Effect of retirement on sleep disturbances: the GAZEL prospective cohort study

Jussi Vahtera, MD, PhD[1 2], Hugo Westerlund, PhD[3], Martica Hall, PhD [4], Noora Sjösten, PhD [2], Mika Kivimäki, PhD [2 5], Paula Salo, PhD [2], Jane E. Ferrie, PhD [5], Markus Jokela, PhD [2], Jaana Pentti, BA[2], Archana Singh-Manoux, PhD [5 6], Marcel Goldberg, MD, PhD [6], Marie Zins, PhD [6]

[1] Department of Public Health, University of Turku and Turku University Hospital, Turku, Finland
[2] Finnish Institute of Occupational Health, Helsinki, Finland
[3] Stress Research Institute, Stockholm University, Sweden
[4] Department of Psychiatry, University of Pittsburgh School of Medicine, Pennsylvania, USA
[5]Department of Epidemiology and Public Health, University College London Medical School, UK
[6] INSERM, U687-IFR69, Hôpital Paul Brousse, AP-HP, France

Funding.
JV, NS, MK and PS are supported by the Academy of Finland (grants #117604, #124271, #124322 and #129262) and MK is additionally supported by the BUPA Specialist research grant; HW is supported by the Swedish Council for Working Life and Social Research (FAS, grants #2004-2021, #2007-1143); JEF is supported by the MRC (Grant number G8802774); AS-M is supported by a EUYRI award from the European Science Foundation.

Correspondence:
Prof Jussi Vahtera, Department of Public Health, University of Turku, Lemminkäisenkatu 1, FI-20014 University of Turku, Finland. Telephone +358 30 474 7520, fax +358 30 474 7555, e-mail: jussi.vahtera@ttl.fi

ABSTRACT

Objectives: Changes in health following retirement are poorly understood. We used serial measurements to assess the effect of retirement on sleep disturbances.

Design: Prospective cohort study.

Setting: The French national gas and electricity company.

Participants: 14,714 retired employees (79% men).

Measurements and Results: Annual survey measurements of sleep disturbances ranging from 7 years before to 7 years after retirement (a mean of 12 measurements). Before retirement 22.2% to 24.6% of participants reported disturbed sleep. According to repeated-measures logistic regression analysis with GEE-estimation the odds ratio (OR) for sleep disturbances in the post-retirement period was 0.74 (95% confidence interval 0.71-0.77) compared to that in the pre-retirement period. The post-retirement improvement in sleep was more pronounced in men [OR 0.66 (0.63-0.69)] than in women [OR 0.89 (0.84-0.95)], and in higher grade workers than lower grade workers. Post-retirement sleep improvement was explained by the combination of pre-retirement risk factors suggesting removal of work-related exposures as a mechanism. The only exception to the general improvement in sleep after retirement was related to retirement on health grounds. In this group of participants, there was an increase in sleep disturbances following retirement.

Conclusions: Repeated measurements provide strong evidence for a substantial and sustained decrease in sleep disturbances following retirement. The possibility that the health and well-being of individuals is significantly worse when in employment than following retirement presents a great challenge to improve the quality of work life in western societies where the cost of the ageing population can only be met through an increase in average retirement age.

INTRODUCTION

In industrial societies world-wide, large post-war baby-boomer generations are entering the final phase of their working lives, moving out of the active labour force into retirement and the post-retirement "third age". [1, 2] Considering the substantial societal and economic impact of these socio-demographic changes, relatively little is known about the consequences of the retirement transition for health trajectories. Previous research on the health consequences of retirement, based on relatively short follow-up periods and a severely restricted number of outcome measurements, has produced conflicting results. Retirement has been associated both with improved [3-5] and deteriorating mental health, [6-8] while other studies have found retirement to be unrelated to either mental or physical health. [9-11] These mixed findings suggest that the impact of retirement on health is complex and includes a host of risk factors (e.g., poor health at retirement, loss of social networks) and protective factors (e.g., loss of job stress, more time to focus on health and social relationships).

Sleep disturbances have seldom been used as outcomes in retirement studies, even though disturbed sleep is common in older adults and increases with age. Studies of the prevalence of insomnia in the general population demonstrate a median prevalence for all insomnia of about 35%, with a range of 10%-15% being assessed as moderate to severe disorders. [12] Sleep disturbances have been shown to be associated with a range of adverse outcomes, including impaired cognitive functioning, [13] decreased quality of life, [14] reduced immune functioning, [15] and the metabolic syndrome, [16 17] as well as increased risk of mood and anxiety disorders, [18] absenteeism and early retirement, [19, 20] occupational accidents, [21] and greater health care costs. [22] There is also strong evidence that during the working years, work schedules and work stress adversely affect sleep. For instance, shift work is a significant correlate of insomnia in industrialised nations [23] and heightened levels of stress are associated with cognitive and physiological arousal which interfere with sleep. [24-26] Moreover,

several epidemiological studies have shown a strong link between work stress and disturbed sleep. [27-30]

Findings from the few existing studies on associations between retirement from work and sleep outcomes, mostly cross-sectional have produced mixed findings. One study observed a higher prevalence of sleep disturbances post-retirement, [31] while others reported better sleep quality, such as longer sleep time and less problems with early awakenings and difficulties in getting back to sleep. [32, 33] To our knowledge, no published evidence exists on trajectories of changes in sleep pre- to post-retirement over an extended time window. Because retirement has been characterized either as an additional stressor or a relief depending on the findings referred to in the literature, [3-8] we did not specify directional a priori hypotheses regarding the prevalence of sleep disturbance during the retirement transition. Due to the impact of sleep on health and functioning, longitudinal information on retirement-related sleep changes would help to answer questions on the long-term consequences of retirement on health. Thus, the aim of this study was to explore the effect of retirement on sleep disturbances using a longitudinal design with annual self-reported measures of sleep disturbances from up to 7 years before and 7 years after retirement. The study is based on a French occupational cohort with two key characteristics: stable employment, similar to public sector employment, and a statutory age of retirement between 55 and 60 years.

METHODS

Study population

The GAZEL cohort was established in 1989 and is comprised of employees from the French national gas and electricity company: Electricité de France-Gaz de France (EDF-GDF). [34] At baseline, 20,625 employees (73% men), aged 35-50, gave consent to participate. EDF-GDF employees hold a civil servant-like status that guarantees job stability and opportunities for occupational mobility. Typically, employees are hired when they are in their 20s and stay with the

company until retirement (usually around 55 years of age). Retirees' pensions are paid by the company. Because of these characteristics, study follow-up is very thorough and losses to follow-up small. [35] GAZEL participants are followed with an annual postal questionnaire mailed to participants' homes requesting data on health, lifestyle, individual, familial, social and occupational factors. Additionally, self-report data are linked to validated occupational and health data collected by the company, including data on retirement, long-standing work disability due to serious diseases, and sickness absence.

In this study, we analyzed data from the Gazel participants who retired between 1990 and 2006. Of all 18,884 retirees, we included in the study only those who provided information on sleep disturbances at least once before and once after the year of retirement. Thus, the cohort consisted of 14,714 employees (11,581 men and 3,133 women) whose mean age at retirement was 55 years (range 37-63).

Data on retirement

Because all pensions are paid by EDF-GDF, company data on retirement are comprehensive and accurate. Statutory age of retirement is between 55 and 60 years depending on type of job. Although partial retirement is rare, retirement can, in some cases, occur below the age of 55. For instance, women who have at least 3 children can retire after 15 years of service, their pension being proportionate to the years served. Retirement on health grounds can be granted in the event of long-standing illness or disability. Illness or disability claims are validated by the social security department of EDF-GDF. From the company records, we obtained data on official retirement, long-standing illness or disability and sickness absence. We defined the year and type of retirement according to the first of the following events: receipt of an official retirement pension (statutory retirement), or long-standing illness or disability or having more than 650 days of sickness absence

in two subsequent years (retirement on health grounds). In the last case the first year is considered as a year of retirement.

Sleep disturbances

Data on sleep were obtained from questionnaires for the years 1989 through 2007. An affirmative response (yes) to a question on the occurrence of "Sleep disturbances" ("Troubles du sommeil"), from a systematic checklist of over 50 medical conditions experienced during the past 12 months, was used as an indicator of sleep disturbances in the survey year. [36] This was coded as a binary variable with the response category "1" for those who gave an affirmative response and the category "0" for those who did not endorse an affirmative response. We took into account all annual sleep measurements over a 15-year time window which ranged from 7 years prior to retirement to 7 years after retirement, using the year of retirement as year 0.

Pre-retirement covariates

Demographic factors included sex, age at retirement and marital status, the latter derived from the survey immediately prior to retirement (married or cohabiting vs. single, divorced, or widowed).

Work-related factors. Derived from the EDF-GDF records, employment grade immediately prior to retirement was classified into three groups: high grade (managers), intermediate grade (technical staff, line managers and administrative associate professionals), and lower grade (clerical and manual workers), based on categorisations from the French National Statistics Institute. Night work, never vs. occasionally or regularly, was derived from the baseline survey. For psychological and physical job demands and job satisfaction, measured on an 8-point scale, [37] we used means of the average over the pre-retirement period measurements of each individual and categorized these into tertiles.

Health-related behaviours. Questionnaire data on the maximum amount of beer, wine, and spirits consumed daily were transformed into units of alcohol per day. The average number of units over

the pre-retirement period was classified as 0-3 units or more than 3 units. [38] In a similar way, survey reports on height and weight were used to calculate the average body mass index (BMI) over the pre-retirement period in order to identify normal weight (BMI <25.0 kg/m^2), overweight (25.0-29.9), and obese (≥30.0) participants.[39]

Health-related factors. Self-rated health was assessed on an 8-point scale (1 = very good….8 = very poor). The mean rating over the pre-retirement time window was dichotomized by categorising response scores 1 - 4 as good health and scores 5 - 8 as sub-optimal health. [40] The mean of pre-retirement responses to two items on mental and physical fatigue, responses on an 8-point scale, were used to identify participants experiencing fatigue (highest tertile vs other tertiles). Affirmative responses (yes) to a checklist of over 50 chronic conditions were used to identify chronic diseases (cancer, diabetes, chronic bronchitis, asthma, angina, myocardial infarction, stroke, osteoarthritis and rheumatoid arthritis) (0=no disease, 1=at least one disease) and presence of depression (1989-1999 only) over the pre-retirement period. [40]

Statistical methods

Associations between the pre-retirement covariates and sleep disturbances prior to retirement (0=no disturbances in any of the 7 years before retirement, 1=disturbances in any year before retirement were analysed using logistic regression adjusted for sex and age at retirement. Next we studied changes in sleep for up to 7 years before and 7 years after retirement in relation to the year of retirement. We applied a repeated-measures logistic regression analysis with the generalized estimating equations (GEE) method. [41] The GEE method takes into account the correlation between sleep measurements within persons and it is not sensitive to missing cases at repeated measurements.

We first calculated the odds and their 95% confidence intervals for sleep disturbances for every year before and after the year of retirement, adjusted for the relevant time of data collection (1989-

99 or 2000-07). These odds were transformed to prevalence estimates which were then used to characterize the sleep trajectory in relation to retirement. To examine the effect of missing values in repeated measurements, we replicated these analyses in a subgroup of participants who had sleep data to year 7 after retirement.

In further analyses we explored the extent to which pre-retirement covariates explained the shape of the trajectory for sleep disturbances in relation to retirement. First we tested whether the shape of the sleep trajectory depended on the variable of interest by entering the interaction term 'year x explanatory variable' into the repeated measures logistic regression models. If the interaction term was significant, we then calculated from these models the overall odds ratio (OR) their 95% confidence intervals (95% CI) for post-retirement sleep disturbances by contrasting the mean sleep disturbances after retirement with the mean sleep disturbances before retirement for each level of the potential explanatory factor. The models were adjusted for sex, age at retirement, year, and time of data collection.

Finally, in order to provide an illustration of the extent to which the trajectory for sleep disturbances in relation to retirement could be accounted for by the pre-retirement covariates, we calculated predicted annual prevalence estimates for sleep disturbances over the 15-year time window for two hypothetical cases: both an upper-grade man retired at the statutory age of 55, one with a low risk profile (i.e. no health or health behaviour related risk factors) and the other with a high risk profile (i.e. all independent health or health behaviour related risk factors associated with the shape of the sleep trajectory). We derived these estimates from a single repeated measures logistic regression analysis that included the interaction term 'year x explanatory variable' for each risk factor in the model. The analyses were conducted using the SAS 9.1 program.

RESULTS

Of the 14,714 respondents included in the study cohort, 10,564 (72%) had retired by the age of 55 and 14,635 (99%) by the age of 60. The proportion of retirees on health grounds was only 4% (Table 1). Before retiring, 35% of the study cohort had occasionally or consistently worked night shifts, 54% were overweight or obese, 34% consumed more than 3 units of alcohol daily, 24% rated their health status as sub-optimal, 49% reported one or more chronic diseases, 32% reported fatigue, and 17% reported depression. The mean number of sleep measurements within the 15-year time window was 12.0 (range 2-15), with a mean of 5.7 measurements in the years before retirement and a mean of 5.5 measurements in the years after retirement. Table 1 also shows that sleep disturbances prior to retirement were strongly associated with work related factors (e.g., high psychological and physical job demands and low job satisfaction), health problems (retirement on health grounds, sub-optimal self-rated health, chronic disease, or depression), as well as both mental and physical fatigue. Other factors associated with disturbed sleep were female sex and living alone. Sleep disturbances were not associated with age at retirement, grade, previous night shift work, or health-related behaviours.

Figure 1 shows the annual prevalence of sleep disturbances in relation to retirement. The trajectory is characterized by two superimposed trends. There is a slowly increasing prevalence of sleep disturbances with increasing age which can be observed both before and following retirement. However, the overall levels of reported sleep disturbances are markedly reduced in the years following retirement, compared to overall levels before retirement. During the years before retirement, 22.2% to 24.6% (95% CI 21.4-25.4) of participants reported disturbed sleep in any year. Sleep disturbance prevalence rates fell from 24.2% (23.4-24.9) in the last year before retirement to 17.8% (17.1-18.4) in the first year following retirement. From the first to the seventh year after retirement this prevalence rate increased to 19.7% (18.8-20.6) but remained significantly lower than at any time point prior to retirement. Compared to the years before retirement, the odds ratio of sleep disturbances in the years after retirement was 0.74 (0.71-0.77). When the analysis was

restricted to the 8,383 participants (57% of the total) for whom data were available for the seventh year after retirement, the findings were almost identical, with an OR 0.72 (0.68-0.75) for sleep disturbances in the years before compared to the years after retirement. Thus, the reductions in sleep disturbances associated with retirement could not be attributed to losses to follow-up prior to the seventh year after retirement.

Table 2 shows the pre-retirement role played by the potential explanatory factors in influencing the shape of the trajectory for sleep disturbances related to retirement and the extent to which post-retirement reductions in sleep disturbances were related to these variables. Of the demographic and work-related factors studied, sex, employment grade, night shift work, and psychological job demands had a significant effect on sleep disturbance profiles. Compared to the years before retirement, improvement in sleep in years 1 to 7 post-retirement was more pronounced in men ($p<0.001$), older age-groups ($p=0.008$), higher employment grades ($p<0.001$), night shift workers ($p=0.002$), and among those exposed to high job demands ($p<0.001$). A significant interaction effect was also observed between several health-related variables and the sleep disturbance profiles. These included mental ($p<0.001$) or physical fatigue ($p=0.007$), self-rated health status ($p=0.02$), and depression ($p<0.001$). The most pronounced reduction in sleep disturbances was reported by participants with depression or mental fatigue prior to retirement. Among them, the odds ratio for sleep disturbances in years 1-7 post retirement compared to the 7 years prior to retirement was 0.55-0.56 (0.52-0.60), while the corresponding odds ratio was 0.76-0.86 (0.73-0.90) among those with no such problems. In all other groups studied, there was also a significant, although less pronounced, improvement in sleep following retirement. The only exception was related to retirement on health grounds, after which there was 1.46 times higher odds (95% CI 1.27-1.69) of sleep disturbances compared to the years before retirement (test of interaction between type of retirement and time $p<0.001$).

Figure 2 shows the annual prevalence of sleep disturbances in relation to retirement for the two hypothetical cases, one with a low risk profile (no modifiable pre-retirement risk factors) and the other with a high risk profile (all modifiable independent pre-retirement risk factors that shape the retirement-related sleep disturbances trajectory). Initial analyses showed that the mutually adjusted interactions with time were significant for the following health or health behaviours related risk factors: BMI ($p=0.033$), psychological job demands ($p=0.006$), physical fatigue ($p<0.0001$), mental fatigue ($p<0.0001$), and depression ($p<0.0001$), but not suboptimal self-rated health. For the high risk profile man, the mean percentage of annual sleep disturbances was 36.3% in the 7 pre-retirement years but 26% lower in the 7 post-retirement years. For the low risk profile man, the mean percentage of annual sleep disturbances within the 7 pre-retirement years was 9.2%, identical to the 7 post-retirement years. Thus, the effect of retirement on the trajectory of sleep disturbances was explained mostly by the pre-retirement risk factors in these data.

DISCUSSION

To our knowledge, this is the first study to examine trajectories in sleep disturbances pre- and post-retirement over an extended time window. In a large occupational cohort from France, we found that statutory retirement at age 55 on average was followed by a sharp decrease in the prevalence of sleep disturbances. The odds of disturbed sleep after retirement were 26% lower than during the pre-retirement period. The reduction in sleep disturbances after retirement was largely explained by pre-retirement risk factors including high psychological demands at work, physical and mental fatigue, depression and overweight. The main strengths of our study were the usage of accurate data on retirement and annual sleep measurements collected prospectively over a 15-year time window.

Three limitations to this study must be noted. First, our measure of disturbed sleep was a 1-item, albeit annual, survey question concerning the occurrence of sleep disturbances during the past 12 months. In this study, the annual prevalence of sleep disturbances was 25-26% before retirement

and 17-18% after it. These figures are in line with those reported for other measures of sleep disturbances elsewhere. [12] For example, in the 2002 "Sleep in America" poll, 27% of the respondents categorized their sleep quality as fair or poor. [13, 42] Moreover, the stability of the sleep trajectory within the pre- and postretirement time periods is consistent with the chronicity of long-term insomnia. [43] Our findings of female sex, chronic diseases and depression as risk factors for sleep disturbances are also consistent with previous results. [23] However, we have no information on the type of sleep disorder reported by the participants, as our survey did not specifically inquire about specific sleep symptoms and disorders.

Second, cohorts such as ours that are followed by surveys or examinations over an extended time period are subject to a healthy survivor effect as participants are likely to permanently drop out due to severe illnesses as a function of time. Because sleep disturbances correlate with many severe illnesses, those completely lost to follow-up probably did worse in terms of sleep than their remaining counterparts. This implies that the trajectory observed may overestimate the long-term benefits of retirement. However, we were able to follow 8383 participants (57%) until the 7th year after retirement. Because the findings were almost identical, loss-to-follow-up is an unlikely source of bias in this study.

Third, the serial data for this study came from the French national gas and electricity company, in which the workers employed by a company operate throughout France, both in rural and urban areas, in a wide range of occupations. In comparison to most employees in the Western world the personnel obviously enjoy benefits rarely seen elsewhere. Typically, employees have civil servant status that guarantees job stability and opportunities for occupational mobility, they stay within the company their whole career until their retirement between 55 and 60 years of age, and their pensions (80% of their salary) are paid by the company. We do not know the extent to which the results seen in this cohort would hold for other working populations and conditions of employment.

Our results are consistent with some earlier studies, which have found retirement from work to be associated with better sleep quality [32, 33] and improved mental health. [3-5] However, contradictory results have also been reported. [6-8] Retirement is nowadays seen as a life transition, which can be anticipated and even controlled to some extent. [44] Whether retirement is experienced as a stressful or satisfying transition depends on organizational, financial, and family contexts and their interaction with psychological factors. Our findings suggest that positive outcomes in retirement transition, especially when encountering problems with health prior to retirement, are likely to be the result of removal from work related harmful exposures rather than actual health benefits from retirement.

Although improvement in sleep after retirement was observed in all demographic groups, there was significant variation in the extent to which sleep improved. The finding that women benefited from retirement less than men is interesting, as women not only report sleep disturbances more often than men [21, 45] but also retire earlier. [7] Due to the accumulation of domestic responsibilities, women are generally exposed to long working hours at home. [46] Following retirement, men may experience a notable decrease in their total working hours with no concomitant increase in domestic responsibilities while for retired women more time may be needed for caregiving activities and domestic work. In addition, sleep disturbances are common in postmenopausal women [47] and in our data, almost all women were likely to be postmenopausal after retirement, as they retired aged 53.9 years on average (range 37 to 62). Thus, sex differences in social roles and expectations outside work, as well as postmenopausal symptoms affecting sleep may explain why sleep improved substantially less in retired women than men. Consistent with previous research showing the importance of socioeconomic circumstances in adjusting to retirement, [3] we observed that retirement was more beneficial for employees in high employment grades than for those in lower grades. Unsurprisingly, nightshift workers benefited from retirement more than day workers. Shift work is known to disrupt circadian rhythms and increases the risk of insomnia. [21]

The influence of retirement on sleep disturbances did not depend on physical illnesses, but instead, the most pronounced improvement in sleep was found among those participants who reported psychological problems, such as depression or mental fatigue prior to retirement. The most common co-morbidity of insomnia is psychiatric disorder, especially depression. The prevalence of psychiatric diagnoses is about 40% to 50% in patients with chronic insomnia. [43] In our study the prevalence of depression among those reporting sleep disturbances prior to retirement was 34-37%. The relationship between insomnia and depression has recently received significant research attention, as it has been found that insomnia represents a risk factor for the development of a subsequent depressive disorder. [43, 48, 49] It has been suggested that insomnia and depression have a common pathology that makes the individual vulnerable to both conditions. [43] Given the bidirectional relationship between chronic insomnia and depression, our finding of the lowering odds of sustained sleep disturbances in depressed individuals by up to 45% in the years following retirement compared to the years preceding retirement is important. It is possible that the post-retirement decrease in sleep disturbances helped recovery from depression in this cohort. However, more research is needed to examine this possibility.

The only exception to the general improvement in sleep after retirement was related to retirement on health grounds. In this group of participants, there was an increase in sleep disturbances following retirement. The retirement was granted on the grounds of physical illness, and poor physical health has been shown to predict early retirement, [50] and involuntary retirement to have adverse effects on health and well-being. [44] It is possible that in the cohort studied by us the health problems leading to retirement on health grounds were so severe that they continued to disturb sleep in the post-retirement years. [43]

Further research is needed to investigate underlying mechanisms, i.e. whether improvements in sleep after retirement are explained by the removal of exposure to adverse work characteristics, by positive changes in lifestyle, by changes in the way individuals rate their sleep, or by lower demands on health after work life. Further research is also needed to examine whether our findings are generalizable to other labour market sectors and cultures.

In conclusion, intra-individual repeated measurements in the GAZEL cohort provide strong evidence for a substantial and sustained decrease of sleep disturbances following retirement. This retirement-related sleep trajectory was fully explained by the pre-retirement risk factors suggesting that positive outcomes in retirement transition are likely to result from removal of work related stress rather than actual health benefits from retirement. The possibility that the health and well-being of individuals is significantly worse during employment compared to post-retirement presents a great challenge to improve the quality of work life. Due to the increasing numbers of individuals living years beyond retirement age, governments in most Western countries seek to increase the economically active proportion of the population by pushing retirement age upwards. At a time when people are expected to survive several decades beyond retirement and years spent in disability are costly, consideration should be given to the restructuring of work to enable older workers to remain economically active without compromising their future health.

REFERENCES

1. Mathers CD, Loncar D. Projections of global mortality and burden of disease from 2002 to 2030. PLoS Med 2006;3:e442.
2. Oeppen J, Vaupel JW. Demography. Broken limits to life expectancy. Science 2002;296:1029-31.
3. Mein G, Martikainen P, Hemingway H, Stansfeld S, Marmot M. Is retirement good or bad for mental and physical health functioning? Whitehall II longitudinal study of civil servants. J Epidemiol Community Health 2003;57:46-9.
4. Drentea P. Retirement and mental health. Journal of aging and health 2002;14:167-94.
5. Buxton JW, Singleton N, Melzer D. The mental health of early retirees-- national interview survey in Britain. Soc Psychiatry Psychiatr Epidemiol 2005;40:99-105.
6. Bosse R, Aldwin CM, Levenson MR, Ekerdt DJ. Mental health differences among retirees and workers: findings from the Normative Aging Study. Psychol Aging 1987;2:383-9.
7. Alavinia SM, Burdorf A. Unemployment and retirement and ill-health: a cross-sectional analysis across European countries. Int Arch Occup Environ Health 2008;82:39-45.
8. Mojon-Azzi S, Sousa-Poza A, Widmer R. The effect of retirement on health: a panel analysis using data from the Swiss Household Panel. Swiss Med Wkly 2007;137:581-5.
9. Villamil E, Huppert FA, Melzer D. Low prevalence of depression and anxiety is linked to statutory retirement ages rather than personal work exit: a national survey. Psychol Med 2006;36:999-1009.
10. Butterworth P, Gill SC, Rodgers B, Anstey KJ, Villamil E, Melzer D. Retirement and mental health: analysis of the Australian national survey of mental health and well-being. Soc Sci Med 2006;62:1179-91.
11. Ekerdt DJ, Bosse R, Goldie C. The effect of retirement on somatic complaints. J Psychosom Res 1983;27:61-7.
12. Sateia MJ, Doghramji K, Hauri PJ, Morin CM. Evaluation of chronic insomnia. An American Academy of Sleep Medicine review. Sleep 2000;23:243-308.
13. Altena E, Van Der Werf YD, Strijers RL, Van Someren EJ. Sleep loss affects vigilance: effects of chronic insomnia and sleep therapy. J Sleep Res 2008;17:335-43.
14. Zammit GK, Weiner J, Damato N, Sillup GP, McMillan CA. Quality of life in people with insomnia. Sleep 1999;22 Suppl 2:S379-85.
15. Savard J, Laroche L, Simard S, Ivers H, Morin CM. Chronic insomnia and immune functioning. Psychosom Med 2003;65:211-21.
16. Jennings JR, Muldoon MF, Hall M, Buysse DJ, Manuck SB. Self-reported sleep quality is associated with the metabolic syndrome. Sleep 2007;30:219-23.
17. Hall MH, Muldoon MF, Jennings JR, Buysse DJ, Flory JD, Manuck SB. Self-reported sleep duration is associated with the metabolic syndrome in midlife adults. Sleep 2008;31:635-43.
18. Neckelmann D, Mykletun A, Dahl AA. Chronic insomnia as a risk factor for developing anxiety and depression. Sleep 2007;30:873-80.
19. Vahtera J, Pentti J, Helenius H, Kivimaki M. Sleep disturbances as a predictor of long-term increase in sickness absence among employees after family death or illness. Sleep 2006;29:673-82.
20. Sivertsen B, Overland S, Neckelmann D, et al. The Long-term Effect of Insomnia on Work Disability. Am J Epidemiol 2006;163:1018-24.
21. Roth T. Prevalence, associated risks, and treatment patterns of insomnia. J Clin Psychiatry 2005;66 Suppl 9:10-3; quiz 42-3.
22. Ozminkowski RJ, Wang S, Walsh JK. The direct and indirect costs of untreated insomnia in adults in the United States. Sleep 2007;30:263-73.
23. Sateia MJ, Nowell PD. Insomnia. The Lancet 2004;364:1959-73.
24. Morin CM, Rodrigue S, Ivers H. Role of stress, arousal, and coping skills in primary insomnia. Psychosom Med 2003;65:259-67.
25. Hall M, Thayer JF, Germain A, et al. Psychological stress is associated with heightened physiological arousal during NREM sleep in primary insomnia. Behavioral sleep medicine 2007;5:178-93.
26. Hall M, Vasko R, Buysse D, et al. Acute stress affects heart rate variability during sleep. Psychosom Med 2004;66:56-62.
27. Linton SJ. Does work stress predict insomnia? A prospective study. Br J Health Psychol 2004;9:127-36.
28. Akerstedt T, Fredlund P, Gillberg M, Jansson B. Work load and work hours in relation to disturbed sleep and fatigue in a large representative sample. J Psychosom Res 2002;53:585-8.

29. Ota A, Masue T, Yasuda N, Tsutsumi A, Mino Y, Ohara H. Association between psychosocial job characteristics and insomnia: an investigation using two relevant job stress models--the demand-control-support (DCS) model and the effort-reward imbalance (ERI) model. Sleep Med 2005;6:353-8.
30. Ribet C, Derriennic F. Age, working conditions, and sleep disorders: a longitudinal analysis in the French cohort E.S.T.E.V. Sleep 1999;22:491-504.
31. Ito Y, Tamakoshi A, Yamaki K, et al. Sleep disturbance and its correlates among elderly Japanese. Archives of gerontology and geriatrics 2000;30:85-100.
32. Kronholm E, Hyyppa MT. Age-related sleep habits and retirement. Annals of clinical research 1985;17:257-64.
33. Marquie JC, Foret J. Sleep, age, and shiftwork experience. J Sleep Res 1999;8:297-304.
34. Goldberg M, Leclerc A, Bonenfant S, et al. Cohort profile: the GAZEL Cohort Study. Int J Epidemiol 2007;36:32-9.
35. Melchior M, Krieger N, Kawachi I, Berkman LF, Niedhammer I, Goldberg M. Work Factors and Occupational Class Disparities in Sickness Absence: Findings From the GAZEL Cohort Study. Am J Public Health 2005;95:1206-12.
36. Moneta GB, Leclerc A, Chastang JF, Tran PD, Goldberg M. Time-trend of sleep disorder in relation to night work: a study of sequential 1-year prevalences within the GAZEL cohort. J Clin Epidemiol 1996;49:1133-41.
37. Chiron M, Bernard M, Lafont S, Lagarde E. Tiring job and work related injury road crashes in the GAZEL cohort. Accid Anal Prev 2008;40:1096-104.
38. Nabi H, Consoli SM, Chastang JF, Chiron M, Lafont S, Lagarde E. Type A behavior pattern, risky driving behaviors, and serious road traffic accidents: a prospective study of the GAZEL cohort. Am J Epidemiol 2005;161:864-70.
39. WHO Consultation on Obesity. *Obesity: preventing and managing the global epidemic.* WHO Technical Report Series 894. Geneva: World Health Organization, 2000: 8-10**.**
40. Goldberg P, Gueguen A, Schmaus A, Nakache JP, Goldberg M. Longitudinal study of associations between perceived health status and self reported diseases in the French Gazel cohort. J Epidemiol Community Health 2001;55:233-8.
41. Lipsitz SR, Kim K, Zhao L. Analysis of repeated categorical data using generalized estimating equations. Stat Med 1994;13:1149-63.
42. Van Dongen HP, Vitellaro KM, Dinges DF. Individual differences in adult human sleep and wakefulness: Leitmotif for a research agenda. Sleep 2005;28:479-96.
43. Roth T, Roehrs T. Insomnia: epidemiology, characteristics, and consequences. Clinical cornerstone 2003;5:5-15.
44. van Solinge H, Henkens K. Adjustment to and satisfaction with retirement: two of a kind? Psychol Aging 2008;23:422-34.
45. Leger D, Guilleminault C, Dreyfus JP, Delahaye C, Paillard M. Prevalence of insomnia in a survey of 12,778 adults in France. J Sleep Res 2000;9:35-42.
46. Ala-Mursula L, Vahtera J, Kouvonen A, et al. Long Hours in Paid and Domestic Work and Subsequent Sickness Absence: Does Control over Daily Working Hours Matter? Occup Environ Med 2006.
47. Nelson HD. Menopause. Lancet 2008;371:760-70.
48. Harvey AG. Insomnia: symptom or diagnosis? Clin Psychol Rev 2001;21:1037-59.
49. Buysse DJ, Angst J, Gamma A, Ajdacic V, Eich D, Rossler W. Prevalence, course, and comorbidity of insomnia and depression in young adults. Sleep 2008;31:473-80.
50. Mein G, Martikainen P, Stansfeld SA, Brunner EJ, Fuhrer R, Marmot MG. Predictors of early retirement in British civil servants. Age Ageing 2000;29:529-36.

Acknowledgments.
The authors thank Ms. Alice Guéguen and Mr. Hans Helenius for their statistical comments.
The authors 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".

Contributors.
JV together with HW posed the question and designed and conducted the study. JV made all the analyses and carried the main responsibility of writing the paper. JV will act as guarantor of the paper. All authors made substantial contribution to conception and design, or analysis and interpretation of data; 2) drafting the article or revising it critically for important intellectual content; and 3) gave final approval of the version to be published.

Competing interests: " All authors declare that the answer to the questions on your competing interest form are all No and therefore have nothing to declare".

Abbreviations: OR, odds ratio; CI, confidence interval; GEE, generalized estimating equations; EDF-GDF, Electricité de France-Gaz de France (France's national gas and electricity company).

Figure legends

Figure 1. Sleep disturbances in relation to retirement. Annual prevalence (95% CI) within $\pm$7 years to retirement derived from repeated measures logistic regression analyses with GEE estimation adjusted for time of data collection (1989-99 or 2000-07).

Figure 2. Sleep disturbances in relation to retirement for participants with a low and high risk profile (high profile: high job demands, overweight, mental and physical fatigue, and depression). Annual predicted prevalence (95% CI) derived from repeated measures logistic regression analyses with GEE estimation.

Table 1 — Baseline characteristics and their association with sleep disturbances over the 7 years before retirement.

		Sleep disturbances before retirement	
Covariate	**Number (%)**	**OR***	**95% CI**
Sex			
Men	11581 (79)	1	
Women	3133 (21)	2.20	2.02-2.39
Age at retirement			
<54 years	4386 (30)	0.94	0.87-1.02
54-56 years	7501 (51)	1	
>56 years	2827 (19)	0.94	0.86-1.02
Grade			
Higher	4864 (33)	1	
Intermediate	8020 (55)	1.06	0.98-1.14
Lower	1815 (12)	1.04	0.93-1.17
Marital status			
Married	13066 (89)	1	
Single, divorced or widowed	1643 (11)	1.52	1.37-1.69
Type of retirement			
Statutory	14104 (96)	1	
Early	610 (4)	1.54	1.29-1.84
Night work			
No	9569 (65)	1	
Yes	5125 (35)	1.02	0.95-1.10
Psychological job demands			
Low	5097 (35)	1	
Moderate	5254 (36)	1.77	1.63-1.92
High	4320 (29)	3.10	2.84-3.38
Physical job demands			
Low	5310 (36)	1	
Moderate	4860 (33)	1.25	1.16-1.35
High	4491 (31)	1.58	1.46-1.72
Job satisfaction			
High	3905 (28)	1	
Moderate	5013 (36)	1.46	1.34-1.59
Low	5009 (36)	2.05	1.88-2.24
Body mass index (kg/m^2)			
<25	13118 (92)	1	
25 to 30	13118 (92)	1.03	0.96-1.11
≥30	1206 (8)	1.10	0.97-1.24
Alcohol consumption (unit / day)			
0-3	8800 (66)	1	
>3	4452 (34)	1.02	0.95-1.10
Sub-optimal self-rated health			
No	11163 (76)	1	
Yes	3534 (24)	2.93	2.70-3.18
Mental fatigue			
No	9970 (68)	1	
Yes	4728 (32)	4.59	4.26-4.96
Physical fatigue			
No	9987 (68)	1	
Yes	4715 (32)	3.09	2.87-3.33
Chronic disease			
No	7438 (51)	1	
Yes	7276 (49)	1.75	1.63-1.87
Depression			
No	12156 (83)	1	
Yes	2452 (17)	7.28	6.47-8.18

*Adjusted for sex and age at retirement

Table 2 — Changes in sleep disturbances following retirement. Overall odds ratios (OR) for sleep disturbances and their 95% confidence intervals (95% CI) in the 7 years after retirement compared to the 7 years prior to retirement are derived from repeated measures logistic regression GEE analyses adjusted for sex, age at retirement, year and time of data collection (1989-99 or 2000-07).

	Interaction with time	**Sleep disturbances in years +1 to +7 compared to the years -1 to -7**	
Covariate		**OR**	**95% CI**
Sex	p<0.0001		
Men		0.66	0.63-0.69
Women		0.89	0.84-0.95
Age at retirement	p=0.008		
<54 years		0.77	0.72-0.81
54-56 years		0.71	0.67-0.75
>56 years		0.72	0.67-0.78
Grade	p<0.0001		
Higher		0.63	0.59-0.67
Intermediate		0.74	0.70-0.77
Lower		0.85	0.78-0.92
Marital status	p=0.823		
Type of retirement	p<0.0001		
Statutory		0.69	0.66-0.72
Early		1.46	1.27-1.69
Night work	p=0.002		
No		0.75	0.72-0.78
Yes		0.66	0.62-0.70
Psychological job demands	p<0.0001		
Low		0.91	0.86-0.97
Moderate		0.72	0.68-0.76
High		0.59	0.56-0.63
Physical job demands	p=0.784		
Job satisfaction	p=0.952		
Body mass index (kg/m^2)	p=0.006		
<25		0.77	0.73-0.81
25 to 30		0.66	0.62-0.70
≥30		0.74	0.67-0.82
Alcohol consumption (unit / day)	p=0.140		
Sub-optimal self-rated health	p=0.019		
No		0.74	0.71-0.78
Yes		0.68	0.64-0.72
Mental fatigue	p<0.0001		
No		0.86	0.82-0.90
Yes		0.56	0.53-0.60
Physical fatigue	p=0.007		
No		0.74	0.70-0.78
Yes		0.68	0.64-0.72
Physical illness	p=0.378		
Depression	p<0.0001		
No		0.76	0.73-0.80
Yes		0.55	0.52-0.59

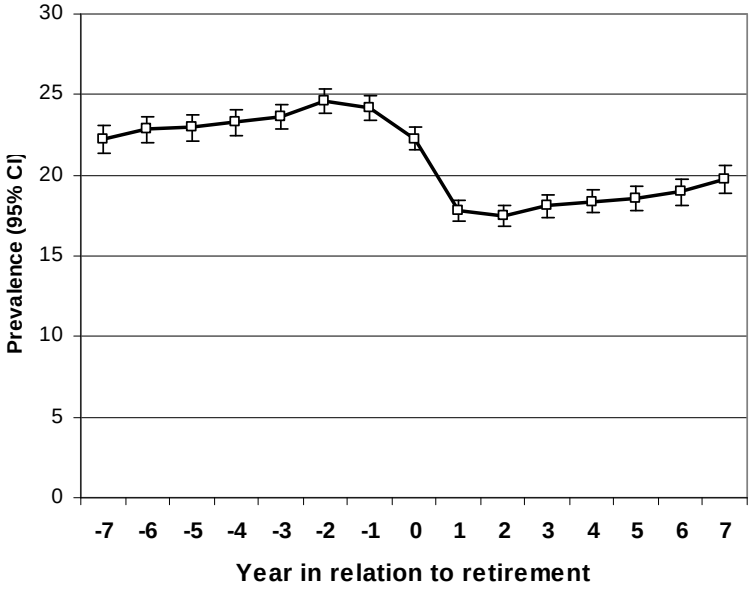
30
25
20
15
10
5
0
Prevalence (95% CI)
-7
-6
-5
-4
-3
-2
-1
0
1
2
3
4
5
6
7
Year in relation to retirement

Figure 1.

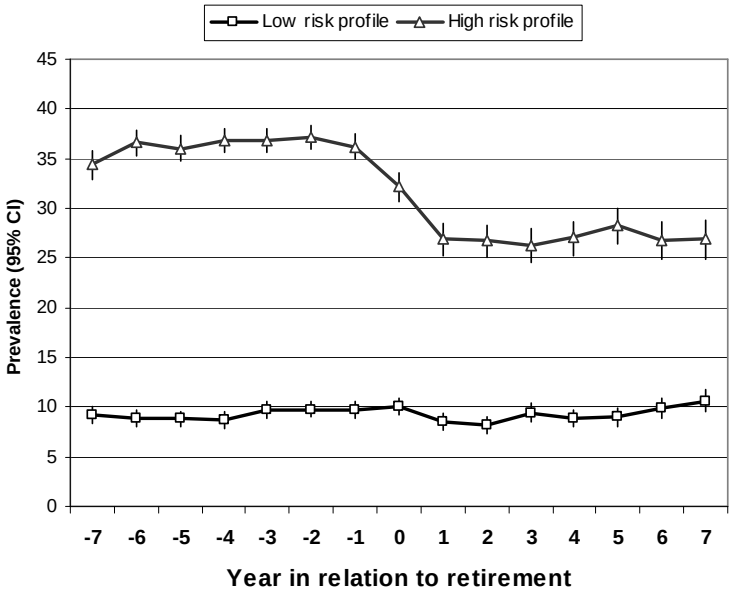
Low risk profile
High risk profile
Prevalence (95% CI)
45
40
35
30
25
20
15
10
5
0
-7
-6
-5
-4
-3
-2
-1
0
1
2
3
4
5
6
7
Year in relation to retirement

Figure 2.