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Research Article

Occupational and educational differentials in mortality in French elderly people: magnitude and trends over recent decades

Emmanuelle Cambois

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Max Planck Institute for Demographic Research

International Union for the Scientific Study of Population

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Occupational and educational differentials in mortality in French elderly people: magnitude and trends over recent decades

Emmanuelle Cambois [1]

Abstract

Mortality follow-up of two census samples allowed an estimate of socio-economic differentials in mortality for old men, using occupational classes and levels of education reported by individuals when they were active. The study shows persisting mortality differentials after 60 years of age. Over the 1960-65 and 1990-95 periods mortality differentials remained constant between non-manual upper classes and manual workers, while differentials have increased between the upper classes and the least skilled manual workers. Educational status has an impact on the mortality risks, independently from occupational status; the magnitude of its impact slightly changed over time. Level of education partly explains occupational differentials in mortality. The study shows that a differentiated increase in the average level of education can impact on trends in occupational differentials in mortality.

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1. Introduction

As mortality has dropped in old age over the last couple of decades, the elderly population raises new concerns, especially public health concerns. This "emerging" population group, which has long been under-represented in studies, has become a central research topic. In this context, the evidence for social inequalities in health until very old ages creates some important questions (Marmot and Shipley 1996, Hayward, Pienta, and McLaughlin 1997, Martelin, Koskinen, and Valkonen 1998, Cambois, Robine, and Hayward 2001, Bassuk, Berkman, and Amick 2002). For instance, it is essential to assess if the tremendous gains in life and disability-free life expectancies have been equally shared in the population (Cambois, Robine, and Hayward 2001). The consequences in terms of care needs in future years will depend on these trends, and be reinforced by socially differentiated health care needs and health care use (McNiece and Majeed 1999). In this context, monitoring health and mortality differentials in old age is important.

French data on mortality differentials come from two cohorts of adults in working ages formed by INSEE in 1954 and 1975 and specifically devoted to this topic. The cohorts are census samples for which mortality is regularly collected. Several studies have already been conducted with these mortality follow-ups for previous periods (Calot and Febvay 1965, Desplanques 1985, Desplanques 1993, Mesrine 1999). Those studies demonstrate a steady pattern in French population: occupational classes show an increasing mortality gradient from upper and intermediary occupations to manual workers, with farmers, independent craft and trade related businesses owners and clerks between the two extremes. The most recent update was for the period 1982-96, it shows a 9 year gap in life expectancy at age 35 between the occupational group extremes of managerial staff and unskilled manual workers (Mesrine 1999). Female mortality differentials are less well documented with French data. The 1954 cohort only included women as the spouses of men of the sample, providing partial information. Moreover inactive women, which are almost half of them, were assess according to their husband's occupational status. Nevertheless, when data can be used to produce estimates, such as for the 1975 cohort, mortality differentials based on occupational status appear narrower than they are for men; the largest gap in life expectancy at age 35 is also between upper classes and unskilled workers and reaches 5.5 years (Mesrine 1999). Even if mortality differentials change from one study to another, it is not possible to draw conclusions about trends. Changes in the occupational structure of the population should be carefully taken into account in order to interpret possible increase or decrease in mortality gaps between classes. Trends analysis conducted on the male population, using three aggregated occupational classes and data from both cohorts, indicates a general increase in life expectancy for all classes over the 1980's as well as

an overall stagnation of the differentials; upper classes and manual workers gained a little more than 2 years of life expectancy at age 35 and kept a 5 year gap in 1990 (Cambois, Robine, and Hayward 2001).

Until recently these data did not allow us to focus specifically on the elderly. Estimations have been provided by Desplanques for the 75-90 year olds for the 1980's, using the 1954 cohort. Differentials remain at these older ages and the gradient found for younger people still exists in the elderly (Desplanques 1993). However, most calculations were based on models. Although the underlying assumptions are reasonable given the current knowledge on mortality in the elderly, research is still needed to give better documentation of mortality differentials and trends in older ages (Cambois 2001).

The present study benefits from the aging of the cohorts which has provided new estimates to gauge magnitude and trends in social differentials in mortality for men at older ages in recent decades in France. Due to the specificity of the data used, a first part of the paper is devoted to the description of the study population, before providing the results. As the differentials are being estimated for both occupational status and level of education, this study assesses the possible independent impact of these two social criteria. Finally, the study intends to highlight the contribution of education and occupation to mortality from one cohort to the other, as the social structure of the population changes over time.

2. Data and method

2.1. 1954 and 1975 cohorts

The follow-ups are based on nationally representative stratified samples, issued from 1954 and 1975 population censuses. Study populations are distributed according to social status, represented by occupational classes. Deaths within the cohorts have been recorded until 1995, the last update available, allowing an estimate of mortality risks according to the occupational status from baseline up to the mid 1990's.

In 1954, the sample consists of men from age 30 to age 69, distributed between twelve main occupational classes according to their current occupation, if working. Men were excluded from the follow-up if they were inactive. According to available published information from the census, in 1954, inactive men in the 35-54 age bracket represented around 4% of the population, increasing with age due to retirement, inducing a greater probability of inactivity in the cohort which included people up to the age of 69 (Desplanques 1985). Some specific occupational classes were also left out: these were some classes of limited size or whose economic status and place in the

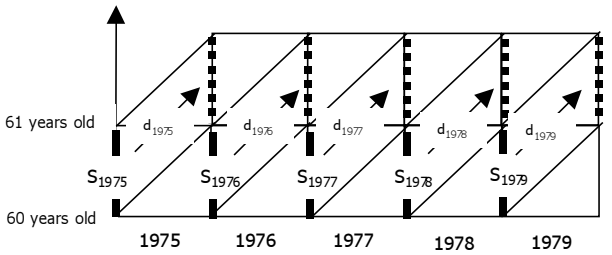
society have changed over time (coal workers, some fishery workers) and some classes which are highly heterogeneous in terms of social background, financial or social status of its members (artists). Again, according to published information, in the 35-54 population in 1954, these classes represented 7% to 10% of the population, varying with age. Men included in the follow-up, who were active and part of the twelve major occupational classes, represented approximately 87.5% percent of the total male population aged 35 to 54 (Desplanques 1985); this percentage decreases with age due to the increase in the probability of being retired (discussed later). In the 1954 cohort, the sizes of the occupational classes ranged from approximately 30,000 to 44,000 men, producing a total sample of around 460,000 men. In 1975, the sample coverage was extended to the whole population including both men and women, active and inactive. The age bracket was limited to ages 30 to 64. Sample size in 1975 is around 500,000 men and 500,000 women.

2.2. Mortality risks

Death record linkage is done using a national identification registry which is limited to those born after 1891, born in French metropolitan territory and with French nationality; it therefore excludes those born in French overseas territories and foreigners as well as the oldest old in the first cohort. It limits the use of the first cohort to the age range 30 to 63 years old.

With longitudinal data such as these mortality follow ups, mortality risks are usually estimated through annual perspective probabilities for each year of age. Given a population aged x at the beginning of the year, the mortality probability is the ratio of the number of deaths occurring in this population within the year over this population. Age specific mortality risks can be assessed over a period of several years rather than yearly in order to increase the number of events and strengthen the estimations. In this case, average annual perspective mortality probabilities are estimated as shown in example (Box 1): the numerator is the sum of deaths occurring in each year of age during each year of the period, the denominator is the sum of survivors of each age at the beginning of the years of the period. Weighted data are used to estimate mortality risks.

$$q^{60} = \frac{\sum_{i=1975}^{1979} d_i}{\sum_{i=1975}^{1979} S_i}$$



The sum of deaths recorded for each year at this age (1975,…, 1979) is rated by the sum of the survivors of this age at the beginning of each year.

Box 1: *Estimation of annual mortality probabilities at age 60 years over the period 1975-1979. Formula and corresponding Lexis diagram for the perspective mortality probabilities.*

In this study, we use aggregated estimates to compare mortality levels in the occupational classes. This is the estimated annual mortality probability in the ten year age group under consideration. The age specific mortality probabilities, obtained as described above, are applied to the age groups of the sample cohort in 1969 and in 1990, providing an estimated total number of deaths, which is rated by the whole population. Standardized mortality rates are also computed, rating the total number of deaths of each class by the hypothetical total number of deaths which would be obtained if age specific mortality probabilities of the whole study population was applied to the different occupational classes.

2.3. Study population

The cohorts were initially 30 to 63 years old men in 1954 and 30 to 64 years old in 1975; aging of these cohorts allow an assessment of mortality differentials at older ages, using recent mortality records. Because we want to assess trends, both cohorts should be used in order to obtained differentials at two points in time. The last update for mortality data date from 1995; therefore, with the most recent cohort, the distance from baseline can not be more than the 15 year period, using a five year period to collect mortality data, going from 1990 to 1994. In 1990, the 1975 cohort ranged between age 45 and 79 years. Based on this constraint, the first cohort is analyzed for a similar

mortality record period, both in terms of length and distance from baseline. Mortality within the 1954 cohort is collected for the 1969-1973 period.

The study is limited to men who are active and part of one of the twelve classes initially included in 1954 cohort population (around 90% of the male population in 1954). Classes under consideration are the following: *Upper occupations* (intellectual occupations, upper managerial staff and administrators, medical doctors, independent professionals, engineers), and *intermediary occupations* (managerial staff, school teachers, skilled technicians, medical and social workers, intermediary managerial and administrators) represent skilled, non-manual occupations requiring a high level of education and training. *Farmer class* only includes farm managers and not the farm workers. *Craftsmen and trade related workers* are independent shop or business owners. *Clerk class* includes either those employed in administrative departments or in craft and trade related businesses. *Clergy and other* constitutes a small part of the population but they are distinguished from any other classes in both cohorts and include, in 1975, the army and police; we will not discuss results for this group. *Manual workers* class includes foremen, skilled manual workers (which in 1954 also included some foremen), farm workers, semi-skilled manual workers and unskilled manual workers.

Because those already retired at baseline are not recorded in the 1954 cohort, it is necessary to focus on workers at baseline to be able to attribute a determined occupational status to individuals. We have restricted the study population to those being initially 60 years old or less, instead of including 3 additional years of age where the proportion of retired starts to be high. We limit the age range to those aged from 50 to 60 years at baseline, providing trends in mortality differentials in ages 65 to 75, from the period 1969-73 to period 1990-94. Sample sizes for our study populations are 60,259 men aged 50 to 60 years old at baseline in 1954, among which 42,893 have survived until 1969. They are 67,454 at baseline in 1975 cohorts of whom 52,718 have survived until 1990. Whilst published information from 1954 does not allow us to find the exact percentage of the population excluded from this present study, this information can be drawn from the 1975 cohort which represents the whole population. Using weighted data, for age 50 to 60 at baseline in 1975, 16% of the 1975 cohort is excluded from the study: 10% are already retired at baseline, 2% are in occupations which were not taken into account and 4% were inactive other than retired.

2.4. Covariate

In order to make explicit the trends in mortality differentials, we have included an analysis of the level of education as a covariate known to be strongly linked to mortality

risks, independently from the other social variables it can represent (Shrijvers et al. 1999, Davey Smith et al. 1998a, Ross and Wu 1995). We have done logistic regression calculations for the risk of dying over our study periods for each cohort, controlling for occupational status, age and level of education. Four levels of education have been used, taking the French Baccalaureate (Bac) as a reference point. This qualification precedes university and corresponds to 12 years from the beginning of primary school (entered around age 6). The levels of education are: leaving school with *no qualifications* at all; with diploma *lower than Bac* corresponding to primary school education or other professional qualifications; with *Bac*; with diploma *higher than Bac*.

3. Description of study populations

3.1. Change in occupational structure

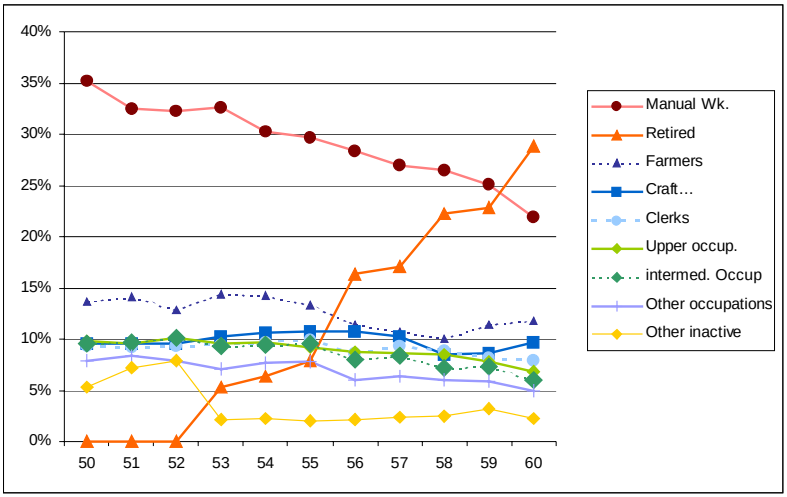
Looking at the situation in 1969 and 1990 the occupational structure of the study populations has changed significantly from the first cohort to the second one (Table 1). Proportions of the two upper classes have increased from 12.1% to 23.2%. Proportions of farmers and independent craft and trade workers have reduced, from 25.3% to 16.3% and from 16.1% to 11.9% respectively. The proportion of clerks has increased from 9.1% to 10.7%. The manual workers class remains stable, being around 37% of the population both in 1969 and in 1990 but its internal structure has been modified, the proportions of farm workers and unskilled workers have reduced, whereas semi-skilled worker groups as well as skilled and foremen classes combined, classes which overlap a little in 1954 due to the classification rules, have grown. Over the period, the French population underwent a development in the service sector and increasing qualification of its workers, while farming activities decreased dramatically.

Table 1: *Change in the occupational structure of the study population, for the 1954 and 1975 cohorts of men aged 65 to 75 in 1969 and 1990 (weighted data)*

	1954 cohort, 65-75 years old in 1969	**1975 cohort, 65-75 years old in 1990**
Upper occupations	5.9%	12.0%
Intermediary occupations	6.3%	11.2%
Farmers	25.3%	16.3%
Craft, trade and business workers	16.1%	11.9%
Clerks	9.1%	10.7%
Clergy and other	0.3%	0.6%
Manual workers (farm, skilled & unskilled):	37.0%	37.4%
Farm workers	*5.6%*	*3.0%*
Foremen	*5.7%*	*4.4%*
Skilled workers	*11.2%*	*13.6%*
Semi-skilled workers	*9.3%*	*11.7%*
Unskilled workers	*5.2%*	*4.7%*
All study	100%	100%
Total	1,313,300	1,608,240

3.2. Distribution of 1975 cohort between active classes and inactive

In 1975 cohort, both active and inactive populations are included. Graph 1 shows proportions by age of the occupational classes, those retired or otherwise inactive at baseline.



Graph 1: *Distribution of the 1975 cohort according to occupational classes Men aged 50 to 60 years in 1975*

Whereas the proportions remain similar at each age for most classes, the proportion of those being retired in 1975 increases with age and the proportion of those being manual workers or farmers decreases. By excluding the inactive men from the study population in both the 1954 and 1975 cohorts, we are excluding individuals who were not able to remain at work and among them we exclude a higher proportion from the manual workers and farmers classes than from other classes. This limitations of the sample used should be kept in mind as a possible cause of under estimation of the mortality risks in the oldest ages under consideration for the whole study population and, more specifically, for manual workers and farmers.

3.3. Distribution of the population according to the level of education

Table 2 shows the distribution of the different occupational classes between the 4 levels of education under consideration.

Table 2: *distribution of occupational class according to the level of education in 1954 and 1975 cohorts for men aged 65 to 75 in 1969 and 1990*

	1954 cohort, 65-75 years old in 1969				1975 cohort, 65-75 years old in 1990			
	No qualific.	Lower than Bac	Bac	Bac and above	No qualif.	Lower than Bac	Bac	Bac and above
Upper occup.	5.2%	39.1%	13.6%	42.1%	4.1%	30.8%	21.3%	43.8%
Intermed. Occup	12.8%	71.8%	11.7%	3.7%	8.1%	58.8%	23.0%	10.1%
Farmers	69.2%	29.9%	0.8%	0.1%	46.3%	52.2%	1.0%	0.5%
Craft etc.	37.9%	57.7%	2.4%	2.0%	22.9%	65.0%	9.1%	2.9%
Clerks	38.8%	58.6%	2.1%	0.5%	24.1%	67.9%	6.1%	1.9%
Manual Wk.	66.0%	33.7%	0.2%	0.2%	45.6%	51.4%	2.7%	0.4%
Farm Wk.	85.7%	14.2%	0.1%	0.0%	69.0%	30.0%	0.6%	0.4%
Foremen	43.0%	56.3%	0.3%	0.4%	18.5%	71.1%	9.4%	1.0%
Skilled MnWk	55.7%	43.7%	0.3%	0.3%	36.2%	60.5%	3.1%	0.3%
Semi sk. Wk	73.0%	26.9%	0.0%	0.1%	52.4%	46.1%	1.1%	0.4%
Unskilled ManWk	79.6%	20.2%	0.2%	0.0%	66.3%	33.2%	0.5%	0.0%
All	52.8%	41.6%	2.4%	3.2%	31.5%	53.3%	8.1%	7.2%

The average level of education has improved over the 20 years separating our two study periods. In 1990, 15.3% of the different groups included in the study have a Bac or more whilst in 1969 it was only 5.6% (Table 2). There is a clear shift from categories with lower qualifications than a Bac toward categories with Bac and higher. This pattern applied to every occupational classes. But Table 2 also highlights the tremendous differences in the educational structure of the upper occupations class and the rest of the population. The proportions in the two extremes, upper occupation class and unskilled manual workers, were 45.7% and 0.2% respectively with a level of education higher than a Bac in 1969, they were 65.1% and 0.5% respectively in 1990. The proportions with qualifications below Bac level in these two classes are respectively 39.1% and 20.2% in 1969, and 30.8% and 33.2% respectively in 1990. The shift in the educational level did not operate from the same levels in these two classes. The proportion with lower qualifications than a Bac is decreasing in the upper classes compared with those with higher than a Bac; this proportion is increasing in unskilled classes due to an overall decrease in the number of people without any qualifications. The decline in the proportion of unskilled workers in the French male population could

be the result of occupational moves by those who benefited from a higher level of education towards occupations requiring more skill; a decreasing proportion of people with diplomas entering unskilled occupations. Although this pattern did not result in complete stagnation of the level of education in the unskilled workers, the increase in the proportion of people with a Bac or with higher qualifications than a Bac was less sizeable in this class than in the rest of the population. Farmer class and manual workers have a similar educational structure in 1969, but in 1990 a larger proportion of farmers have an educational level below the Bac compared with manual workers. The pattern identified for the unskilled manual workers also applied to farmers. Differentials between classes for level of education remain great in 1990.

3.4. Mortality pattern operating between baseline and study periods

Mortality probabilities at older ages are computed with the part of the baseline samples remaining at the beginning of our study periods. The attrition between baseline and 1969 or 1990 is the result of the deaths recorded over this time period. Differentiated mortality risks have operated between baseline and the study period due to well documented mortality differentials at adult ages as described in the introduction to this paper. Therefore the occupational structure of the study population differs from the structure observed at baseline, representing the effect of differentiated mortality over life course. Over the 15 year period between baseline and the study period, manual workers undergo the highest attrition and therefore represent a decreasing proportion of the cohorts while it is aging (Table 3). Conversely, the other classes have smaller proportions at baseline than after the 15 years. Because the linkage methodology has improved from first to second cohort, attrition cannot be directly analyzed as true mortality and differences in attrition for each class between the two cohorts cannot be interpreted only as mortality trends. Nevertheless, most of the decrease in the attrition from one cohort to the other is due to mortality decrease in each occupational class and the decrease in the attrition has obviously not been similar for all classes. Change in the occupational structure of the study population from one cohort to the other is also the result of mortality differentials in ages 30 to 65 years and of differentiated changes in mortality levels over time. Distribution at baseline changes compared to distribution in our study populations 15 years later (Table 3).

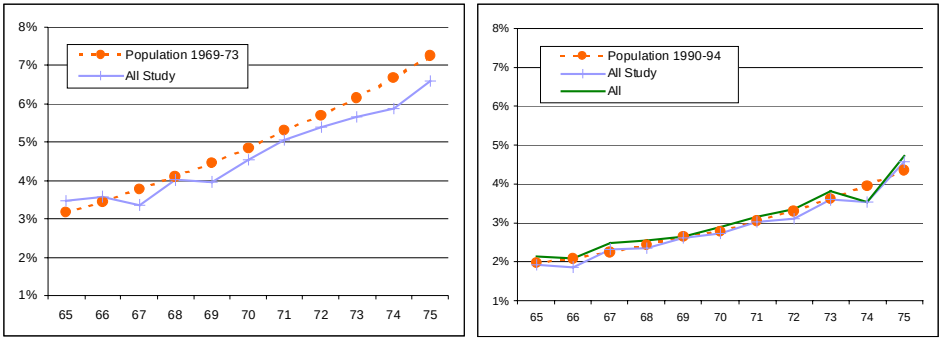
Table 3: *1954 and 1975 cohorts baseline and 15 years later sample size and structure, proportion remaining after 15 year, by occupational class, men aged 50 to 60, weighted data*

	1954 cohort sample					1975 cohort sample				
	At baseline, 1954		in 1969		%.	At baseline, 1975		in 1990		%.
Upper occup.	101 419	(5.3%)	77 115	(5.9%)	76%	196 250	(11.0%)	166 190	(12.0%)	85%
Intermediary occup.	113 456	(6.0%)	83 343	(6.3%)	73%	190 980	(10.7%)	155 210	(11.2%)	81%
Farmers	456 141	(24.0%)	331 751	(25.3%)	73%	277 140	(15.5%)	226 100	(16.3%)	82%
Craft, trade workers	301 802	(15.9%)	210 896	(16.1%)	70%	211 155	(11.8%)	165 805	(11.9%)	79%
Clerks	175 612	(9.2%)	119 871	(9.1%)	68%	196 355	(11.0%)	148 950	(10.7%)	76%
Manual workers	746 947	(39.3%)	485 951	(37.0%)	65%	702 675	(39.4%)	520 073	(37.4%)	74%
Clergy and other	5 815	(0.3%)	4 373	(0.3%)	75%	10 750	(0.6%)	8 280	(0.6%)	77%
All study	1 901 192	(100%)	1 313 300	(100%)	69%	1 785 305	(100%)	1 390 608	(100%)	78%
Retired	-		-		-	219 470		138 090		63%
Other occupations	-		-		-	49 870		36 123		72%
Other inactive	-		-		-	81 940		43 420		53%
All	-		-		-	2 136 585		1 608 240		75%

3.5. Mortality pattern in our study populations compared to population based estimates

Estimates of mortality risks for the whole study populations have first been compared to population based estimates (Graph 2). For the 1975 sample, we also compared the age specific probabilities estimated in our study for the whole cohort including the inactive population, more comparable with the population based figures. Population based mortality probabilities are those recently provided by Vallin and Meslé (2001) and we estimate average annual probabilities for the two study periods 1969-73 and 1990-94. Data related to the 1954 cohort population underestimate mortality risks compared to the population based estimates and the gap is increasing with age; the discrepancy is both due to the exclusion of those inactive from the study population and due to a failure in the linkage between death records and cohort population. With the 1975 cohort, the bias is less important and did not change with age despite the problem of a larger exclusion of the inactive population in older ages. The effect of excluding a larger proportion of those manual workers and farmers, as previously shown in Graph 1, contributes to the larger underestimation of mortality in the oldest ages. For the pattern in the 1975 cohort, failures in linkage in the 1954 cohort may be the major explanation for the underestimation of its mortality. The methodology used to link deaths and cohort populations includes both manual processing and computer processing techniques and matches have not been fully successful, especially with the

1954 cohort. Mortality risks are underestimating the true mortality in the study population. Several methods were used by INSEE, who set up the cohorts, to improve the initial linkage; the analysis of deaths collected after the first matching process has shown that the failure is independent of occupational classes (Desplanques 1985). Therefore, the cohorts underestimate mortality levels, at least in the 1954 cohort, but provide reliable estimates of the relative risks of mortality.

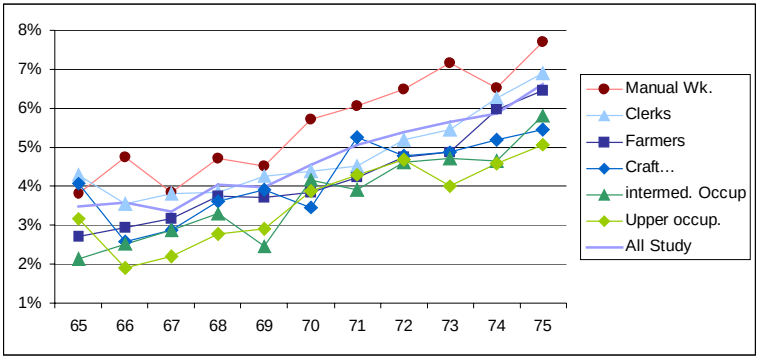


Graph 2: *Age specific death probability for the study population compared to population based data (data from Vallin & Meslé, 2001)*

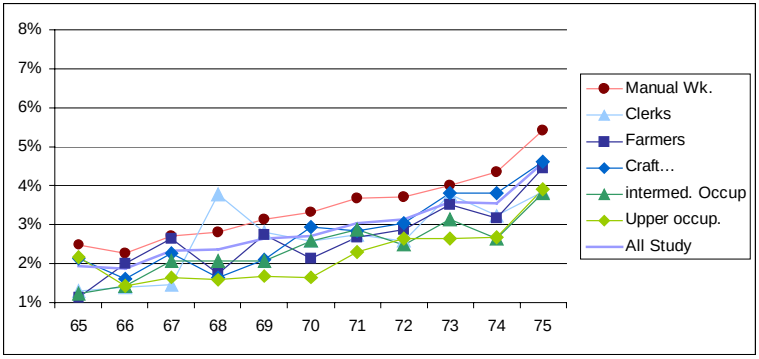
Population based data indicate a mortality decrease at all ages over the 20 years separating the two study periods. The aggregate mortality probability of the age range for the French men dropped from 4.7% to 2.6%. This trend has led to an increase in partial life expectancy in the age group 65-74, from 8.18 years to 8.86 years out of the maximum 10 year life span in this age range. The underestimation of mortality risks with the 1954 cohort prevents us from drawing conclusions about trends in mortality from one cohort to the other. With more accurate death matching for the first cohort, decrease in mortality levels from one cohort to the other would have been steeper than the decrease shown in the following tables. Therefore, assuming that the linkage problem between the death register and the 1954 cohort is independent of the social status, trends in mortality differentials are studied through changes in relative risks within each cohort rather than comparing trends in mortality levels.

4. Results

Age specific mortality probabilities have been computed for each occupational class included in the study. As shown in Graphs 3 and 4, despite overlapping curves due to the size of the groups in this study, there is a clear gap between manual workers with the highest mortality risks and intermediary or upper occupations with the lowest risks. As the overall male population, our study population and each occupational class of the study have benefited from a decrease in the mortality risks from the first to the second cohort, although gains cannot be assessed with these data sets.



Graph 3: *Age specific death probability by occupational class and in all active populations, period 1969/73 in age group 65-75*



Graph 4: *Age specific death probability by occupational class and in all active, period 1990/94 in age group 65-75*

Table 4 gives the aggregate mortality probabilities for the age bracket 65-74, the relative differences between mortality in each class and the average mortality probability, and standardized mortality ratios (SMR). Aggregate mortality probability of the study populations is 4.4% in 1969 and 2.6% in 1990. In Table 4, the mortality gradient is clearly depicted for both periods, ranging from 3.4% for the upper occupations to 5.2% for the manual workers over the period 1969-73 and from 2% to 3.1% for the same classes over the period 1990-94. Manual worker class is heterogeneous in term of mortality risks. Risks in sub-classes range from 4% for foremen to 5.8% for unskilled workers over the first period and from 2.4% to 3.6% over the second period. The intermediary occupations, farmers, craft and trade related business owners and clerks range between the upper occupations and manual workers classes. Relative differences between mortality probabilities in the different classes and the overall study population are stable or are narrowing from the first cohort to the second one, except for the unskilled manual workers where it is increasing. Upper classes, farmers and craft and trade businesses owners have a lower mortality risk than the total population. Clerks have a similar risk in the first study period and a lower risk in the second period. Manual workers have a 20% higher risk than the average and a 45% higher risk than those in upper occupations, at both periods. Differences between upper classes and manual workers are stable over time; but among the manual workers differentials are large, leading to an increase in the extreme population groups. Unskilled workers' risk is 32% higher than the risk of the whole study population; the risk of the unskilled workers is twofold the risk of the upper occupations. This gap has even widened from the first study period to the second one.

Table 4: *Aggregate mortality probabilities in 65-75 age group, absolute differences in mortality probabilities between classes and overall population and standardized mortality rates according to occupational classes in 1954 and 1975 cohort (men, 1969-73 and 1990-94)*

	1954 cohort sample			1975 cohort sample		
	q_{65-74}	*Relative difference	SMR	q_{65-74}	*Relative difference	SMR
Upper occupations	3.4%	-23%	0.76	2.0%	-23%	0.76
Intermediary occupations	3.5%	-20%	0.79	2.1%	-19%	0.83
Farmers	3.9%	-11%	0.89	2.3%	-12%	0.91
Craft, trade and business workers	4.0%	-9%	0.90	2.5%	-4%	0.95
Clerks	4.7%	7%	1.01	2.5%	-4%	0.94
Manual workers (farm, skilled & unskilled):	5.2%	18%	1.19	3.1%	19%	1.20
Farm workers	5.4%	23%	1.25	3.0%	15%	1.16
Foremen	4.0%	-9%	0.92	2.4%	-8%	0.96
Skilled workers	5.4%	23%	1.25	3.1%	19%	1.20
Semi-skilled workers	5.1%	16%	1.18	3.2%	23%	1.24
Unskilled workers	5.8%	32%	1.32	3.6%	38%	1.39
All study	4.4%	-	1	2.6%	-	1

* Relative difference: difference between the mortality probability of the class and the mortality probability of the overall population divided by the mortality probability of the overall population

Trends in standardized mortality risks and confidence intervals (95%) are represented in Graph 5. Over the 20 years separating the two study periods, the SMR have only slightly changed. There is only a significant increase in SMR for the intermediary occupations class and an almost significant decrease for the clerks class. As a result, the difference between the upper occupations and intermediary occupations become significant over the 1990-94 period. Differences between farmers and craft and trade related workers are not significant; that is also the case for the clerks class in the second study period due to the decrease in its SMR. The risk in the manual workers class remains clearly higher than the risk in any other classes despite the fact that it encompasses the foremen group which benefits from a lower mortality risk compared to the whole study population.

Graph 5: *Trends in standardized mortality risks (SMR) based on the study population risks of both periods (base 1), 1969-73 and 1990-94 represented by confidence interval (95%)*

4.1. Covariate

The level of education can partly explain the relationship between occupational classes and the level of mortality. Table 5 displays the logistic regression of the risk of dying for the periods 1969-73 and 1990-94 respectively for the 1954 and 1975 cohorts, for our study populations. Model 1 shows the odd ratios and 95% confidence intervals separately for each occupational class, in reference to the risk of the upper occupations class, and for each level of education in reference to those with no degree, controlling for age. Model 2 includes simultaneously occupations and the level of education. For both cohorts, age has its own impact on mortality and the magnitude of this impact remains equal even with the addition of occupations and the level of education in the multivariate regression.

Table 5: *Logistic regression of the risk of dying over 1969-73 (1954 cohort) and over 1990-94 (1975 cohort) controlling for age, occupational class (Model 1) and for age, occupational class and level of education (Model 2); men 50-60 years old at baseline.*

	1954 cohort, 65-75 years old in 1969				1975 cohort, 65-75 years old in 1990			
	Model 1 (unadjusted)		Model 2 (adjusted)		Model 1 (unadjusted)		Model 2 (adjusted)	
Upper occup.	1.00		1.00		1.00		1.00	
intermed. Occup	1.02	[0.94-1.11]	0.99	[0.90-1.09]	1.10	[1.00-1.21]	1.02	[0.92-1.13]
Farmers	1.16	[1.04-1.29]	1.01	[0.90-1.14]	1.24	[1.11-1.38]	1.03	[0.91-1.16]
Craft…	1.25	[1.12-1.38]	1.13	[1.01-1.27]	1.27	[1.13-1.41]	1.11	[0.98-1.25]
Clerks	1.32	[1.19-1.47]	1.20	[1.07-1.35]	1.27	[1.14-1.43]	1.11	[0.98-1.26]
Manual Wk.	1.73	[1.60-1.88]	1.51	[1.37-1.66]	1.58	[1.45-1.72]	1.33	[1.20-1.46]
No degree	1.00		1.00		-		1.00	
Lower than Bac	0.78	[0.75-0.82]	0.88	[0.84-0.93]	0.81	[0.76-0.85]	0.84	[0.79-0.89]
Bac	0.63	[0.59-0.67]	0.81	[0.75-0.88]	0.72	[0.66-0.78]	0.82	[0.74-0.90]
Bac or higher	0.63	[0.58-0.68]	0.79	[0.71-0.87]	0.54	[0.48-0.60]	0.64	[0.57-0.73]

Model 1: Odd ratios of the mortality risks adjusted for age according to the occupational class and according to the level of education.
Model 2: Odd ratios of the mortality risks adjusted for age and mutually adjusted for occupational class and according to the level of education

In model 1, the odds ratio of the risk of dying in the intermediary occupations is significantly different from the one in the upper occupations in 1975 cohort but not in 1954 cohort, as already shown by the SMR. Controlling for age, education is strongly linked with mortality risks in both cohorts, and having no qualifications is associated with significantly higher mortality risks than other levels of education. Among those who have qualifications, in the 1954 cohort, the risk is significantly lower for those who have the Bac or higher than for those who have a lower educational level. In the 1975 cohort, the distinction has shifted and is between those having the Bac or lower and those having higher than this qualification.

In model 2, mortality differentials between the occupational classes are reduced in the 1954 cohort and are not significant anymore in the 1975 cohort, except for manual workers. Model 2 highlights significant mortality differentials according to the level of education while controlling for occupational classes, especially between those with no qualifications and those with at least a college degree in both cohorts. In 1975 cohort, those with higher qualifications than the Bac benefit from a large under mortality risk compared to people with lower than this level of education. In recent years, the level of education is more discriminating for the elderly as socially differentiation criteria than it was 20 years previously. This pattern results from the change in the educational distribution of the population which is less skewed in the 1975 cohort than in the 1954 cohort (Table 2). This trend accompanies an upward shift in the level of education in

every class, but with a smaller improvement in manual workers than in any other class. Moreover, the improvement in the average level of education has been less for the unskilled workers than for the whole manual worker class and relative risks of mortality in the least skilled classes tend to increase. Trends for farmers follow a similar pattern.

This study also shows that the relationship between the level of education in a group and its mortality risk is not straightforward. Indeed, on the one hand, the SMR of the intermediary occupation class has increased despite a large improvement in the average level of education, and on the other hand, the educational structures of the manual workers and the farmers are similar despite dramatically different mortality in these two classes.

5. Discussion

As previously highlighted in France and elsewhere, men's occupational classes show a gradient in mortality. This study shows that the gradient is stable with age and from time period to time period. In the first half of the 1990's, in the age group 65-75, *manual workers* have a 45% higher risk of dying than *upper occupations*, and within the manual workers class, *unskilled workers* have more than a 60% higher risk. The moderate changes in mortality differentials over time in the study population indicate that improvement in life expectancy over recent decades have benefited every occupational classes. Trends analysis shows a stagnation of the differentials between upper occupations and manual workers, with constant SMRs for both classes in the two cohorts (respectively around 0.76 and 0.20). But the analysis also shows an increase in differentials between the upper class and the *unskilled* manual workers, with a slight increase in the SMRs for the latter (from 1.32 to 1.39). Other studies show similar outcomes for trends in differentials. Martelin showed a stagnation in differentials at older ages in Finland, whatever the social criteria used to stratify the population (education, occupation, marital status) (Martelin, Koskinen, and Valkonen 1998). Studies giving trends for the whole adult population report widening inequalities between extreme occupational classes, for Finland (Martikainen and Valkonen 2001), England and Wales (Drever, Whitehead, and Roden 1996) and Scotland (Marang-van de Mheen et al. 1998). In these three studies the evidence of a widening in inequalities is explained by a greater decrease in mortality due to cardiovascular, accident or suicide in the upper classes than in the other classes and, most especially, greater than in the unskilled manual workers class. Our study showed both a widening gap between the two class extremes and a stagnation in the differentials when considering the whole group of manual workers.

Furthermore, with this approach it was possible to highlight how changes in the composition of the classes under consideration can interfere in mortality differentials. Indeed, not only the size of the unskilled manual worker class has changed over time within the manual worker class, but also its inner social structure. In the first cohort, this class was composed of individuals with different social backgrounds. In the second cohort the class was restricted to those considered as the least privileged among the unskilled. This was shown by trends in the average level of education in this class, less favorable for the unskilled worker class than for the other classes from one cohort to the other. The resulting increase in mortality in the class is, at least partly, due to structural changes. The high relative mortality risks of the least privileged unskilled workers is revealed in the second cohort while the former counterparts with lower risks may have more frequent access to more qualified occupations. This structural change prevents us from concluding, from this kind of results, that there is a worsening of the mortality risk among the unskilled workers, especially when the gap between upper classes and the whole manual worker class remained stable. These findings show that a more precise distribution of the population between classes and within classes would be an appropriate way to follow comparable specific population groups from time period to time period, even when using relative inequalities indices; different social groups can be distinguished within one large class which reflect different situations and specific relationships with mortality determinants.

The study shows an independent impact of education on mortality risk while controlling for occupational classes; education explains a significant part of occupational differences in mortality. Lifelong deterioration process might explain these patterns. As demonstrated by Davey Smith, occupation and education refer to different periods of life and reflect specific life situations which explain the outcome of different diseases. Criteria such as education are related to childhood deprivation and the related health problems, while others tend to refer to adulthood and related life conditions, work environment and behaviors (Davey Smith et al. 1998a, Shrijvers et al. 1999). Many studies show how difficult life circumstances from early childhood (deprivation, nutrition problems, stress, conflicts, low birth weight and slow growth) contribute to later social differentials in health and mortality risks (Kuh and Ben Sholmo 1997, Hart, Davey Smith, and Blane 1998, Holland et al. 2000, Davey Smith et al. 1998b, Barker, 1997a, Barker 1997b ; Bartley et al. 1994, Elo and Preston, 1992, Montgomery, Bartley, and Wilkinson 1997, Marmot and Wadsworth 1997, Bosma, van de Mheen, and Mackenbach 1999, van de Mheen et al. 1998, Blackwell, Hayward, and Crimmins 2001, Gliksman et al. 1995). Other studies also document the independent detrimental impact on health of hard physical and psychosocial work conditions, often associated to unskilled and manual occupations (Schrijvers et al. 1998, Mare, 1990, Moore and Hayward 1990, Power and Matthew 1997, Pavalko, Elder, and Clipp 1993,

Holte, Tambs, and Bjerkedal 2000, Cassou et al. 2001, Siegrist, 1996, Karasek, 1990). Therefore, the independent effect of education on the mortality differentials when controlling for adult occupation may reflect the specific contribution of childhood conditions on various health patterns in adulthood. The residual effect of being manual workers while controlling for education, even in the latest cohort, shows an independent contribution of life and work conditions associated with this type of occupation, partly explaining differentials mortality risks. Nevertheless, these data sets do not provide enough information to disentangle these different effects.

The major limitation of the present study is the omission of the inactive population and foreigners from the sample, which prevents us from generalizing these findings to the whole French male population. While inactive status reported during working age for males is often explained by a deteriorated health status, our figures concern a selected part of the population with rather lower mortality risk than the risk of those who were excluded (Martikainen and Valkonen 1999). To corroborate these findings, figures from 1975 cohort, which include inactive and retired people, show a higher mortality risk for them even when controlling for age (figures not shown). Moreover, while the time lag between the occupational status reports and the mortality period is large (15 years), this study population not only excludes those who were not working at baseline but also those active who died during the 15 years after baseline: in this sense, the study not only underestimates mortality levels but also mortality differentials in the population. Nevertheless, in this study, attention was drawn to time trends and to the effect of social change on observed mortality differentials. With this type of objective, comparing two populations with the same classes and an identical time lag between censuses and mortality record was important. The bias could only be induced by changes over time in the probability of moving out of the labor force; if the study population excludes an increasing proportion of the population which have high levels of mortality, the stable mortality differentials between the upper classes and manual workers shown here would hide an overall widening of inequalities in the general French population. In a previous work, based on published census data from 1954 and 1975, we have estimated that the proportion of inactive people was similar or even decreased from 1954 to 1975 when the cohorts were constituted, ensuring that both cohorts at least included similar parts of the population when focusing on active people (Cambois, Robine, and Hayward 2001). This could be more problematic when comparing a younger active population over the same time period, due to recent trends in the labor force structure.

It is not only the mobility out of the labor force which could interfere but, more generally, the impact of occupational mobility at the individual level, during the working lifetime, can also have an impact on mortality differentials estimates. There is no information on the occupational moves during the 15 years between the baseline report of the occupational class and the mortality record; for instance, those who

became inactive or those who were upgraded are still treated as a member of the initial class. Previous work first showed that the larger the distance between baseline report and mortality record, the lower the differentials (Cambois, in press). Occupational mobility creates a homogenization of the mortality risks in the occupational class. For instance those who join the upper occupation class have low mortality risks, close to the average of the upper occupations, and those who leave this class have higher mortality risks than the average; mortality risks in upper occupations are more concentrated around the average after the moves, with a lower level. This pattern applies for the different classes. As a consequence, for a given male population, differentials between classes based on baseline report of occupational status are smaller than differentials based on updated report. This pattern does not produce a bias in our study as long as estimates are computed under the same conditions in both cohorts. In this study, to take this bias into account the distance between baseline and mortality record period are the same for both cohorts. Moreover, focusing on older ages, occupational mobility is limited and its impact on the magnitude of the differentials is almost non-existent, as shown in a specific study (Cambois, 2001).

We should point out that it is more reasonable to focus on the male population due to these issues on inactivity and occupational mobility. Indeed, half of the women were inactive during those periods and women have more occupational mobility than men, especially away from and towards the inactive class (Cambois, 2002). The impact of excluding the inactive population on mortality differentials estimates is much greater for women than for men (Martikainen and Valkonen 1999).

Finally, the mortality linkage tends to underestimate mortality in the 1954 cohort, but seems to be independent of social status, as described earlier. Therefore, trends in mortality risks should be more favorable in each class than it appears in the tables of this study when comparing mortality levels; but this bias does not change the conclusions about trends in SMR.

6. Conclusion

For the first time, trends in social differentials in mortality at older ages can be assessed with observations, rather than modeling techniques. The study first confirms the persistent mortality differentials in old people as suggested for the 1980's in France based on data issued from the 1954 cohorts (Desplanques 1993) and elsewhere. It was not possible to compare the magnitude of the mortality gaps in these studies different because they are based on various mortality indicators, study periods, study designs and social classifications. Nevertheless, studies based on occupational status are showing existing differentials after retirement, although the differentials are attenuated with age.

Non manual administrators and managers keep their advantage over manual workers in France as they do in Great Britain, Finland or the United States (Marmot and Shipley 1996, Martelin, Koskinen and Valkonen 1998, Bassuk, Berkman, and Amick 2002). There is no drastic selective effect leveling off the mortality risk for those surviving until older ages. There is evidence for life course accumulation of health risks resulting in a lifelong health deterioration process; mortality risks are higher for those who have had health damaging experiences in childhood, adulthood, at work and in their daily environment (Breeze et al. 2001, Cassou et al. 2001, Grundy and Holt 2000). This process explains the existence of inequalities until the oldest ages, caused by permanent contributions of life events and life or work conditions to health status. The protective behavioral, cultural or environmental background of individuals can partly compensate the risk accumulation in disadvantaged classes, giving them more chance of surviving until older ages, but does not eliminate mortality or health differentials. This argument and evidence of old age mortality differentials counteract a possible inversion of the relative risks with age for the different social groups.

This study also underlines the complex relationship, at the population level, between trends in mortality and changes in the occupational structure of the population and in its average level of education. The impact of educational level on mortality has increased as the average level of education in the population rose. This highlights the increasing selective effect of having no qualifications which has become a status increasingly predictive of high mortality risks; in highly educated societies, no school qualifications may reflect health problems or unfavorable circumstances in childhood. This pattern is illustrated by various trends in the least skilled occupations: a relatively bad progression of mortality, the low increase in their average level of education and a progressively decreasing proportion of people entering these occupations. Nevertheless, it is not yet possible to disentangle the contribution of childhood conditions and of damaging work environment in the over-mortality risk for the least skilled occupation class. Linkage of these data with the causes of death should be fruitful in this area. The pattern for least skilled occupations also illustrates the importance of structural changes in the population when monitoring the magnitude of the differentials; there is a trade off between larger relative risks of mortality and a decreasing proportion of the population, while the relative risk for the whole manual worker group is stable and represents the same proportion of the male population over the period of the study.

In future years, older cohorts will be more educated than they are in this study. In 1990, those with no qualifications make up 31.5% of the study population aged 65 to 74, they are 27.6% in the age group below, the 45 to 64 year olds. In addition to the life context that it reflects, education proved to have an active protective effect (Ross and Wu 1995, Ross and Mirowski 1999). Assumptions about the benefits from knowledge accumulation on access to health information and services can be explained by the

positive effect of schooling. Based on this finding, the progressive decrease in the proportion of people with no qualifications would improve health in the whole population and also in each class benefiting from this trend; classes with less favorable development could be left behind. This pattern has already begun, as shown in this study with the unskilled classes, but with no significant increase in the overall occupational differentials due to the combined change in the occupational structure of the population.

References

Barker, D.J. (1997a). "The Long-Term Outcome of Retarded Fetal Growth." *Clinical Obstetrics and Gynecology*, 40:853-63.

Barker, D.J. (1997b). "Maternal Nutrition, Fetal Nutrition, and Disease in Later Life." *Nutrition*, 13:807-13.

Bartley, M., Power, C., Blane, D., Davey Smith, G., Shipley, M. (1994). "Birth weight and later socioeconomic disadvantage: evidence from the 1958 British cohort study." *British Medical Journal*, 309:1475-1478.

Bassuk, S.S., Berkman, L.F., Amick, BC. (2002). "Socioeconomic status and mortality among the elderly: findings from four US communities." *American Journal of Epidemiology*, 155, 6:520-533

Blackwell, M.D., Hayward, M., Crimmins, E. (2001). "Does Childhood Health Affect Chronic Morbidity in Later Life?." *Social Science and Medicine*, 52:1269-84.

Bosma, H., van de Mheen, H.D., Mackenbach, J.P. (1999). "Social class in childhood and general health in adulthood questionnaire: study of contribution of psychological attributes." *British Medical Journal*, 318, 2:18-22.

Breeze, E., Fletcher, A.E., Leon, D.A., Marmot, M.G., Clarke, R.J.,Shipley, M.J. (2001). "Do socioeconomic disadvantages persist into old ages? Self reported morbidity in a 29 year follow-up of the White Hall study." *American Journal of Public Health*, 91, 2:277-283.

Calot, G., Febvay, M. (1965). "La mortalité différentielle suivant le milieu social : présentation d'une méthode expérimentée en France sur la période 1955-1960." *Etudes et Conjoncture*, 20, 11:75-159.

Cambois, E. (2001). Mortality differentials at old ages. Meeting of the IUSSP Committee on Health and Longevity, Beijing October 2001

Cambois, E. Careers and mortality: evidence on how far occupational mobility predicts differentiated risks. *Social Sciene and Medicine* (in press)

Cambois, E., Robine, J.M., Hayward, M.D. (2001). "Disability-free life expectancy differentials according to occupational status in the French male population: 1980-1991." *Demography*, 38, 4:513-24.

Cassou, B. Deriennic, F., Monfort, C., Iwatsubo, Y., Amphoux, A. (2001). Evolution de la santé après la retraite et condition de travail durant la vie active: à propos d'une cohorte de retraités parisiens suivi depuis 10 ans. In Cassou et al. (eds). Travail, santé, vieillissement: relations et évolutions: colloque des 18 et 19 novembre 1999. Paris.Toulouse: Octarès

Davey Smith, G., Hart, C.L., Hole, D., Mackinnon, P., Gillis, C.,Watt, G.,Blane, D.,Hawthorne, V. (1998a). "Educational and occupational social class: which is the more important indicator of mortality risks ?." *J Epidemiol Community Health*, 52, 3:153-160.

Davey Smith, G., Hart, C.L., Blane, D., Hole, D. (1998b). "Adverse socioeconomic conditions in childhood and cause specific adult mortality: prospective observational study." *British Medical Journal*, 316:1631-1635.

Desplanques, G. (1985). "La mortalité des adultes: résultats de deux études longitudinales (période 1955-1980)." *Les Collections de l'INSEE*, D102

Desplanques, G. (1993). L'inégalité sociale devant la mort In: INSEE (ed). La société française: données sociales 1993. Paris: INSEE, 251-258

Drever, F., Whitehead, M., Roden, M. (1996). "Current patterns and trends in male mortality by social class (based on occupation)." *Population Trends*, 86:15-20.

Elo, I.T., Preston, S.H. (1992). "Effects of Early Life Conditions on Adult Mortality: A Review." *Population Index*, 58:186-212.

Gliksman, M.D., Kawaschi, I., Hunter, D., Colditz, G.A., Manson, J.A.E.,Stampfer, M.J. (1995). "Childhood socioeconomic status and risk of cardiovascular disease in middle aged US women: a prospective study." *Journal of Epidemiology and Community Health*, 49:10-15.

Grundy, E., Holt, G. (2000). "Adult experiences and health in early old age in Great Britain." *Social Science and Medecine*, 51:1067-1074.

Hart, C.L., Davey Smith, G., Blane, D. (1998). "Social mobility and 21 year mobility in a cohort of Scottish men." *Social Science and Medecine*, 47, 8:1121-1130.

Hayward, M.D., Pienta, A.M., McLaughlin, D.K. (1997). "Inequalities in men's mortality: the socio-economic status gradient and geographic context." *Journal of Health and Social Behaviour*, 38, dec:313-330.

Holland, P., Berney, L., Blane, D., Davey Smith, G., Gunnel, D.J.,Montgomery, S.M. (2000). "Life course accumulation of disadvantage: childhood health and hazard exposure during adulthood." *Social Science and Medecine*, 50, 9:1285-1295.

Holte, H.H., Tambs, K., Bjerkedal, T. (2000). "Manual work as predictor for disability pensioning with osteoarthritis among the employed in Norway 1971-1990." *International Journal of Epidemiology*, 29:487-494.

Karasek, R.A. (1990). "Lower Health Risk with Increased Job Control among White-collar Workers." *Journal of Organizational Behavior*, 11:171-85.

Kuh, D.L.J., Ben Sholmo, Y. (eds). (1997). A life course approach to chronic disease epidemiology Oxford: Oxford University Press

Marang-van de Mheen, P.J., Davey Smith, G., Hart, C.L., Gunning-Schepers LJ . (1998). "Socioeconomic differentials in mortality among men within Great Britain and contributory causes." *Journal of Epidemiology and Community Health*, 52:214-218.

Mare, R.D. (1990). Socio-economic careers and differentials among older men in the United States. In: Vallin, J., D'Souza, S., Palloni, A. Measurement analysis of mortality: new approach Oxford: Clarendon362-387

Marmot, M.G., Shipleys, M.J. (1996). "Do socioeconomic differences in mortality persist after retirement? 25 year follow-up of civil servants from the first Whitehall study." *British Medical Journal*, 313:1177-80.

Marmot, M.G., Wadsworth, M.E.J. (eds). (1997). "Fetal and early childhood environment: long term implications." *Br Med Bull*, 53, issue 1

Martelin, T., Koskinen, S., Valkonen, T. (1998). "Socio-demographic mortality differences among the oldest old in Finland." *Journal of Gerontology: Social Sciences*, 53B, 2:S83-S90.

Martikainen, P., Valkonen, T. (1999). "Bias related to the exclusion of the economically inactive in studies on social class differences in mortality." *International Journal of Epidemiology*, 28:899-904.

Martikainen, P., Valkonen, T., Martelin, T. (2001). "Change in male and female life expectancy by social class: decomposition by age and cause of death in Finland 1971-95." *Journal of Epidemiology and Community Health*, 55:494-499.

McNiece, R., Majeed, A. (1999). "Socioeconomic differences in general practice consultation rates in patients aged 65 and over: prospective cohort study." *British Medical Journal*, 319:26-28.

Mesrine, A. (1999). Les différences de mortalité par milieu social restent fortes In: INSEE (ed). La société française: données sociales 1999 Paris: INSEE, 228-235

Montgomery, S.M., Bartley, M.J., Wilkinson, R. (1997). "Family conflict and slow growth." *Arch Dis Child*, 77:326-330.

Moore, D.E., Hayward, M.D. (1990). "Occupational careers and mortality of elderly men." *Demography*, 27:31-53.

Pavalko, E.K., Elder, G.H., Clipp, E.C. (1993). "Work lives and longevity: insights from a life course perspective." *Journal of Health and Social Behavior*, 34:363-380.

Power, C., Matthews, S. (1997). "Origins of health inequalities in a national population sample." *Lancet*, 350, nov:1584-1589.

Ross, C.E., Mirowsky, J. (1999). "Refining the association between education and health: the effect of quantity, credential and selectivity." *Demography*, 36, 4:445-460.

Ross, C.E., Wu, C.L. (1995). "The links between education and health." *American Sociological Review*, 60:719-745.

Shrijvers, C.T., Stronks, K., van de Mheen, H.D., Mackenbach, J.P. (1999). "Explaining educational differences in mortality: the role of behavioral and material factors." *American Journal of Public Health*, 89, 4:535-540.

Shrijvers, C.T., van de Mheen, H.D., Stronks, K., Mackenbach, J.P. (1998). "Socioeconomic inequalities in health in the working population: contribution of the working conditions." *International Journal of Epidemiology*, 27:1011-8.

Siegrist, J. (1996). "Adverse Health Effects of High EffortLow Reward Conditions." *Journal of Occupational Health Psychology*, 1:27-41.

Vallin, J., Meslé, F.(2001). Tables de mortalité françaises pour les XIXe et Xxe siècles et projections pour le XXIe siècle Paris : INED (coll Données Statistiques, 4)

van de Mheen, H., Stronks, K., Looman, C.W.N., Mackenbach, J.P. (1998). "Does childhood socioeconomic status influence adult health through behavioural factors?." *International Journal of Epidemiology*, 27:431-437.