lynch & Kaplan, 2004; Leclerc, 1989). For France the contribution of cancer to social inequalities was large in the period 1970-1980 (Leclerc, 1989); it remains large, especially for men (Menvielle, Luce, Geoffroy-Perez, Chastang & Leclerc, 2005). In other European countries widening inequalities in the period 1983-1993 were also observed for lung cancer (Mackenbach & al, 2003). The increase of inequalities for cardiovascular mortality in France has been described and discussed (Lang & Ducimetiere, 1995). The authors indicated that disparities between active and inactive people had increased, which suggested the role of a health-related selection process towards unemployment. For "other causes of deaths" social inequalities were larger in France than in other European countries in the period 1970-1980 (Leclerc, 1989).

The magnitude of the inequalities given here for France cannot easily be compared with results from other studies. Some of these compare non-manual to manual workers (Mackenbach & al., 2003; Donkin & al, 2002); others assess SES according to educational level (Khang YH, Lynch JW, Yun S, Lee, 2004) or income (Davey Smith & al., 2002), or according to occupation at death, rather than at the census as in our study (Marang-Van de Mheen & al., 1998). Comparisons between countries are sensitive to methodological choices, such as how SES is defined for those not working. It is also necessary to take into account the age differences between studies, since the magnitude of inequalities varies with age.

In many developed countries labour market flexibility has increased, which implies health-based selection processes and negative health effects of lack of security (Bartley & Ferrie,

2001; Virtanen, Luikkonen, Vahtera, Kivimäki & Koskencuo, 2003). One of the questions raised here is to which extend labour market flexibility increases social inequalities in mortality. It would be difficult to quantify this phenomena with precision. At least, one conclusion is that traditional description of inequalities limited to employed groups can be misleading, since the labour market status is closely associated with health (Lissau, Rasmussen, Moss Hesse & Hesse, 2001). Specific studies are needed to improve our understanding of the effects of changes in the labour market, such as increased unemployment, on various segments of the population and to quantify these effects on mortality.

Appendix - Global model and estimates of the absolute differences for mortality.

In the models presented in Table 5 and Figure 3, the reference (100 in figure 3) is the mortality of a person with the average SES at the first period. SES was coded on a scale from -0.5 to 0.5. This coding was preferred to a coding from 0 to 1, because interaction terms were added to the model. Details of the estimation of absolute differences according to the model are given below for men; The figures for "mortality" in figure 3 are not mortality rates, but standardised mortality ratios, with the reference (100) as mentioned above.

The RII for the first period is 3.937. Hence the estimate of mortality at the bottom of the social scale for this period is $100 \times (3.937)^{\frac{1}{2}} = 198.4$. The estimate at the top of the social scale for the same period is $100 \times (3.937)^{-\frac{1}{2}} = 50.4$. The difference is 148.

For the most recent period, the mortality for someone with an average SES is 100 x 0.742, and the RII is 3.937 x 1.468. Hence the estimates for the bottom and the top of the social scale are:

$100 \times 0.742 \times (3.937 \times 1.468)^{\frac{1}{2}} = 178.38$

$100 \times 0.742 \times (3.937 \times 1.468)^{-½} = 30.86$

The difference is 147.5.

The reference 100 might be replaced by the standardized mortality rate at the middle of the social scale for the first period, which is not exactly the mortality rate of the general population, because the relation between the relative social situation and mortality is not linear in the model. Hence there is a slight difference between the mortality rate of the general population, which is average mortality, and the mortality of an "average" person (according to his or her SES).

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