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Lifelong socioeconomic trajectory and premature mortality: the French GAZEL study.

ABSTRACT

Background: Studies conducted in the United Kingdom and Scandinavia show an inverse association between lifetime socioeconomic position and adult mortality. However, there is virtually no data from other countries and few investigations have examined non-cardiovascular mortality in men and women.

Methods: We studied lifelong socioeconomic trajectories (father's occupation, own occupation in young adulthood and in midlife) and premature (<= 65 yrs) mortality (all-cause, smoking-related cancer, diseases of the circulatory system, external causes) in the French GAZEL cohort study (14 972 men and 5 598 women, followed 1990-2004). Hazard ratios (HRs) were estimated using Cox regression models adjusted for age, marital status, tobacco smoking, alcohol consumption, body mass index and fruit and vegetable consumption.

Results: Men and women who experienced lifelong disadvantage or downward intergenerational mobility were at high risk of dying prematurely, compared to those with a favorable trajectory (age-adjusted HRs for all-cause mortality: cumulative disadvantage: 1.61, 95% CI 1.26-2.06 in men, 1.95, 95% CI 1.10-3.47 in women; downward mobility: 1.87, 95% 1.35-2.58 in men, 2.05, 95% CI 1.12-3.75 in women). Results were strongest for mortality due to chronic diseases (smoking-related cancers and diseases of the circulatory system). These associations were partly explained by marital status, body mass, alcohol consumption, cigarette smoking, and fruit and vegetable consumption.

Conclusions: In France, where the leading cause of premature mortality is cancer, lifelong socioeconomic position is associated with the risk of dying before age 65. Adult factors appear more relevant than childhood socioeconomic circumstances.

Keywords: Lifecourse; socioeconomic trajectory; occupational grade; premature mortality; France; men; women; GAZEL

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BACKGROUND

In studies conducted in Scandinavia, the United Kingdom, and the United States, lifelong socioeconomic circumstances have been shown to predict adult mortality, particularly due to cardiovascular causes (1-8). Of those, few investigations examined non-cardiovascular causes of death (3;4;7). Yet, in OECD countries, cancer, suicide, and injury account for 50% of mortality prior to age 70 and there is need for additional data on non-cardiovascular causes of death (9).

To date, few studies in this area included women. A recent investigation from the United States, reported that the degree of association between lifelong socioeconomic position and women's cardiovascular mortality is similar to that observed in men(6), however this may not be the case for other causes of death, and particularly for cancer mortality. Across industrialized countries, men's premature cancer mortality (ages 35 to 65) is primarily due to lung cancer(10), the rates for which are highest in socioeconomically disadvantaged groups(11). Among women, the leading cause of cancer mortality is breast cancer, and while incidence rates are generally higher in affluent groups(12), data on mortality rates across socioeconomic groups appear inconsistent(13;14).

Our aim was to investigate the association between lifelong socioeconomic circumstances and premature mortality in France, where men's premature mortality rates, and particularly premature cancer mortality rates, are among the highest in Europe (French men's mortality rates are especially high for cancers of the lung and of the upper aerodigestive airways)(15). Using data from the GAZEL cohort study, we studied all-cause and cause-specific mortality before age 65 over a 15-year period of follow-up.

MATERIALS AND METHODS

Study population

The GAZEL study is an occupational cohort of 15 015 men and 5 623 women employed by France's national gas and electricity company (Electricité de France-Gaz de France – EDF-GDF). In 1989, all male employees aged 40 to 50 and all female employees 35 to 50 were asked to participate in this long-term epidemiological study (women represent 20% of employees which is why they were oversampled): 45% of those eligible agreed to participate. Since baseline, participants complete a yearly mailed questionnaire (average response rate 75%). In addition, certain socio-demographic and health data are available from company records. As in other large cohorts, study participants were healthier than eligible nonrespondents (16).

EDF-GDF is a large public sector company and guarantees all employees job security and opportunities for upward mobility. A majority of employees are hired around age 20 and stay with the company until retirement (very few leave voluntarily and they are never downgraded). After retirement, the company pays former employees' pensions. Overall, the GAZEL cohort's follow-up is very thorough - less than 1% were lost to follow-up since 1989.

Measures

Socioeconomic position

We measured socioeconomic position at different points in time: in childhood (father's occupation), at job market entry (occupational grade at hire) and in midlife (occupational grade in 1989). Father's occupation was reported in the 1989 GAZEL study questionnaire ('What is, or was, your father's occupation?'); own occupational grade was obtained from EDF-GDF company records. Occupational grade, coded using France's national job classification, was dichotomized into 'high' or 'low' grade (managers, craftsmen, professionals and technicians vs. manual workers, clerks and farmers)(17). French farmers are a heterogeneous group, but their average income and education levels are comparable to manual workers', which is why we included them in the 'low' grade group (18). Among GAZEL cohort members, there were no farmers, craftsmen or self-employed, only among fathers. Adult occupational grade was available for the entire cohort, but 12% of participants did not report their father's occupation. The socio-demographic characteristics of the entire sample are presented in Tables 1 and 2 ('father: job grade unknown'), but the analysis was restricted to those with valid father's occupation data.

Based on these 3 measures, we identified 6 lifelong socioeconomic trajectories(19): 1) high grade father's job→high grade job at hire→high grade job in 1989; 2) high→low→high; 3) high→low→low; 4) low→high→high; 5) low→low→high; 6) low→low→low (owing to their public sector employee status, GAZEL cohort participants either remained in the same job or moved up). In cause-specific mortality analyses, to study a sufficient number of cases in each group, we used a summary measure based on father's and own midlife occupational grade (4 groups: 1) high→high, 2) high→low, 3) low→high; 4) low→low).

In additional analyses, we used three other measures of childhood socioeconomic circumstances: educational level (reported in 1989: >=high school diploma vs. <high school diploma), height (reported in 1990 and dichotomized at the median: 1.73m for men, 1.62m for women), and birth during World War II (1939-1945 vs. 1946-1954)(1). We also investigated the relationship between premature mortality and participants' detailed job trajectory (6

categories: stable manager; technician/professional→manager; manual worker/clerk→manager; stable technician/professional; manual worker/clerk→technician/professional, stable manual worker/clerk).

Socio-demographic and health characteristics

Age, marital status (married/living with a partner vs. single/widowed/divorced), cumulative tobacco smoking (never smoker,<10,10-19.9,20-39.9,>=40 pack-years) and alcohol consumption (men: 0,1-2,3-4,>=5 drinks/day; women: 0,1,2-3,>=4 drinks/day)(20) were obtained from the 1989 GAZEL survey. The consumption of fruit and vegetable (daily vs. less than daily), body weight and height were collected in 1990. Participants' body mass index (BMI) was studied in 4 categories: <20, 20-24.9, 25-29.9,>=30 kg/m². In secondary analyses, we additionally controlled for 1989 self-rated health (good vs. poor), which had little effect on our overall results.

Study outcome

Mortality data were obtained from EDF-GDF company records (all-causes: 1989-April 30, 2004). The causes of death, recorded by France's national death registry (INSERM-CépiDC) were matched with GAZEL records for the period January 1st 1989-December 31, 2001. Underlying diagnoses were coded using the International Classification of Disease (10th version) (21). In men, we distinguished smoking-related cancers (oral cavity:C01-C14, oesophagus:C15, pancreas:C25, larynx: C32, lung: C34, respiratory airways: C39, bladder: C67); diseases of the circulatory system (I00-I99) and external causes: V01-X84). In women, due to a small number of cases, we grouped all deaths due to cancer (C00-C97). To reduce the possibility that illness caused a lack of occupational mobility, all deaths that occurred in the first 12 months of follow-up were excluded from the analysis. Participants were aged 35 to 65 during the study period and all deaths occurred prior to age 65 (in France, deaths that occur before age 65 are considered premature(15), and we refer to 'premature mortality' throughout the paper).

Statistical analysis

Mortality hazard ratios (HRs) were calculated using Cox regression models, with age in 1989 as the time offset. The proportional hazards assumption was met. The fully adjusted models were controlled for marital status, cumulative tobacco smoking, alcohol consumption, BMI, and

fruit and vegetable consumption. The following formula was used to estimate the difference between age and fully adjusted models: % change= $(HR_{age}-1)-(HR_{fully\ adjusted}-1)/(HR_{age}-1)$. In additional analyses, we tested the main effect of childhood socioeconomic position (the full range of father's occupation, educational level, height and birth during World War II) and of career trajectories.

All analyses were conducted separately for men and women, using the SAS statistical software package, version 8.02(22).

The GAZEL study received the approval of France's national ethics committee (Commission Nationale Informatique et Liberté, CNIL). The present study was also approved by the Human Subjects Committee of the Harvard School of Public Health.

RESULTS

14 972 men and 5 598 women were followed from January 1990 to April 2004. During this period, respectively 697 and 118 died; the underlying cause of death was known for all 530 male and 93 female deaths that occurred prior to December 31, 2001. The leading cause was cancer (men: 46%, women: 63%). In men, the most frequent type were smoking-related cancers (22% of deaths); in women, breast cancer (26% of deaths). Other major causes of death included diseases of the circulatory system (men: 18%, women: 8%), and external causes (ex. transport injuries, intentional self-harm: men: 16%, women: 15%). The overall mortality rate was 332/100 000 person-years for men and 148/100 000 for women, roughly half the rates observed in France's general population of the same age(15).

45% of study participants reported that their father worked in a job we classified as 'low grade'(Tables 1 and 2). 82% themselves worked in a 'low grade' job when hired by EDF-GDF, but, by midlife 81% of men and 68% of women moved up to a 'high grade' occupation. Those whose father worked in a 'low grade' job were on average shorter, less likely to have completed high school and more likely to report poor health than those whose father worked in a 'high grade' occupation. However, baseline characteristics were principally associated with adult circumstances: men with 'low' midlife occupational grade were most likely to have remained single, to smoke cigarettes, to drink more than 4 glasses of alcohol per day, to be obese, and to report being in poor health; women in that group were especially likely to be divorced. Participants with 'low' grade jobs were most likely to fail to respond to questions pertaining to alcohol and tobacco consumption, BMI or diet.

(Table 1 and Table 2 here)

Father's occupation and own occupational trajectory

As shown in Figures 1 and 2, compared to participants with the most favorable socioeconomic trajectory ('high grade' father's and own career-long occupation), the risk of mortality was elevated among men and women who experienced lifelong socioeconomic disadvantage ('low grade' father's and own career-long occupation, age-adjusted HRs: men: 1.93, 95% CI 1.38-2.71; women: 1.63, 95% CI 0.65-4.07) or downward intergenerational mobility (father's occupation 'high grade', own career-long occupation 'low grade', age-adjusted HRs: men: 2.24, 95% CI 1.15-3.34; women: 1.71, 95% CI 0.67-4.35). Among men, we observed a similar pattern among those who did not report their father's occupation (compared to participants with the most favorable trajectory, the age-adjusted HR for father's occupation 'unknown' and 'low grade' career-long occupation: 3.24, 95% CI 2.02-4.96).

(Figure 1 and Figure 2 here)

In additional analyses, father's occupation was not associated with men's premature mortality; in women, this association was not statistically significant (for father's occupation, age-adjusted HRs for 'low' compared with 'high' grade: 1.09, 95% CI 0.93-1.28 for men, 1.41, 95% CI 0.95-2.09, for women). Educational level was associated with men's but not women's mortality (compared to >=high school, age-adjusted HRs for <high school: 1.47, 95% CI 1.20-1.79 for men and 1.33, 95% CI 0.80-2.21 for women) and this effect disappeared after adjusting for midlife occupational grade. Height and birth during World War II did not predict premature mortality (not shown).

By contrast, premature mortality was associated with participants' career trajectory: compared to stable managers, men who worked in nonmanagerial jobs since they were hired were at increased risk: age-adjusted HRs were 2.28 (95% CI 1.23-4.20) for stable technicians and professionals and 2.93 (95% CI 1.93-4.44) for stable manual workers and clerks (results not shown).

Father's and own adult occupational grade

As shown in Table 3, compared to those with favorable socioecononomic position throughout life, men who experienced lifelong disadvantage (father's and own midlife occupation 'low' grade) were at high risk of dying from smoking-related cancers and diseases of the circulatory system. For mortality due to smoking-related cancers and external causes, the risk was also elevated among men who experienced downward intergenerational mobility (for external causes the associated HRs did not reach statistical significance).

(Table 3 here)

Adjusting for marital status, tobacco smoking, alcohol consumption, BMI and fruit and vegetable consumption reduced the association between cumulative disadvantage and total mortality by 33%, and by 43% for downward intergenerational mobility (tobacco smoking and alcohol consumption played the most important role).

In further analyses, men's chronic disease mortality was related to the career trajectory: compared with career-long managers, age-adjusted HRs for stable manual workers or clerks were 4.54; 95% CI 1.95-10.58 for smoking-related cancers and 2.18; 95% CI 1.39-3.40 for mortality due to diseases of the circulatory system.

Among women, both cumulative disadvantage and downward intergenerational mobility were associated with a high risk of total and cancer mortality (Table 4).

Table 4 here

In additional analyses, compared to stable managers, both stable clerks and women who were promoted to managerial jobs appeared at high risk of premature mortality, but the associated HRs did not reach statistical significance (not shown).

DISCUSSION

In this prospective study of French men and women, sustained socioeconomic disadvantage predicted premature mortality. Overall, the occupational trajectory in adulthood played a greater role than childhood socioeconomic circumstances. To our knowledge, this is one of few studies on this topic that focused on non-cardiovascular causes of mortality and that was based outside of Scandinavia or the United Kingdom (2;7;23).

Effect of childhood socioeconomic circumstances

Compared with past studies, in the GAZEL cohort, childhood socioeconomic circumstances were weak predictors of premature mortality (2;6;19;23). Father's occupation was obtained retrospectively and without reference to a specific time period, and coded into 'low' or 'high' grade, rather than 'manual' or 'non-manual' worker as in several past investigations (2;6;19). However, when we repeated the analyses using the 'manual vs. non-manual' classification, our results were unchanged and other indicators of childhood socioeconomic circumstances (1;24) yielded similar null results – only educational attainment predicted mortality, but this effect disappeared after adjusting for midlife occupational grade. It may well be that educational attainment impacts health in part through occupational exposures and experiences in adulthood. Our measures of childhood socioeconomic

circumstances were associated with one another, and we believe that they are valid. However, we acknowledge that we used broad indicators which may have lacked precision(25).

The distribution of father' occupation in the GAZEL cohort is comparable with the distribution of occupations in France in the 1950s and 1960s, as reported by the national census. Yet, our study population only comprised working men and women, and did not include individuals who were excluded from the job market, and who may have suffered the harshest childhood circumstances. This is the case in all occupational cohorts, yet in some, such as the Whitehall study of civil servants, associations between childhood socioeconomic circumstances and adult mortality have been reported (26). Therefore, although the GAZEL study is a selected population, our null findings with regard to father's occupation are probably not entirely due to selection effects.

The most plausible explanation has to do with mortality patterns. In the GAZEL study, as in the French population, men's leading cause of death was smoking-related cancer (lung, upper aerodigestive airways, oesophagus, pancreas, bladder). Although there are reports of an association between childhood socioeconomic position and lung cancer(25), our findings are consistent with the hypothesis that these tumors are principally associated with adult exposures related to tobacco and alcohol, and stressful environmental exposures(27).

In women, our data suggest a possible, albeit not statistically significant, association between father's occupation and premature mortality. The leading cause of women's death was breast cancer (26%) and an association would be consistent with mounting evidence that breast cancer reflects early life influences (e.g. birth weight, birth length, age at menarche, age at first birth (28-32). We plan to reexamine that hypothesis when a sufficient number of site-specific cancer deaths is accrued.

Occupational trajectories in adulthood and premature mortality

In our study, premature mortality from all-causes was chiefly associated with occupational trajectories in adulthood: the risk of dying prematurely was highest in men and women who worked in low grade occupations throughout their career. This was most apparent for chronic disease mortality. It is important to note that, as other investigations based on occupational cohorts, our study was influenced by the 'healthy worker' effect (that is participants were healthier than the general population, as demonstrated by lower mortality rates). In addition, men and women who agreed to participate in the GAZEL cohort were healthier than eligible non-respondents(16).

The association between the occupational trajectory and mortality likely reflects both the selection of less healthy individuals into lower grade occupational groups and an increase

in mortality risk as a consequence of a disadvantaged occupational position. GAZEL study participants were probably healthy when they joined EDF-GDF, and health-related selection at job entry is unlikely. However, as shown by previous reports from this cohort, health characteristics and health behaviors (e.g. excessive alcohol consumption) influenced later career progress (20;33). The high risk of mortality from external causes among men employed in a lower grade job than their father, which needs to be confirmed in studies with a larger number of cases, suggests shared common (and possibly omitted) causes of both a high risk of premature death and restricted socioeconomic attainment.

Health selection is unlikely to be the only explanation, however. Individuals working in low grade jobs are more likely to engage in health-damaging behaviors, to be exposed to physical and chemical hazards, stress, and insufficient social support and to have lesser access to quality health care, all of which increase premature mortality risks (34-36). The extent to which health selection and social causation contribute to socioeconomic inequalities in premature mortality requires further research(37).

Women

To date, few investigations of lifelong socioeconomic factors and mortality included women and those that did primarily focused on cardiovascular mortality (6;7;23). In our study, 54% of female deaths were due to cancer, 48% of which were attributable to breast cancer. Our cause-specific analyses were restricted by a limited number of deaths, but overall, our results provide support for the hypothesis that sustained socioeconomic disadvantage is associated with increased breast cancer mortality rates (38). The underlying mechanisms are probably related to a worse prognosis, rather than a higher risk of occurrence, but incidence rates of breast cancer among socioeconomically disadvantaged women may be increasing over time, and require close monitoring(39;40).

Overall, associations between occupational grade, educational level, health and behavioral characteristics were weaker in women than in men. This could reflect a smaller number of deaths. In addition, occupational grade is probably a less salient indicator of women's socioeconomic position than men's. Even in our cohort of public sector employees, women systematically work in lower grade jobs, even accounting for age, educational attainment, the number of years with the company, and part-time work. This is indicative of national trends in France, where despite a strong female workforce participation (42% in 1990, 46% in 2000), occupational gender inequalities persist (in 1990, 7% of women worked as managers, compared to 13% of men; in 2000 these figures were respectively 10 and 16%)

(41;42). Thus, researchers studying socioeconomic health disparities in women should consider using multiple measures that take into account household characteristics (e.g. multiple role occupancy, division of labor), husband's socioeconomic position, as well as work/family relations(43;44).

Conclusion

In France, where the leading cause of premature mortality is cancer, men and women who experience unfavorable lifelong socioeconomic conditions, particularly in adulthood, are at high risk of dying before age 65. It is important to note that we studied employees of a large public sector company who are healthier than the general population, and the associations we report probably underestimate the effects of lifelong socioeconomic disadvantage on mortality in the general population. Other studies in settings were cancer is the leading cause of premature mortality are needed.

- What is already known?

Studies from Scandinavia and the United Kingdom report an association between childhood and adult socioeconomic position and mortality. Most of these studies focused on cardiovascular mortality. Data from other countries, regarding non-cardiovascular causes of death are scarce.

- What this paper adds

In France, where cancer is the leading cause of mortality, cumulative disadvantage and downward intergenerational mobility predict the risk of premature death (<=age 65) in men and women. Adult factors have a stronger predictive effect than childhood circumstances, particularly for deaths due to smoking-related cancers. Additional research on socioeconomic position across the lifecourse and mortality in settings with diverse mortality patterns is needed.

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Table 1 Baseline characteristics of GAZEL cohort men according to father's and own midlife occupational grade.

	Father's job: high grade		**Father's job: low grade**		**Father's job grade: unknown**		
Own midlife occupational grade	**High (→)[*] n=5 587**	**Low (↓) n=624**	**High (↑) n=5 678**	**Low (→) n=1 467**	**High n=1 273**	**Low n=342**	**p-value[†]**
Age ($\overline{\chi}$, sd)	44.0 (2.80)	44.6 (2.72)	44.9 (2.85)	44.6 (2.89)	45.2 (2.80)	44.9 (2.96)	***
Height <1.73 m (%)	35.1	38.1	41.0	41.2	37.3	40.0	***
Missing data	12.6	19.0	12.1	20.9	13.3	24.8	
Educational level (%)							
<High School	61.4	94.2	79.5	97.9	74.4	97.1	***
>=High School	38.7	5.8	20.5	2.1	25.6	2.9	
Yrs at EDF-GDF ($\overline{\chi}$, sd)	22.0 (5.33)	19.6 (6.64)	22.4 (5.50)	19.0 (6.64)	22.2 (5.37)	18.6 (6.82)	***
Low grade job at hire (%)	70.6	100	85.4	100	80.5	100	***
Marital status (%)							
Married/with partner	93.3	90.4	93.9	92.1	91.6	89.2	
Single	2.3	4.5	2.0	3.7	3.3	7.1	***
Separated/widowed	4.4	5.1	4.1	4.2	5.1	3.7	
Cumulative smoking (%)							
Never smoker	33.2	28.2	35.5	35.6	31.7	31.0	
<10 pack-years	17.7	14.1	16.6	14.7	16.1	16.4	***
10-20 pack-years	21.0	21.6	19.9	17.4	21.5	16.4	
20-40 pack-years	20.6	25.6	19.8	22.9	20.7	24.0	
>=40 pack-years	5.1	6.2	5.2	5.4	6.2	6.4	
Missing data	2.2	4.1	3.0	4.0	3.8	5.8	
Alcohol consumption (%)							
0	1.5	4.3	1.6	3.1	2.3	3.8	
1-2 drinks/day	67.9	56.4	67.6	56.6	67.8	55.5	***
3-4 drinks/day	18.6	19.4	18.7	12.2	17.2	17.3	
>=5 drinks/day	10.0	17.7	10.0	15.9	9.9	17.0	
Missing data	1.9	5.1	2.1	3.3	2.8	6.4	
BMI (%)							
<20 kg/m²	1.8	1.4	1.2	1.6	0.9	3.5	***
25-30 kg/m²	37.1	34.6	41.0	37.4	38.2	37.1	
>30 kg/m²	4.1	5.9	4.2	7.0	5.1	7.9	
Missing data	12.8	19.0	12.3	21.0	13.4	24.9	
Fruits and vegetable (%)							
< daily	36.5	35.5	37.4	32.9	34.6	31.0	***
Missing data	11.1	18.2	10.8	19.7	12.2	23.7	
Poor self-rated health (%)	11.1	17.8	12.5	17.0	13.3	23.3	***
N deaths[‡]							
all-cause	221	44	241	91	64	35	
smoking-related cancers	32	8	41	18	11	5	
other cancers	41	6	42	15	14	3	
circulatory system diseases	36	8	20	23	11	2	
external causes	27	6	34	7	7	2	

[*] →: stable socioeconomic circumstances, ↓: downward intergenerational mobility; ↑: upward intergenerational mobility

[†] P-value comparing baseline characteristics across lifecourse trajectories: ***: <0.0001, **: <0.01, *: <0.05

[‡] The causes of death were coded using the 10the version of the International Classification of Diseases: smoking-related cancers (C01-C14, C15, C25, C32, C34, C39, C67); circulatory system diseases (I00-I99), external causes: V01-X84).

Table 2 Baseline characteristics of GAZEL cohort women according to father's and own midlife occupational grade.

	Father's job: high grade		**Father's job: low grade**		**Father's job grade: unknown**		
Own midlife occupational grade	**High (→)[*] n=1 970**	**Low (↓) n=630**	**High (↑) n=1 512**	**Low (→) n=771**	**High n=457**	**Low n=259**	**p-value[†] [†]**
Age ($\overline{\chi}$, sd)	42.3 (4.21)	41.3 (3.98)	42.5 (4.14)	41.0 (4.06)	42.7 (4.06)	42.1 (4.08)	***
Height <1.62 m (%)	37.8	38.7	39.6	42.8	40.7	41.7	***
Missing data	14.8	21.1	16.6	21.5	18.8	21.6	
Educational level (%)							
<High School	65.6	84.1	81.7	91.6	79.0	89.9	***
>=High School	34.4	19.9	18.3	8.4	21.0.	10.1	
Yrs at EDF-GDF ($\overline{\chi}$, sd)	18.8 (7.09)	15.4 (7.49)	19.5 (6.73)	14.7 (7.45)	19.7 (7.02)	15.1 (8.20)	***
Low grade job at hire	79.9	100	90.5	100	90.6	100	***
Marital status (%)							
Married/ with partner	78.6	77.4	79.2	75.8	75.4	70.8	
Single	8.0	5.2	7.2	6.3	8.5	6.6	**
Separated/Widowed	13.4	17.4	13.6	17.8	16.1	22.6	
Cumulative smoking (%)							
Never smoker	62.5	62.5	69.1	69.0	65.0	62.6	
<10 pack-years	17.4	18.9	14.1	13.4	13.8	13.1	**
10-20 pack-years	10.7	9.2	7.7	7.9	8.1	10.8	
>=20 pack-years	6.2	5.4	5.9	5.7	7.2	7.7	
Missing data	3.1	4.0	3.2	4.0	5.9	5.8	
Alcohol consumption (%)							
0	4.2	5.4	3.6	5.6	6.1	5.0	
1 drink/day	84.1	79.5	85.1	81.4	79.4	83.8	***
2-3 drinks/day	7.9	9.8	8.4	7.5	8.9	3.5	
>=4 drinks/day	2.0	1.8	1.2	1.7	2.2	1.9	
Missing data	1.8	3.5	1.7	1.7	3.4	5.8	
BMI (%)							
<20 kg/m²	17.6	15.0	15.7	15.6	14.6	13.9	**
25-30 kg/m²	10.3	10.7	10.0	12.2	11.3	13.1	
>30 kg/m²	2.6	3.0	2.8	3.0	3.5	1.9	
Missing data	15.0	21.6	16.8	21.7	19.0	21.6	
Fruit and vegetable (%)							
< daily	23.9	24.2	21.6	21.6	24.5	22.4	***
Missing data	11.6	18.8	14.2	18.6	16.9	19.3	
Poor self-rated health (%)	14.1	14.3	10.9	18.2	15.6	21.4	***
N deaths[‡]							
all causes	28	17	35	20	13	4	
cancer	11	8	17	11	6	3	

[*] →: stable socioeconomic circumstances, ↓: downward mobility over the lifecourse; ↑: upward mobility over the lifecourse

[†] P-value comparing baseline characteristics across lifecourse trajectories: ***: <0.0001, **: <0.01, *: <0.05

[‡] The causes of death were coded using the 10the version of the International Classification of Diseases: cancer (C00-C97).

Table 3 Father's and own midlife occupational grade and premature mortality in the GAZEL cohort study: men (40-65 yrs; 1990-2001). Crude rates, age-adjusted and fully adjusted Hazard Ratios (HR, 95% Confidence Intervals (CI)[*].

	Father's job: high grade[†]		**Father's job: low grade**	
Own midlife occupational grade	**High[‡] (→) N=5534**	**Low (↓) N=618**	**High (↑) N=5612**	**Low (→) N=1449**
All-causes				
Rate/ 100 000 p-yrs *(n cases)*	282 *(221)*	503 *(43)*	303 *(241)*	447 *(90)*
Age-adjusted HR (95% CI)	1.0	1.87 (1.35-2.58)	1.07 (0.89-1.29)	1.61 (1.26-2.06)
Fully adjusted HR[§] (95% CI)	1.0	1.54 (1.11-2.13)	1.10 (0.92-1.32)	1.45 (1.13-1.85)
Smoking-related cancers				
Rate/ 100 000 p-yrs *(n cases)*	46 *(33)*	101 *(8)*	56 *(41)*	96 *(18)*
Age-adjusted HR (95% CI)	1.0	2.76 (1.61-4.75)	1.03 (0.72-1.48)	2.09 (1.34-3.25)
Fully adjusted HR (95% CI)	1.0	2.25 (1.30-3.89)	1.09 (0.76-1.57)	1.92 (1.23-3.01)
Other cancers				
Rate/ 100 000 p-yrs *(n cases)*	57 *(41)*	75 *(6)*	58 *(42)*	80 *(15)*
Age-adjusted HR (95% CI)	1.0	2.10 (1.20-3.69)	0.89 (0.63-1.27)	1.62 (1.04-2.54)
Fully adjusted HR (95% CI)	1.0	1.93 (1.10-3.40)	0.95 (0.65-1.30)	1.57 (0.99-2.47)
Diseases of the circulatory system				
Rate/ 100 000 p-yrs *(n cases)*	50 *(36)*	102 *(8)*	27 *(20)*	124 *(23)*
Age-adjusted HR (95% CI)	1.0	2.08 (0.96-4.48)	0.54 (0.31-0.94)	2.56 (1.51-4.32)
Fully adjusted HR (95% CI)	1.0	1.73 (0.80-3.77)	0.57 (0.33-0.98)	2.35 (1.38-4.01)
External causes				
Rate/ 100 000 p-yrs *(n cases)*	37 *(27)*	76 *(6)*	46 *(34)*	37 (7)
Age-adjusted HR (95% CI)	1.0	2.01 (0.83-4.89)	1.24 (0.74-2.05)	1.00 (0.44-2.32)
Fully adjusted HR (95% CI)	1.0	1.58 (0.64-3.88)	1.25 (0.75-2.08)	0.85 (0.36-1.97)
Other causes				
Rate/ 100 000 p-yrs *(n cases)*	35 *(25)*	115 *(9)*	41 *(30)*	48 *(9)*
Age-adjusted HR (95% CI)	1.0	3.43 (1.60-7.36)	1.18 (0.69-2.01)	1.46 (0.68-3.14)
Fully adjusted HR (95% CI)	1.0	2.49 (1.14-5.44)	1.22 (0.71-2.08)	1.28 (0.59-2.77)

[*] ICD-10 codes of mortality causes: smoking-related cancers: C01-C15;C25;C32;C34;C39;C67; diseases of the circulatory system I00-I99; external causes: V01-X84.
[†] High grade jobs: manager, technician, administrative associate (+craftsman, father only); low grade jobs: clerk, manual worker (+farmer, father only).
[‡] →: stable socioeconomic circumstances, ↓: downward mobility over the lifecourse; ↑: upward mobility over the lifecourse
[§] Adjusted for age, marital status, cumulative tobacco smoking, alcohol consumption, BMI and fruit and vegetable consumption.

Table 4 Father's and own midlife occupational grade and premature mortality in the GAZEL cohort study: women (35-65 yrs; 1990-2001). Crude rates, age-adjusted and fully adjusted Hazard Ratios (HR, 95% Confidence Intervals (CI))[§].

	Father's job: high grade[*]		**Father's job: low grade**	
Own midlife occupational grade	**High[†] (→) N=1965**	**Low (↓) N=624**	**High (↑) N=150**	**Low (→) N=769**
All-causes				
Rate/100 000 p-yrs *(n cases)*	100 *(28)*	192 *(17)*	164 *(35)*	186 *(20)*
Age-adjusted HR (95% CI)	1.0	2.05 (1.12-3.75)	1.61 (0.98-2.64)	1.95 (1.10-3.47)
Fully adjusted HR[‡] (95% CI)	1.0	2.01 (1.09-2.76)	1.68 (1.01-2.76)	1.92 (1.07-3.43)
Cancer				
Rate/100 000 p-yrs *(n cases)*	43 *(11)*	99 *(8)*	87 *(17)*	122 *(12)*
Age-adjusted HR (95% CI)	1.0	2.47 (1.00-6.16)	1.99 (0.93-4.26)	2.76 (1.19-6.37)
Fully adjusted HR (95% CI)	1.0	2.51 (1.00-6.31)	2.03 (0.95-4.35)	2.74 (1.17-6.39)
Other causes				
Rate/ 100 000 p-yrs *(n cases)*	39 *(10)*	37 *(3)*	41 (8)	71 (7)
Age-adjusted HR (95% CI)	1.0	0.89 (0.09-8.01)	0.64 (0.11-3.53)	1.43 (0.26-7.89)
Fully adjusted HR (95% CI)	1.0	0.86 (0.09-8.08)	0.73 (0.12-4.16)	1.60 (0.27-9.38)

[*] High grade jobs: manager, technician, administrative associate (+craftsman, father only); low grade jobs: clerk, manual worker (+farmer, father only).
[†] →: stable socioeconomic circumstances, ↓: downward mobility over the lifecourse; ↑: upward mobility over the lifecourse
[‡] Adjusted for age, marital status, cumulative tobacco smoking, alcohol consumption, BMI and fruit and vegetable consumption.
[§] ICD-10 codes of mortality causes: smoking-related cancers: C01-C15;C25;C32;C34;C39;C67; diseases of the circulatory system I00-I99; external causes: V01-X84.

Figure 1 Father's occupational grade, own occupational trajectory and all-cause premature mortality : men of the GAZEL cohort study (40-65 yrs; 1990-2004). Rate/ 100 000 and age-adjusted hazard ratios (HR; 95% Confidence interval).

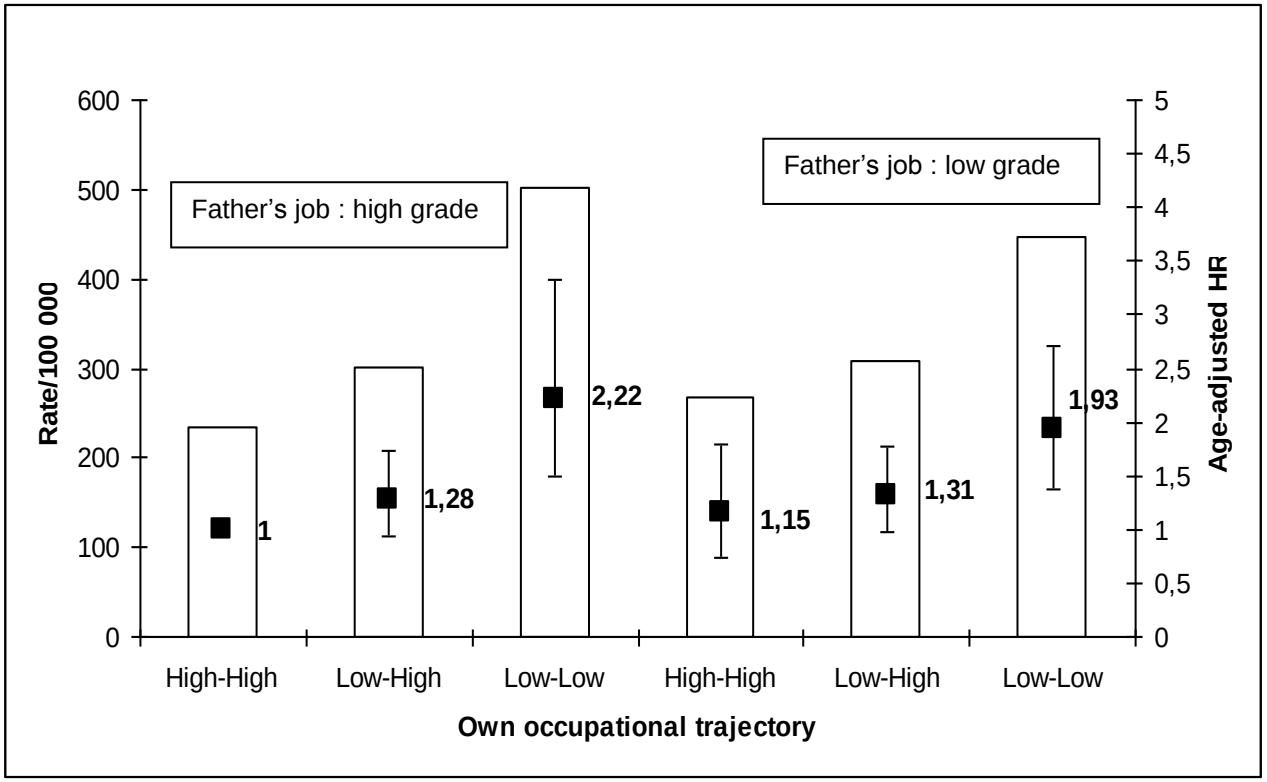

Figure 2 Father's occupational grade, own occupational trajectory and all-cause premature mortality: women of the GAZEL cohort study (35-65 yrs; 1990-2004). Rate/ 100 000 and age-adjusted hazard ratios (HR; 95% Confidence interval).