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► **To cite this version:**

Hugo Westerlund, Mika Kivimäki, Archana Singh-Manoux, Maria Melchior, Jane E Ferrie, et al..  
Self-rated health before and after retirement in France (GAZEL): a cohort study.. *The Lancet*, 2009,  
374 (9705), pp.1889-96. 10.1016/S0140-6736(09)61570-1 . inserm-00431840

**HAL Id: inserm-00431840**

**<https://inserm.hal.science/inserm-00431840>**

Submitted on 13 Nov 2009

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# Self-rated health before and after retirement: findings from the French GAZEL cohort study

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## **Funding:**

HW and CL are supported by the Swedish Council for Working Life and Social Research (FAS, grants #2004-2021, #2007-1143), JV and MK are supported by the Academy of Finland (grants #117604, #124271, #124322 and #129262), MK is additionally supported by the BUPA Foundation Specialist research grant, JEF is supported by the MRC (Grant number G8802774), ASM is supported by a EUYRI award from the European Science Foundation. This work was additionally supported by a grant from the ESRC Research Seminar Series Competition 2007/8 (RES-451-26-0491).

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**Date:** 11 August 2009

Words in abstract: 247

Words in main text: 3,607 incl. table references etc.

Number of figures: 3

Number of tables: 2

Number of references: 36

## SUMMARY

*Background.* Despite the need to increase the proportion of the population in work in most Western countries, few studies have investigated longitudinally how perceived health is influenced by work and retirement among older workers.

*Methods.* We examined trajectories of self-rated health in 14,714 employees (79% men) from the national French gas and electricity company, the GAZEL cohort, for up to 7 years prior, and 7 years post-retirement, using yearly measurements from 1989 to 2007. Data were analysed using repeated-measures logistic regression with generalised estimating equations (GEE).

*Findings.* Overall, suboptimal health increased with age. However, between the year before retirement and the year after, the estimated prevalence of suboptimal health fell from 19.2% [95% confidence interval 18.5%-19.9%] to 14.3% [13.7%-14.9%], corresponding to an 8–10 year gain in health. This retirement-related improvement was found in men and women, across occupational grades, and was maintained throughout the seven-year post-retirement follow-up period. A poor work environment and health complaints before retirement were associated with a steeper yearly increase in the prevalence of suboptimal health while still in work, and a greater retirement-related improvement. However, those with a combination of high occupational grade, low demands, and high satisfaction at work showed no such retirement-related improvement.

*Interpretation.* These findings suggest that the burden of ill-health, in terms of perceived health problems, is substantially relieved by retirement for all but those with ideal working conditions. This indicates a need to redesign work for older workers in order to achieve higher labour market participation.

*Funding.* The Swedish Council for Working Life and Social Research (Sweden), The Academy of Finland (Finland), INSERM (France), The BUPA Foundation (UK), The Medical Research Council (UK), The European Science Foundation (EU), and The Economic and Social Research Council (UK).

## **INTRODUCTION**

Due to increasingly top-heavy population pyramids, governments in most Western countries are seeking to increase the proportion of the population in work by pushing up retirement age.(1, 2) However, reversing the downward trend in de-facto retirement age (2-4) in this way is likely to be difficult,(5) particularly if older workers experience suboptimal health at work (4) while looking forward to a relatively healthy ‘third age’ beyond retirement.

Surprisingly little is known about the impact of work and retirement on older workers’ perceptions of health, a strong predictor of morbidity and mortality,(6-8) as well as of early retirement.(9) Previous studies have produced conflicting findings, some suggesting that health improves after retirement (10-13), others that it deteriorates,(14-16) and still others that it remains unaffected.(17-20) To date, however, there is no published evidence on changes in health measured repeatedly over an extended period of time covering both several years of employment preceding retirement, and several years following retirement.

In this prospective study, we used yearly measurements of self-rated health in a large and varied French occupational cohort to examine trajectories of health from seven years before retirement, to seven years after. We sought to determine how people’s perceived health is affected when they retire from work.

## **METHODS**

### **Study population**

The GAZEL cohort was established in 1989 and comprises employees of the French national gas and electricity company: Electricité de France-Gaz de France (EDF-GDF), from which the name of the study is derived.(21) At baseline, 20,624 employees (73% men), aged 35-50, gave consent to participate (Fig. 1). EDF-GDF employees hold civil servant-like status that entails job security and opportunities for occupational mobility. Typically, employees are hired when they are in their 20s

and stay with the company until retirement. Information on health, lifestyle, and individual, familial, social, and occupational characteristics of the GAZEL participants is collected by annual surveys.

<INSERT FIG. 1 ABOUT HERE>

In this study, we analysed data from GAZEL participants who retired between 1990 and 2006, inclusive (Fig. 1). Of all 18,884 retirees, we included in the study those who had provided self-rated health assessments at least once prior to and once after the year in which they retired. Thus, the cohort consisted of 14,714 employees (11,581 men and 3,133 women), retired at the mean age (standard deviation) of 54.6 (2.9) years.

### **Ascertainment of retirement**

We obtained data on official retirement date, long-standing illness or disability, and sickness absence from the company records. Because all retirement pensions are paid by EDF-GDF, company data on retirement are comprehensive and accurate, and less than 1% of the participants were lost to follow-up since 1989.<sup>(22)</sup> Statutory age of retirement is between 55 and 60 years depending on the type of job; the longer an employee has worked in a blue collar setting, the earlier she is allowed to retire. Although partial retirement is rare, retirement can occur before the age of 55. For instance, women with at least three children can retire after 15 years of service. Retirement on health grounds can be granted in the event of long-standing illness or disability.

We defined the year and type of retirement according to the first of the following events: receipt of an official retirement pension (statutory retirement), long-standing illness or disability, or over 650 days of sickness absence in two consecutive years. In the last case, the first year of permanent sickness absence is considered the year of retirement. Retirement from long-standing illness,

disability, or through prolonged sickness absence was considered early retirement. Age of retirement was divided into categories of 54 or earlier, 55, and 56 or later.

### **Self-rated health**

Self-rated health was assessed using a standard measure included in the annual questionnaires sent to all participants January 1989–2007: ‘How would you judge the state of your general health?’ The participants responded on an 8-point Likert scale (1 = very good...8 = very poor), which was dichotomised by categorising response scores 1–4 as good health and scores 5–8 as sub-optimal health, as previously validated.(23) We used all annual measurements in a 15-year time window ranging from the 7<sup>th</sup> year preceding retirement to the 7<sup>th</sup> after retirement.

### **Other variables**

Of the demographic factors, we included sex, year of birth, and marital status (last reported before retirement) in the analyses. We measured work-related factors as potential modifiers of the effect of retirement on self-rated health. We hypothesised that larger changes in self-rated health would follow retirement from an unfavourable occupational position and poor work environment, compared with retiring from a satisfying work setting. The work-related factors assessed were occupational grade, psychological and physical job demands, and job satisfaction. Occupational category immediately prior to retirement was derived from EDF-GDF records and was classified into three grades: higher (managers), intermediate (technical staff, line managers, and administrative associate professionals), and lower (clerical and manual workers), based on categorisations from the French National Institute of Statistics and Economic Studies ([www.insee.fr/en](http://www.insee.fr/en)). We measured psychological and physical job demands by the questions ‘Do you find that your job is psychologically tiring?’ and ‘Do you find that your job is physically tiring?’,(24) and job satisfaction by ‘All in all, are you satisfied with your work?’(25) Participants responded on 8-point scales and we calculated the means of these measurements in the three years preceding retirement. Mean scores were categorised into tertiles.

We assessed physical illnesses, musculoskeletal problems, mental health problems, and sickness absence during the last three years of employment to determine whether the trajectories of self-rated health were dependent on these conditions. We anticipated an improvement in self-related health after retirement among those with pre-retirement illnesses due to the difficulty in coping with modern work life with compromised health. A checklist was used to determine the following physical illnesses – chronic bronchitis or asthma, angina, myocardial infarction, stroke, diabetes, or cancer – and to assess depression.(26) An affirmative response regarding one or more of these conditions in any of the three years preceding retirement defined presence of a chronic condition. Presence of musculoskeletal problems was defined as an affirmative response to any musculoskeletal illness or complaint (back pain, neck- and shoulder pain, arthritis, rheumatoid arthritis, and sciatica) in all three years preceding retirement. High sickness absence, obtained from company records, was defined as more than 21 sick-leave days in the three-year calendar period preceding retirement (i.e. >7 days per year on average).

### **Statistical methods**

The analysis was based on a 15-year observation window with the year of retirement as year 0 and a 7-year observation period both before (years -7 to -1) and after retirement (years +1 to +7). To study the associations between potential explanatory variables and suboptimal health in the years -1 and +1, we used logistic regression analyses adjusting, where appropriate, for sex, age of retirement, occupational grade, type of retirement, and time of data collection (1989-1999 vs. 2000-2007). To examine changes in the likelihood of suboptimal self-rated health, we applied a repeated-measures logistic regression analysis using the generalised estimating equations (GEE) method with autoregressive correlation structure.(27) GEE takes into account the intra-individual correlation between measurements (see webappendix) and is not sensitive to missing measurements.

We calculated the annual odds of suboptimal self-rated health and their 95% confidence intervals (CI) adjusting for time of data collection, and transformed the odds to prevalence estimates in order to plot the trajectory of suboptimal health in relation to retirement. To study the slopes in three distinct time intervals, we used a single GEE model to fit the equation

$$\text{odds} = e^{a + b_1 \cdot x - b_2 + b_3 + c} \quad | \quad -7 \leq x \leq -1$$

$$\text{odds} = e^{a - b_1 + b_2 \cdot x + b_3 + c} \quad | \quad -1 < x \leq 1$$

$$\text{odds} = e^{a - b_1 + b_2 + b_3 \cdot x + c} \quad | \quad 1 < x \leq 7$$

where  $x$  is the year in relation to retirement,  $a = -1,780$   $[-1.829; -1.731]$  the intercept,  $b_1 = 0.056$   $[0.048; 0.065]$  the first slope,  $b_2 = -0.188$   $[-0.210; -0.164]$  the second slope,  $b_3 = 0.039$   $[0.029; 0.049]$  the third slope, and  $c = 0.210$   $[0.185; 0.235]$  a correction factor for time of data collection. To assess the fit of this model, we used the Quasi-Likelihood under the Independence model Criterion (QIC) and the related QICu statistic – lower values indicating better fit – (28) to compare this model, with its 2 inflection points, to two *a priori* models, one with 0 inflection points (a linear, age-related trajectory), and one with 1 inflection point at retirement (change in slope). The suggested model with 2 inflection points has clearly lower values of both QIC (156409.7844) and QICu (156400.4175) compared with the *a priori* models with 0 and 1 inflection points (QIC 156707.2266 and 156703.4106 respectively; and QICu 156697.5844 and 156693.8583 respectively), indicating that the model with 2 inflection points best fits the data.

We explored the effects of potential explanatory or modifying variables on the shape of the trajectory of self-rated health in relation to retirement by first testing whether the shape of the trajectory was dependent on the variable of interest by entering the interaction term ‘year \* explanatory variable’ into the regression model. If the interaction was significant, we calculated the

odds ratios of suboptimal health year  $-1$  compared with  $-7$ , year  $+1$  compared with  $-1$ , and  $+7$  compared with  $+1$ , for different levels of the explanatory variable using contrasts in the regression models.

In order to provide an illustration of the extent to which work-related factors account for the health trajectory in relation to retirement, we calculated annual prevalence estimates for suboptimal health over the 15-year time window for two scenarios involving men who retired at the statutory age of 55 and before the year 2000: one with a low-risk profile of work-related factors (i.e. higher occupational grade, physical and psychological demands in the lowest tertile, and job satisfaction in the highest tertile) and the other with a high-risk profile (low grade, high demands, low satisfaction). We derived these estimates from a single repeated measures logistic regression analysis that included the interaction term 'year \* explanatory variable' for each risk factor in the model.

The analyses were conducted using SAS 9.2 for Windows, SAS Institute Inc., Cary, NC, USA.

### **Role of the funding source**

The study sponsors did not contribute to the study design and had no role in data collection, data analysis, data interpretation, or writing of the report. The corresponding author had full access to all the data in the study and had final responsibility for the decision to submit for publication.

## **RESULTS**

Most of the 14,714 respondents were men (79%), married (89%), and, during the observation period, belonged to higher (33%) or intermediate (55%) employment grades due to upward social mobility within the company. Of the respondents, 10,564 (72%) retired before 56 years of age, and 14,635 (99%) before age 61. The percentage of respondents who retired for health reasons (early retirees) was 4% (Table 1). During the three years before retirement, 11% suffered from depression,

29% from musculoskeletal complaints, 15% from physical illness, and 32% had >21 days of sickness absence.

< INSERT TABLE 1 ABOUT HERE >

Table 1 shows that the odds of suboptimal health both immediately before and immediately after retirement were higher among married respondents, those who took early retirement, reported high psychological and physical demands, low job satisfaction, depression, musculoskeletal complaints, severe medical conditions, and had had high sickness absence. Women had a higher risk of suboptimal health than men before, but not after, retirement.

<INSERT FIG. 2 ABOUT HERE>

Fig. 2 shows the estimated annual prevalence of suboptimal health in relation to retirement, based on a total of 174,765 person-measurement observations (79.2% of the theoretical maximum of 220,710 person-measurements that would have been generated if every participant had responded to all 15 annual surveys in the observation window). The prevalence increased with increasing age both before and after retirement, broken by a sharp decrease around retirement, a pattern also evident in a sensitivity analysis using self-rated health as a continuous variable (see Webappendix Table W1). Thus, we modelled the 15-year trajectory of suboptimal health in three time intervals, from year -7 to -1, from -1 to +1, and from +1 to +7. This function fits the data well and indicates that the increase in prevalence of suboptimal health was steeper before retirement (on average 0.8 percentage points per year) than after (0.5 percentage points per year). Retirement marked a sharp drop in the prevalence of suboptimal health from 19.2 % [18.5–19.9] the year before to 14.3 % [13.7–14.9] the year after, a decrease of 4.9 percentage points. This means that the prevalence of suboptimal health returned to levels observed approximately 8 years earlier, and, given the change in slope, was estimated to stay lower than pre-retirement levels for about 10 years.

The retirement-related improvement in suboptimal health appears to occur over a two-year period (Fig. 2). This is because the survey is conducted each January, while retirement is spread over the year. In addition, some employees stop working several months before their official retirement date due to accumulated periods of vacation not taken during their employment.

To rule out selective sample retention as an explanation for these findings, we fitted a similar function for those 8,295 participants who responded to the survey 7 years after retirement (Webappendix, Fig. W1). The trajectory remained unaltered. To further test the robustness of the findings, we used multiple imputation based on all available data to create five datasets with values for all missing data on self-rated health for the seven years pre- and post-retirement imputed. We then fitted a function for each of these datasets (Webappendix Fig. W2), which yielded five trajectories very similar to the fitted function shown in Fig. 2.

<INSERT TABLE 2 ABOUT HERE>

Table 2 shows how potential explanatory and modifying variables affected the shape of the trajectory of suboptimal health before, around, and after retirement. There was no difference in trajectories between men and women before or around retirement. After retirement, men who initially had better health had a relatively pronounced increase in prevalence of suboptimal health (OR=1.35 [1.25–1.46]) whereas no increase was observed for women (OR=0.99 [0.86–1.14]). Marital status was not related to the shape of the health trajectory ( $p=0.17$ ) and was therefore dropped from the analyses presented in Table 2. Those who retired after the age of 55 had had a less steep increase in prevalence of suboptimal health before retirement than those who retired at 55 or earlier. They also benefited less from retirement, and had a smaller increase in suboptimal health after retirement; whereas those who retired before 55 (not counting those who retired on health grounds) benefited more from retirement than the other groups. Those who retired early on health

grounds had a significantly worse trajectory before retirement, and contrary to all other groups their likelihood of suboptimal health increased sharply around retirement (OR=5.82 [4.46–7.60]); after retirement, however, they experienced a strong decrease in prevalence of suboptimal health (OR=0.24 [0.18–0.31]).

As shown in table 2, there was no relative difference in the retirement-related improvement in health between employment grades, but employees in lower and intermediate grades had a significantly less favourable trajectory before retirement than those in higher grades. After retirement the latter pattern was reversed and no additional deterioration was seen among those in lower grades (OR=1.01 [0.85–1.19]).

High demands, both psychological and physical, were related to larger increase in prevalence of suboptimal health before retirement and greater benefit around retirement (Table 2). High job satisfaction was associated with a significantly slower increase in the prevalence of suboptimal health before retirement and less benefit from retirement, whereas those with low job satisfaction benefited the most from retirement.

Respondents who suffered from depression in any of the three years preceding retirement had a significantly worse health trajectory before retirement, benefited more from retirement, and had a less steep increase in the likelihood of suboptimal health thereafter than those who had not been depressed. Musculoskeletal symptoms in the three years preceding retirement, presence of one or more physical illnesses before retirement, as well as sickness absence >21 days during the three years preceding retirement were all related to worse trajectories in health before retirement and larger retirement-related improvements (Table 2).

<INSERT FIG. 3 ABOUT HERE>

Fig. 3 shows the estimated trajectories for self-rated health for two scenarios, one a low-risk profile of work-related factors, and one with a high-risk profile. In the low-risk scenario, there is no retirement-related improvement in health.

## **DISCUSSION**

In a large French occupational cohort, retirement was associated with a substantial decrease in prevalence of suboptimal health, corresponding to an 8–10 year gain in perceived health. This pattern was remarkably consistent across occupational grades and sex, and, although the effect was stronger for those who had had a poor work environment or health problems before retirement, a significant improvement was observed also among other groups, with the exception of those with ideal working conditions. In addition, the prevalence of suboptimal health increased at a significantly faster rate before rather than after retirement. These findings suggest that the burden of ill-health in terms of perceived health problems among older workers with poor working conditions is considerably relieved by retirement.

A major strength of this study is that it is based on repeated yearly measurements over an extended time period in a stable occupational cohort. Although observational data cannot prove causality and rule out residual confounding, the findings – that a steady increase in prevalence of suboptimal health is sharply broken and decreases substantially on retirement, followed by a less steep increase after retirement – strongly suggests that the improvement is indeed related to retirement. Since most people in this cohort retired on a statutory basis at 55 or very close to that age, reversed causality is unlikely, indicating that retirement may actually cause an improvement in perceived health. Our outcome, self-rated suboptimal health has repeatedly been shown to be associated with mortality,(6-8) including in this cohort,(29) and is also a valid measure of well-being and morbidity.(26)

In contrast to previous research which showed health benefits of retirement exclusive to higher grade employees,(10) we observed that retirement was as beneficial, in relative terms, for

employees in lower occupational grades, which means that the absolute benefit was larger in the lower grades. This may reflect the greater work-related health burden prior to retirement previously observed among workers in the lower grades.(30-32).

Not surprisingly, high physical and psychological job demands as well as low job satisfaction during the later years in work were associated with a steeper increase in suboptimal health before retirement and greater benefit from retirement. However, those with a low-risk profile of work-related factors showed no such retirement-related improvement. This probably indicates that work puts an extra burden on health when it is highly demanding and not satisfying, but that the effects of this burden are reversible. Our results also show that marital status did not much influence the observed association between retirement and sub-optimal health, potentially indicating that the retirement related improvement was more related to work than to private life.

The data come from employees in a company operating throughout France, both in rural and urban areas, comprising a wide range of occupations. However, in comparison to many employees in the Western world (and certainly outside it) the participants retired early and benefited from good social security. Indeed, adverse effects generated by reduced income are likely to be relatively small in this cohort. We observed a smaller benefit from retirement among employees who retired after the age of 55 than among those who retired at 55 or earlier. Working longer could be a marker of better working conditions, as employees who have worked in blue-collar settings, with more exposure to occupational hazards and health problems,(33) were allowed to retire earlier.

The substantial improvement in all groups and regardless of confounders (barring the 4% who retired on health grounds) suggests that the observed pattern may be fairly generalisable to other settings with relatively generous social security after retirement, indeed to a large proportion of employees in Western countries.

Our findings are in agreement with observations in other European countries. Improvement in perceived health after retirement was observed in Sweden;(34) and in the Whitehall II study mental health functioning deteriorated among those who continued working but improved among retirees from the higher employment grades.(10) Further research is needed to ascertain the generalisability of our results outside the GAZEL cohort, as well as to investigate underlying mechanisms, i.e., whether improvements in health after retirement are explained by the removal of exposure to adverse work characteristics, by positive changes in lifestyle, by a change in health ratings as a result of adjusted expectations(35, 36), or by lower demands on health in retirement.

### **Policy implications**

Our findings should cause concern among policy-makers attempting to convince workers to stay longer in the workforce. Older workers who experience deteriorating perceived health, and who may additionally be aware that many of their slightly older friends and former colleagues enjoy excellent health since they retired, may feel more motivated to retire early than to continue working beyond statutory retirement age. If our findings apply in settings where social security is less comprehensive than for the GAZEL participants, financial incentive might not be enough – and indeed not the most ethical way – to counteract the drift towards an ever earlier retirement age. Arguably the best option is to redesign working life for older workers in order to make it healthier and more satisfying, and thus, hopefully, achieve better occupational health, improved quality of life, increased productivity, and a larger proportion of the population in work.

### **Contributors**

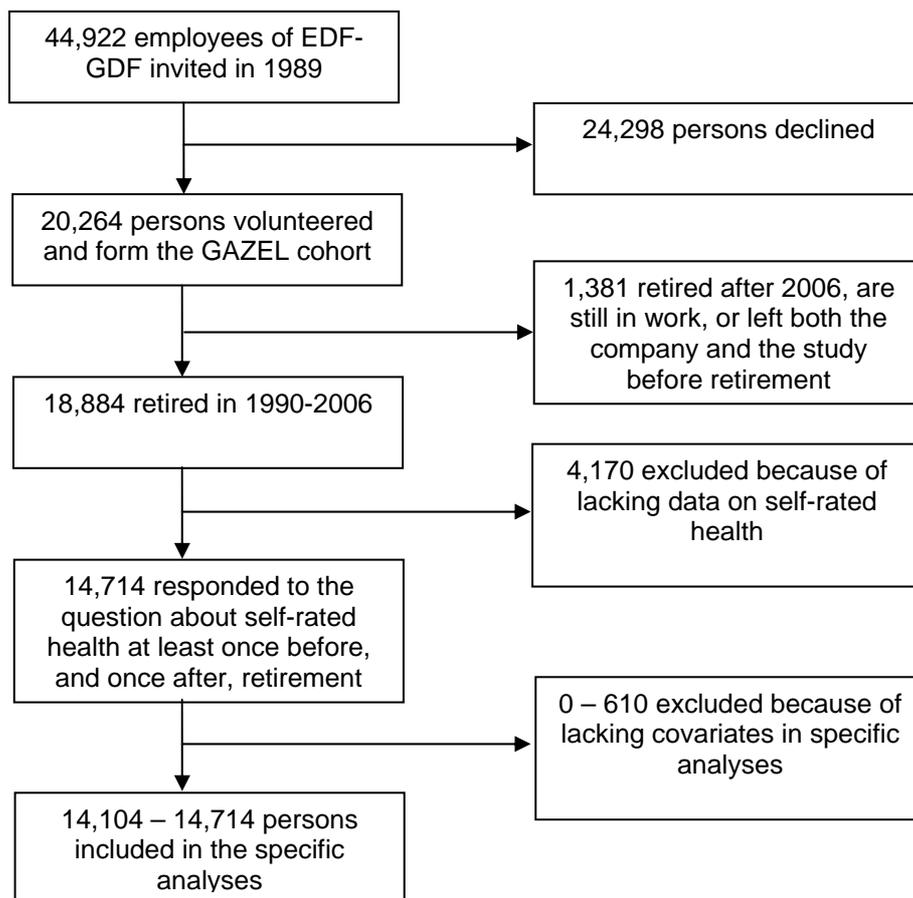
HW and JV designed the original hypothesis and ran all the analyses in close dialogue with MK. JP provided statistical advice. HW wrote the first draft of the report, apart from the methods section which was written by JV and HW. All authors interpreted the results, revised the text, and approved the final draft of the report.

### **Conflict of interest statement**

We declare that we have no conflict of interest.

### **Acknowledgments**

The authors wish to express their thanks to EDF-GDF, especially to the Service Général de Médecine de Contrôle, and to the ‘Caisse centrale d’action sociale du personnel des industries électrique et gazière’. We also wish to acknowledge the Risques Postprofessionnels – Cohortes de l’Unité mixte 687 Inserm – CNAMTS team responsible for the GAZEL data base management. The GAZEL Cohort Study was funded by EDF-GDF and INSERM, and received grants from the ‘Cohortes Santé TGIR Program’.



**Fig. 1.** – *Flowchart describing the selection of participants in the study.*

**Table 1** — Characteristics of the participants and their association with suboptimal self-rated health before and after retirement.

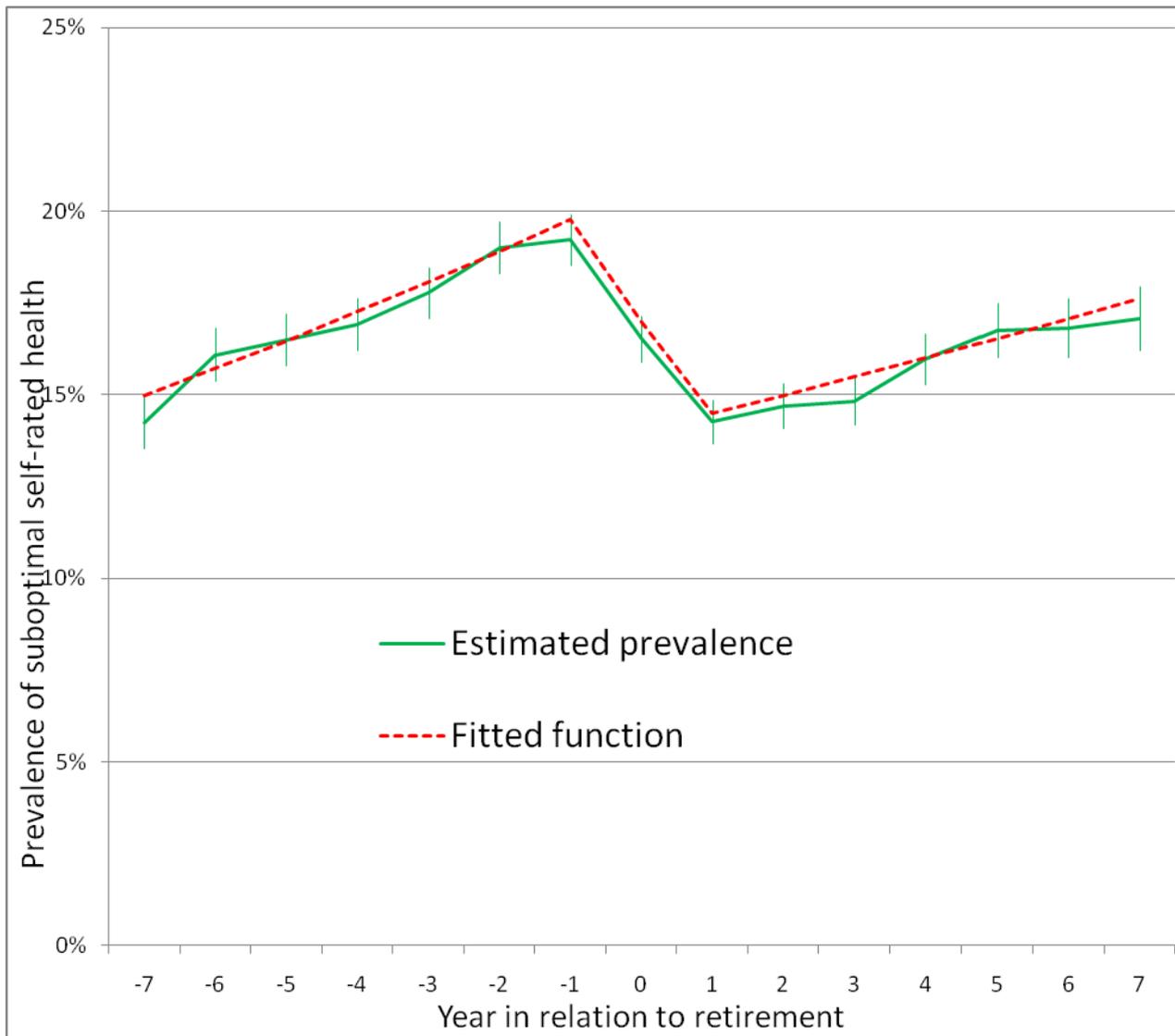
| Covariate  | Number (%) | Odds ratios and 95% CIs for suboptimal self-rated health before and after retirement |                  |
|--|------------|--|------------------|
|  |            | Before (year -1)   | After (year +1)  |
| Retirement age <sup>1,2,4,5</sup>                |            |  |                  |
| <55 years of age                                 | 5878 (40)  | 1.22 (1.10–1.36)   | 0.96 (0.84–1.10) |
| 55 years of age                                  | 4686 (32)  | 1  | 1                |
| >55 years of age                                 | 4150 (28)  | 1.00 (0.88–1.13)   | 1.16 (1.00–1.34) |
| Type of retirement <sup>1,2,3</sup>              |            |  |                  |
| statutory  | 14104 (96) | 1  | 1                |
| early  | 610 (4)    | 2.78 (2.28–3.38)   | 38.1 (29.4–49.3) |
| Sex <sup>2,3,4</sup>                             |            |  |                  |
| men  | 11581 (79) | 1  | 1                |
| women  | 3133 (21)  | 1.19 (1.07–1.32)   | 1.10 (0.97–1.26) |
| Marital status <sup>1,2,3,4</sup>                |            |  |                  |
| not married/cohabitating                         | 1643 (11)  | 1  | 1                |
| married or cohabitating                          | 13066 (89) | 1.33 (1.16–1.52)   | 1.43 (1.22–1.68) |
| Employment grade <sup>1,3,4</sup>                |            |  |                  |
| higher   | 4864 (33)  | 1  | 1                |
| intermediate                                     | 8020 (55)  | 1.35 (1.22–1.50)   | 1.28 (1.13–1.46) |
| lower  | 1815 (12)  | 1.97 (1.70–2.28)   | 1.84 (1.54–2.20) |
| Psychological demands <sup>1,2,3,4,6</sup>       |            |  |                  |
| low  | 4848 (35)  | 1  | 1                |
| intermediate                                     | 5092 (37)  | 1.86 (1.66–2.09)   | 1.82 (1.58–2.10) |
| high   | 3895 (28)  | 2.99 (2.66–2.26)   | 2.33 (2.02–2.70) |
| Physical demands <sup>1,2,3,4,6</sup>            |            |  |                  |
| low  | 5115 (37)  | 1  | 1                |
| intermediate                                     | 4740 (34)  | 1.39 (1.24–1.56)   | 1.43 (1.24–1.64) |
| high   | 3970 (29)  | 2.32 (2.07–2.59)   | 2.10 (1.82–2.41) |
| Job satisfaction <sup>1,2,3,4,6</sup>            |            |  |                  |
| low  | 4872 (37)  | 1  | 1                |
| intermediate                                     | 4785 (36)  | 0.67 (0.60–0.74)   | 0.74 (0.65–0.85) |
| high   | 3558 (27)  | 0.39 (0.35–0.45)   | 0.55 (0.47–0.64) |
| Depression <sup>1,2,3,4,6</sup>                  |            |  |                  |
| no   | 12385 (89) | 1  | 1                |
| yes  | 1529 (11)  | 4.00 (3.54–4.52)   | 2.56 (2.20–2.98) |
| Musculoskeletal complaints <sup>1,2,3,4,6</sup>  |            |  |                  |
| 0-2 of 3 years                                   | 9830 (71)  | 1  | 1                |
| 3 of 3 years                                     | 4084 (29)  | 1.90 (1.74–2.09)   | 1.61 (1.43–1.80) |
| Physical illness <sup>1,2,3,4,6,7</sup>          |            |  |                  |
| no   | 11789 (85) | 1  | 1                |
| yes  | 2125 (15)  | 2.52 (2.27–2.81)   | 2.05 (1.80–2.35) |
| Sickness absence >21 days <sup>1,2,3,4,5,6</sup> |            |  |                  |
| no   | 9995 (68)  | 1  | 1                |
| yes  | 4719 (32)  | 2.95 (2.68–3.25)   | 2.01 (1.79–2.26) |

<sup>1</sup>Adjusted for sex; <sup>2</sup>Adjusted for SES; <sup>3</sup>Adjusted for age of retirement; <sup>4</sup>Adjusted for type of retirement;

<sup>5</sup>Among those who retired through statutory pension;

<sup>6</sup>During the three years before the retirement year (-3, -2, and -1);

<sup>7</sup>Respiratory illnesses, cardiovascular disease, cerebrovascular disease, diabetes, or cancer.



**Fig. 2** — *Trajectory of prevalence of suboptimal self-rated health in relation to year of retirement.*

**Table 2** — Changes in self-rated health around retirement (year 0 = year of retirement). Odds ratios (OR) for suboptimal self-rated health and their 95% confidence intervals (95% CI) comparing different time points are derived from repeated measures logistic regression GEE models also including year and time of data collection as covariates.

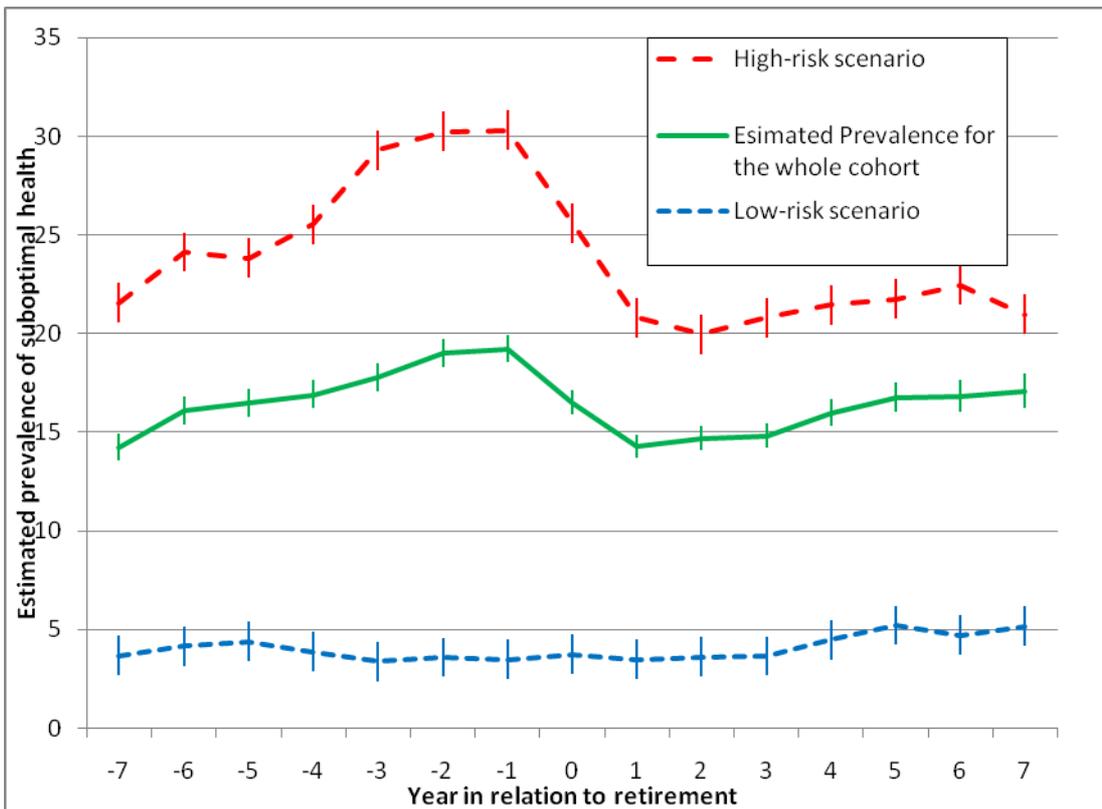
| Covariate                                | Interaction with time | Odds ratios (OR) with 95% CI for suboptimal self-rated health comparing year |                  |                  |
|--|-----------------------|--|------------------|------------------|
|  |                       | -1 with -7   | +1 with -1       | +7 with +1       |
| Retirement age <sup>1</sup>              | p < 0.0001            |  |                  |                  |
| <55 years of age                         |                       | 1.41 (1.28–1.56)   | 0.47 (0.43–0.52) | 1.44 (1.28–1.62) |
| 55 years of age                          |                       | 1.41 (1.27–1.57)   | 0.60 (0.54–0.67) | 1.42 (1.25–1.61) |
| >55 years of age                         |                       | 1.15 (1.03–1.28)   | 0.69 (0.62–0.77) | 1.22 (1.05–1.42) |
| Type of retirement                       | p < 0.0001            |  |                  |                  |
| statutory                                |                       | 1.34 (1.26–1.42)   | 0.57 (0.54–0.60) | 1.37 (1.27–1.48) |
| early                                    |                       | 1.95 (1.46–2.60)   | 5.82 (4.46–7.60) | 0.24 (0.18–0.31) |
| Sex                                      | p = 0.0213            |  |                  |                  |
| men                                      |                       | 1.45 (1.35–1.55)   | 0.68 (0.64–0.73) | 1.35 (1.25–1.46) |
| women                                    |                       | 1.43 (1.27–1.60)   | 0.74 (0.67–0.83) | 0.99 (0.86–1.14) |
| Employment grade                         | p = 0.0088            |  |                  |                  |
| higher                                   |                       | 1.21 (1.08–1.34)   | 0.70 (0.63–0.77) | 1.34 (1.18–1.52) |
| intermediate                             |                       | 1.49 (1.38–1.61)   | 0.68 (0.63–0.73) | 1.24 (1.13–1.36) |
| lower                                    |                       | 1.57 (1.34–1.83)   | 0.72 (0.63–0.82) | 1.01 (0.85–1.19) |
| Psychological demands <sup>2</sup>       | p < 0.0001            |  |                  |                  |
| low                                      |                       | 1.28 (1.14–1.44)   | 0.79 (0.71–0.88) | 1.29 (1.13–1.47) |
| intermediate                             |                       | 1.38 (1.25–1.53)   | 0.73 (0.67–0.80) | 1.12 (1.01–1.26) |
| high                                     |                       | 1.66 (1.51–1.84)   | 0.58 (0.53–0.64) | 1.30 (1.16–1.46) |
| Physical demands <sup>2</sup>            | p < 0.0001            |  |                  |                  |
| low                                      |                       | 1.34 (1.20–1.50)   | 0.73 (0.66–0.81) | 1.28 (1.13–1.46) |
| intermediate                             |                       | 1.39 (1.25–1.54)   | 0.72 (0.66–0.80) | 1.21 (1.07–1.36) |
| high                                     |                       | 1.55 (1.41–1.71)   | 0.62 (0.57–0.68) | 1.19 (1.06–1.32) |
| Job satisfaction <sup>2</sup>            | p = 0.0005            |  |                  |                  |
| low                                      |                       | 1.51 (1.39–1.65)   | 0.61 (0.56–0.67) | 1.24 (1.11–1.38) |
| intermediate                             |                       | 1.47 (1.33–1.63)   | 0.68 (0.62–0.75) | 1.33 (1.18–1.51) |
| high                                     |                       | 1.32 (1.15–1.52)   | 0.86 (0.76–0.98) | 1.34 (1.15–1.56) |
| Depression <sup>2</sup>                  | p < 0.0001            |  |                  |                  |
| no                                       |                       | 1.31 (1.22–1.40)   | 0.72 (0.68–0.77) | 1.25 (1.15–1.35) |
| yes                                      |                       | 1.96 (1.69–2.28)   | 0.51 (0.45–0.59) | 1.02 (0.88–1.18) |
| Musculoskeletal complaints <sup>2</sup>  | p = 0.0008            |  |                  |                  |
| 0-2 of 3 years                           |                       | 1.38 (1.28–1.49)   | 0.76 (0.71–0.82) | 1.23 (1.13–1.34) |
| 3 of 3 years                             |                       | 1.55 (1.42–1.70)   | 0.60 (0.55–0.66) | 1.26 (1.13–1.41) |
| Physical illness <sup>2,3</sup>          | p = 0.0088            |  |                  |                  |
| no                                       |                       | 1.42 (1.32–1.52)   | 0.72 (0.68–0.77) | 1.24 (1.14–1.34) |
| yes                                      |                       | 1.57 (1.39–1.77)   | 0.60 (0.53–0.67) | 1.31 (1.14–1.51) |
| Sickness absence >21 days <sup>1,2</sup> | p < 0.0001            |  |                  |                  |
| no                                       |                       | 1.09 (1.00–1.18)   | 0.67 (0.61–0.72) | 1.41 (1.28–1.56) |
| yes                                      |                       | 1.78 (1.62–1.96)   | 0.44 (0.40–0.48) | 1.29 (1.15–1.45) |

<sup>1</sup>Among those who retired through statutory pension.

<sup>2</sup>During the three years before the retirement year (-3, -2, and -1).

<sup>3</sup>Respiratory illnesses, cardiovascular disease, cerebrovascular disease, diabetes, or cancer.

Note: Marital status was not included in this table since the interaction with time was non-significant.



**Fig. 3** — Trajectories of prevalence of suboptimal self-rated health in relation to year of retirement for two scenarios involving men who retired at the statutory age of 55 and before the year 2000: one with a low-risk profile of work-related factors (higher occupational grade, low physical and psychological demands, and high job satisfaction), and the other with a high-risk profile (low grade, high demands, low satisfaction).

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