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Palmer KT, D'Angelo S, Harris EC, Linaker C, Sayer AA, Gale CR, Evandrou M, van Staa T, Cooper C, Coggon D, Walker-Bone K. [Sleep disturbance and the older worker: findings from the Health and Employment After Fifty study.](#)

*Scandinavian Journal of Work, Environment & Health* 2017

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**DOI link to article:**

<http://dx.doi.org/10.5271/sjweh.3618>

**Date deposited:**

12/01/2017

**Embargo release date:**

04 January 2018



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## **Sleep disturbance and the older worker: findings from the Health and Employment After Fifty study**

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**No of words:**

Abstract 247

Main text: 3388

**Number of Tables:** 4

**Number of Figures:** 0

**Running head** – Risk factors for insomnia in later working life

**Acknowledgements**

The HEAF study is funded by grants from the Medical Research Council, Arthritis Research UK and the Economic and Social Research Council. We wish to thank the CPRD and the 24 general practices that have supported data collection; also, the staff of the MRC LEU who provided invaluable support with data entry and computing, especially Helena Demetriou and Vanessa Cox.

**Competing interests**

Professor Cooper has received consultancy and honoraria from Alliance for Better Bone Health, Amgen, Eli Lilly, GSK, Medtronic, Merck, Novartis, Pfizer, Roche, Servier, Takeda and UCB. The remaining authors have no interests to declare.

### **Authors' contributions**

KTP identified the study questions and with DC designed the study and its measuring instruments. KTP supervised data collection, and with SD, planned the analyses. SD conducted the analyses. KTP wrote the first draft of the paper. KWB, SD, ECH, CL, AAS, CG, ME, TS and CC contributed to the study's design, content, measuring instruments and plan of execution. Additionally, ECH and CL led in data collection, cleaning and preparation, and the enlistment of participating general practices. All authors read and approved the final manuscript.

## **Abstract**

### **Objectives**

To characterise the descriptive epidemiology of insomnia in mid-life and explore the relative importance of different occupational risk factors for insomnia in older workers.

### **Methods**

A questionnaire was mailed to all adults aged 50-64 years registered with 24 English general practices. Insomnia was defined as having at least one of four problems with sleep severely in the past 3 months. Subjects were also asked about employment conditions, feelings concerning work, and their health. Associations were assessed by logistic regression and population attributable fractions (PAF) calculated.

### **Results:**

Analysis was based on 8067 respondents (5470 in paid work). Insomnia was reported by 18.8% of subjects, being commoner in women, smokers, obese individuals, those living alone, and those in financial hardship, and less prevalent in the educated, those in South-East England, and those with friendships and leisure-time pursuits. Occupational risk factors included unemployment, shift working, lack of control and support at work, job insecurity, job dissatisfaction and several of its determinants (lacking a sense of achievement, feeling unappreciated, having difficult work colleagues, feeling unfairly criticised). Population burden of insomnia was associated more strongly with difficulties in coping with work demands, job insecurity, difficult colleagues, and lack of friendships at work (PAF 15-33%) than shift work and lack of autonomy or support (PAF 5-7%). It was strongly associated with seven measures of poorer self-assessed health.

### **Conclusions**

Employment policies aimed at tackling insomnia in older workers may benefit from focussing particularly on job-person fit, job security and relationships in the workplace.

### **Summary – What is new**

Job demands, lack of support and choice, job stress and shift working have been the main occupational risk factors for insomnia considered in previous research. Our findings suggest that these contribute less to the population burden of insomnia in older workers than other workplace factors such as inability to cope at work, job insecurity, having difficult colleagues and lacking work friendships.

## **Introduction**

Chronic insomnia is common. The complaint is often defined in terms of sustained difficulties in falling and staying asleep, early morning waking, awakening unrefreshed, dissatisfaction over sleep and consequent daytime tiredness(1). Estimates of its prevalence vary substantially by definition and setting. However, in population surveys, about 30% of adults report sleep problems at a given time (2-4). while 6-15% meet formal criteria for an insomnia disorder(4). The high prevalence extends to the subset of the population who are in work (5.6), a substantial minority of whom take hypnotic medication (5).

Sleep disturbance has been linked with adverse health, including anxiety, depression and widespread pain (1,3,7,8), coronary heart disease (7,9), and mortality (10). In the workplace, it has also been linked with impaired productivity (7,11,12), absenteeism (7,13), occupational accidents (7,13) and health-related job loss (14). In the province of Quebec alone, annual indirect costs of insomnia-related absenteeism and lost productivity in 2008 were put at almost \$6 billion (15). Thus, the economic burden of the condition is considerable and it is important to prevent.

Established personal risk factors for insomnia include female sex, poor mental health, physical comorbidity and pain, financial worries and low education (1,3,4,7,16). Among risk factors in the workplace, attention has focussed principally on shift working (7,12,17,18) and combinations of workplace demands, support, control and job 'stress' (7,12,17,19-22).

Only occasionally, however, have estimates been made of the population attributable fractions associated with different occupational risk factors for insomnia, to assess their relative importance (22). Moreover, some potentially avoidable risk factors, such as co-worker relationships, have received little attention. Also, studies have rarely focussed on older workers, among whom the occupational causes of sleep disturbance may vary from younger colleagues. One of the few such investigations, of French utility workers (23), reported

improved sleep quality after planned normal retirement, notably in workers retiring from jobs that carried high demands and low rewards. As demographic trends in developed countries now require people to work longer rather than retire, research on avoidable occupational determinants of insomnia in older workers is all the more pertinent.

In this report we provide new data on the descriptive epidemiology of sleep disturbance in mid-life, explore the relative importance of different occupational risk factors for insomnia in older workers, and also assess associations with self-reported ill-health.



## Study population and methods

Our analysis used baseline data from the Health and Employment After Fifty (HEAF) study, a large population-based cohort of older adults resident in England. A report on design, methods and recruitment has been published elsewhere (24). In short, 8,134 adults born between 1948 and 1962 (target age range 50-64 years) were recruited from 24 geographically-dispersed English general practices contributing data to a research database, the Clinical Practice Research Datalink (CPRD). Subjects who returned an initial questionnaire are being followed up annually through further questionnaires and by record linkage. Ethical approval was received from the NHS Research Ethics Committee North West-Liverpool East.

At baseline, the questionnaire included items on personal circumstances, employment conditions and the work environment, sleep disturbance, sickness absence from work and self-assessed health.

We assessed sleep disturbance through a four-part question based on work by Jenkins *et al* (25) and used in another population-based British study (3): “*How much have you been troubled by sleep problems in the past 3 months? a) Difficulty falling asleep? b) Difficulty staying asleep? c) Waking up too early? d) Not feeling refreshed in the morning?*” Response categories were ‘no problem’, ‘mild problem’, ‘moderate problem’ and ‘severe problem’. Individual items were reclassified to create a series of binary variables for analysis (severe problem vs. not), and insomnia overall was defined as a severe problem with any of a) to d). The scale has been shown to have acceptable psychometric properties in terms of internal consistency, test-retest repeatability, and convergent and predictive validity (26-28).

Demographic characteristics included: age and sex; height and weight (used to derive BMI); smoking habits (classified here as current vs. ex/never smoker); highest educational qualification (in three bands); social class (in three bands, higher managerial, intermediate, manual and routine); household composition (living alone vs. not), location of the participant’s

general practice (used as an area-based index of deprivation (29)); weekly personal caring responsibilities (any vs. none); weekly unpaid work as a volunteer (any vs. none); weekly leisure-time activities and weekly social engagement (meeting or doing things with friends or relatives outside the home vs. not); home ownership (owned/owned with a mortgage vs. other); pension entitlement (state pension only vs. private pension); and financial hardship (two items on difficulty managing financially and on many things being unaffordable).

Regarding employment conditions, we asked about: work status (employed, self-employed, unemployed, retired); and for those in paid work, on size of employing organisation; hours worked per week ( $\leq 20$ ,  $>20-40$ ,  $>40$ ); rotating or variable shift working and night shift working (often vs. sometimes/rarely); type of contract (permanent vs. temporary/renewable); whether or not a second paid job was held; entitlement to paid holiday; and whether the job provided a choice over what, when and how to do things (rarely/never vs. often/sometimes), support from colleagues, a supervisor or manager (rarely/never vs. often/sometimes), and payment by output vs. fixed salary.

We also asked about respondents' feelings concerning their work and working relationships – their overall job satisfaction (dissatisfied/very dissatisfied vs. satisfied/fairly satisfied/very satisfied); whether they felt appreciated at work by others (rarely/never vs. often/sometimes); whether their job gave a feeling of achievement (rarely/never vs. often/sometimes); whether they had a work colleague who was very difficult to get on with (yes vs. no); or had been criticised unfairly at work (often vs. sometimes/rarely/never); or felt insecure in employment, overall and in the event of illness (rather insecure/very insecure vs. secure/very secure); and whether they had friends at work with whom they also spent time outside work (yes vs. no). We further asked about total sickness absence in the past 12 months, analysed as 'any absence vs. none' and '>20 vs. <20 days of absence'); whether they had needed to cut down at work in the past 12 months because of health (analysed as 'any vs. none' and 'a lot vs. not'); whether they felt they were coping with work's physical and mental demands (with

some/great difficulty vs. easily); and whether they expected to be physically and mentally able still to carry out the same kind of work in two years' time (no/not sure vs. yes).

Finally, several validated measures of health were assessed: 1) self-rated health (SRH), measured with a single question (30) and dichotomised as 'fair/poor' vs. 'at least good'; 2) low mood, assessed by the Centre for Epidemiologic Studies Depression scale (CES-D) ( $\geq 16$  was considered a cut-point for depression) (31); 3) well-being, measured using the Warwick-Edinburgh Mental Well-being Scale (WEMWBS), with participants in the lowest quintile of scores classified as having 'poor' well-being (32); 4) frailty, assessed using the criteria of Fried et al (33); 5) somatising tendency, assessed using elements of the Brief Symptom Inventory (34); and graded according to the number of somatic symptoms out of five that had been at least moderately distressing during the past week (0, 1,  $>1$ ); 6) memory problems (serious vs. none/not serious); and 7) persistent troublesome musculoskeletal pain (lasting a month or longer in the past 12 months in the back/neck, arms/shoulders or legs, and making it difficult/impossible to get washed or dressed or do household chores (yes vs. no).

Analysis was restricted to respondents who completed the question on sleep disturbance (N=8067) and, for the occupational analyses, to those who were also in paid work (N=5470). Associations with demographic factors and employment conditions were estimated by logistic regression, with results expressed as odds ratios (OR) with 95% confidence intervals (95% CIs). All risk estimates were adjusted for age and sex. Additionally, population attributable fractions (PAF) were computed for certain potentially avoidable occupational determinants of insomnia, to establish the proportions of cases (people with insomnia/sleep disturbance) that might be eliminated in the population if no one had been exposed to that specific factor – i.e. if all people had the same risk as those in the reference category.

In a sensitivity analysis, to explore whether employment status (employed vs. self-employed), educational attainment (university/higher professional degree vs. other), and financial well-

being (finding it difficult to manage financially these days vs. other) acted as effect modifiers of relationships, we looked for significant interactions and where necessary repeated analysis stratifying by these factors.

Finally, we used logistic regression to estimate associations between sleep disturbance and our measures of poor self-assessed health. In this analysis OR were adjusted for age, sex and social class. Statistical analyses were carried out with Stata (Version 14.0) software (StataCorp LP, College Station, Texas).

## Results

In all, 1516 (18.8%) of respondents reported a least one severe sleep problem, including 430 (5.3%) with severe difficulty in falling asleep, 862 (10.7%) with severe difficulty in maintaining sleep, 858 (10.6%) with early wakening, and 979 (12.1%) severely affected by awakening unrefreshed.

Table 1 summarises associations of various personal characteristics with insomnia, and also with specific symptoms of sleep disturbance. Insomnia was more common in women, the less educated, those of lower social class, current smokers, the obese (BMI>30 kg/m<sup>2</sup>), those living alone, those lacking regular leisure time activity and those who had no friends with whom they regularly socialised (OR 1.6-1.9). Even stronger associations were found with various indices of financial hardship (lack of home ownership, reported difficulties in managing financially and affording things, lack of a private pension to supplement the state pension), with OR 2.0-4.7. All of these associations were significant at the 5% level. By contrast, insomnia was less common in the oldest age band and those living in London and the South-East of England. Associations with specific aspects of sleep disturbance showed a similar pattern to insomnia overall, being strongest for difficulty in falling asleep. Further adjustment for social class reduced associations only slightly (data not shown).

Table 2 summarises associations between employment conditions and sleep disturbance. Insomnia and its component symptoms were significantly more common in the unemployed than in employees (OR 2.3-4.2), while severe problems in falling asleep and maintaining sleep were somewhat commoner in retired people (OR 1.2-1.5). However, among those in paid work, weekly working hours, size of employer and permanency of contract had little impact on sleep. As expected, frequent rotating or variable shift working was a risk factor for insomnia and symptoms of sleep disturbance (OR 1.3-1.9), as was night shift working (OR 1.3-2.8). Lack of holiday entitlement also appeared to be a risk factor, although findings were based on few subjects without entitlement and were not statistically significant.

Table 3 shows relationships between sleep disturbance and people's feelings about their work and their work colleagues. As expected, poor sleep was associated with adverse psychosocial working conditions including lack of choice over work (OR 1.5-2.1), lack of support from colleagues (OR 1.7-2.3), and perceived job insecurity (OR 1.5-1.7). Job dissatisfaction was associated with about four-fold higher odds of sleep disturbance, and several potential determinants of dissatisfaction showed stronger associations than did choice/support/demand: these included feeling unappreciated at work (OR 2.4-3.4), lacking a sense of achievement at work (OR 2.6-3.2), finding colleagues to be difficult (OR 1.7-2.2), feeling criticised unfairly at work on a regular basis (OR 3.9-5.2) and not having friendships established at work and pursued outside it (OR 1.3-1.5). Those who reported difficulties in coping with work's demands were significantly more likely to report severe sleep disturbance (OR 2.9-4.3). Findings from Table 3 changed little after adjusting for social class, shift working, BMI, socialising with friends and home ownership, as well as age and sex. (Using forward-backward selection, these variables emerged from those in Table 1 (and shift working) as being associated with insomnia ( $p < 0.2$ ) while improving the model's fit – data not shown).

PAF for insomnia were notable for struggling to cope with work's physical demands (33%), its mental demands (33%), job insecurity (18%), working with difficult colleagues (17%) and lacking friendships at work (15%) (Table 3). By contrast, PAF for lack of control and support at work were lower (7%), and marginally below those for rarely feeling unappreciated at work (9%), lacking a sense of achievement in work (8%) and overall job dissatisfaction (10%). In comparison, the PAF for insomnia associated with financial hardship (depending on the metric chosen from Table 1) ranged from 12% to 16%, that for smoking was 5% (95%CI 3-7%) and that for frequent rotating or variable shift working was 5% (95%CI 2-8%) (or 2% for night shift working, which was less common in the sample).

In a sensitivity analysis, we considered interactions between the factors in Table 3 and

educational attainment, employment status and difficulty in managing financially. Important interactions ( $P < 0.05$ ) were largely confined to educational attainment, whereby lack of choice, feeling unappreciated and not coping with work's demands had a bigger impact on insomnia in those with a university or higher professional qualification than in those without (OR 59-93% higher, PAF 33-91% higher).

Table 4 considers poor sleep in relation to poor self-assessed health. All of the assessed measures of poor health were strongly associated with insomnia and specific symptoms of sleep disturbance, including fair/poor SRH (OR 3.9-6.5), low mood (CES-D score  $\geq 16$ ) (OR 5.5-9.4), poor well-being (WEMWBS  $< 32$ ) (OR 5.2-8.5), pre-frailty (1-2 Fried criteria met, OR 2.2-3.1), frailty (3-5 Fried criteria met) (OR 7.1-17.1), serious or worsening memory problems (OR 4.3-7.4), somatising tendency (OR 3.7-4.7), and persistent troublesome musculoskeletal pain in the past 12 months (OR 3.2-4.1). All associations were significant at the 5% level.

In case the associations of sleep disturbance with difficulty meeting work's physical demands were confounded by physical ill-health, or those with difficulty meeting work's mental demands were confounded by mental ill-health, we conducted further sensitivity analyses. Risk estimates for the former were adjusted also for persistent musculoskeletal pain and frailty and risk estimates for the latter for low mood. OR for insomnia were reduced, but still remained significantly elevated (2.6, 95%CI 2.3-3.1 and 2.0, 95%CI 1.7-2.4 respectively).

Finally, insomnia was found to be strongly and significantly associated with prolonged sickness absence ( $>20$  vs.  $\leq 20$  days) in the previous 12 months (OR 6.1, 95%CI 3.8-8.3).

## **Discussion**

Within our sample, symptoms of sleep disturbance were more common in women and in those who lived alone, were of low social class, suffered financial hardship, or were obese; and were less prevalent at older ages, in the educated, in those living in the South-East of England, and in those engaged in voluntary work, leisure time activities, socialising and friendships. Potential occupational determinants of sleep disturbance included unemployment, shift working, lack of control and support at work, job insecurity, job dissatisfaction and several of its determinants, such as lacking a sense of achievement, feeling unappreciated at work, having difficult colleagues, and feeling criticised unfairly at work. Difficulties in coping with work demands, job insecurity, working with difficult colleagues and lack of friendships at work had particularly high PAF for insomnia and sleep disturbance. Severe sleep problems were commoner in those struggling to cope with work's demands and far commoner in those with poor self-reported health; they were also associated with prolonged sickness absence.

Our study had the benefit of a large, geographically dispersed, population-based sampling frame (since almost everyone in Britain registers with a general practice for healthcare which is free at the point of delivery). A second strength was a focus on several relatively understudied occupational risk factors for sleep disturbance. These advantages in combination enabled us to derive PAF and thus to assess the potentially avoidable proportion of cases in the population, assuming causal relationships.

Study limitations included a relatively low response rate at baseline and the availability, at this baseline phase of the HEAF study, only of cross-sectional data.

Members of the recruited sample were somewhat older, better educated, and wealthier than 50-64 year-olds in the population as a whole, although they were drawn from most English regions and most deciles of affluence and were reasonably representative as judged by employment status, ethnicity and marital status (24). Nevertheless, the prevalence of insomnia



could have been over- or under-estimated if those with insomnia were more or less likely to participate. In comparison, a population survey of five English general practices with a higher response rate reported a higher prevalence of sleep problems (3), although its case definitions were based on frequent rather than severe disturbances of sleep and it studied a wider age range than in the HEAF cohort. More importantly, associations of insomnia with the demographic and occupational predictors of interest would only be biased in our study if they differed importantly between responders and non-responders. This seems unlikely, the more so as questions on sleep disturbance represented only a small part of a far larger question set and were a disguised focus of interest.

The cross-sectional nature of our analysis limits interpretation. Thus, for example, while job dissatisfaction, lacking a sense of achievement, poor inter-personal relationships and poor relational justice at work are likely causes of sleep disturbance, we cannot exclude the possibility that poor sleep sometimes contributes to these outcomes by undermining work performance and people's standing with others. Similarly, associations with many of our measures of impaired health may well be bi-directional. However, some longitudinal studies have indicated that high demands, low choice and poor co-worker support are weakly predictive of impaired sleep (19,21,35), while other cohort evidence indicates that sleep is predictive, for example, of incident depression (8), and this encourages us, in calculating PAF, to assume causal relations for our other less-established findings.

Several well-recognised associations with insomnia emerged from our analysis, including higher rates among women (1-4), the lonely (1), those with socio-economic disadvantage, low education, or a low income (1,16,36), and those in poor health (1,3,4,16). Insomnia has also been linked with consumption of nicotine and with an abnormal BMI (1). Our findings support these observations. We found a lower risk of insomnia in 60-64 year-olds than in 50-54 year-olds. However, the age bands studied were narrower than in other reports, some (but not all) of which have indicated higher rates of insomnia in later life. Differences in age band and

measuring instrument may also explain why the overall prevalence of insomnia was lower in this study than in some other population-based alternatives.

Previous studies in the workplace setting have focussed principally on anti-social work schedules (7,12,17,18) and stressful jobs, defined commonly using the demand-support-control paradigm of occupational stress (7,12,17,19-22,35). In keeping with others, we found higher risks of sleep disturbance in those working shifts or in jobs with low perceived autonomy or co-worker support, as well as in the unemployed (37). We also found strong associations with less commonly studied but relevant occupational circumstances, such as those relating to unfair criticism at work (38,39), and with seldom-studied risk factors for this outcome such as job dissatisfaction, inter-personal conflicts and friendships at work.

Our study is unusual in providing estimates of PAF – the proportions of insomnia that might arise from various avoidable risk factors. The PAF cannot be inferred simply from the relative risk that a factor carries, since it depends also on the frequency of the risk factor in the population at large. For example, while being unfairly criticised at work was a stronger risk factor for insomnia than job insecurity in our sample (OR 4.2 vs. 1.6), because job insecurity was more commonly experienced, it was a bigger potential contributor to the population burden (PAF 18% vs. 4%). When judged in this way, certain of the less studied risk factors in our study appeared potentially to be more important occupational determinants of sleep disturbance than job choice, job support and frequent working of shifts (although it should be noted that cross-sectional analysis may underestimate the lifetime burden of shift working on insomnia, since it assesses a self-selected population tolerant of atypical working hours). There were also some differences between subgroups, such that lack of choice, feeling unappreciated and not coping with work's demands had a bigger impact in the highly educated than in those without qualifications.

Relatively few investigations have focused on sleep disturbance in older workers (19,21), so

our data add new knowledge in a group among whom the aim should be to promote well-being and satisfaction with an extended working life. Although cross-sectional, the data suggest that insomnia in this age group may be caused or aggravated by a number of workplace elements (e.g. feeling unappreciated or unfairly criticised, job insecurity, poor co-worker relationships) that are potentially avoidable through better employment practices and policies. Participants of the HEAF study are being followed-up with linkage to their healthcare records, and this prospective phase should provide information on whether insomnia is predictive of early exit from the labor market and what impact it has on doctor-recorded health outcomes. At this stage, however, the occupational findings, including those on sickness absence, should serve as an encouragement to employers to take action.

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**Table 1: Associations between sleep disturbance and personal characteristics**

Risk factor	Severe difficulty in falling asleep		Severe difficulty in staying asleep		Severe problem in waking early		Feeling unrefreshed		Insomnia	
	OR	95%CI	OR	95%CI	OR	95%CI	OR	95%CI	OR	95%CI
	<b>Sex</b>									
Male	1		1		1		1		1	
Female	2.2	1.8-2.7	1.7	1.5-2.0	1.4	1.2-1.6	1.8	1.5-2.0	1.6	1.4-1.8
<b>Age (years)</b>										
50-54	1		1		1		1		1	
55-59	1.1	0.9-1.5	1.1	0.9-1.3	0.9	0.8-1.1	0.9	0.7-1.0	0.9	0.8-1.1
60-64	0.8	0.6-1.1	0.8	0.7-1.0	0.7	0.5-0.8	0.6	0.5-0.7	0.7	0.6-0.8
<b>Area of practice</b>										
North East & North West	1		1		1		1		1	
West Midlands	0.9	0.6-1.2	0.9	0.7-1.1	1.0	0.8-1.3	0.9	0.7-1.2	1.0	0.8-1.2
East	0.9	0.7-1.2	0.9	0.7-1.1	0.8	0.6-1.0	0.8	0.7-1.0	0.8	0.7-1.0
South Central & West	1.0	0.8-1.3	1.0	0.8-1.2	1.0	0.8-1.2	1.0	0.9-1.2	1.0	0.9-1.2
London & South East	0.6	0.4-1.0	0.7	0.5-1.0	0.8	0.6-1.1	0.7	0.5-0.9	0.7	0.6-0.9
<b>Educational level</b>										
University degree or higher professional	1		1		1		1		1	
Vocational training certificate	1.7	1.3-2.3	1.7	1.4-2.0	1.6	1.3-2.0	1.7	1.4-2.0	1.6	1.4-1.9



Risk factor	Severe difficulty in falling asleep		Severe difficulty in staying asleep		Severe problem in waking early		Feeling unrefreshed		Insomnia	
	OR	95%CI	OR	95%CI	OR	95%CI	OR	95%CI	OR	95%CI
	School only	2.3	1.8-2.9	1.9	1.6-2.3	2.1	1.8-2.5	2.1	1.8-2.5	1.9
<b>Social class</b>										
Higher managerial	1		1		1		1		1	
Intermediate occupations	1.4	1.1-1.9	1.3	1.1-1.5	1.3	1.1-1.6	1.2	1.0-1.5	1.4	1.2-1.6
Routine and manual occupations	2.1	1.7-2.7	1.6	1.4-1.9	1.9	1.6-2.2	1.9	1.6-2.2	1.7	1.5-2.0
<b>Living alone</b>										
No	1		1		1		1		1	
Yes	1.8	1.4-2.2	1.4	1.2-1.7	1.5	1.3-1.8	1.6	1.3-1.8	1.5	1.3-1.7
<b>Being a personal carer</b>										
No	1		1		1		1		1	
Yes	1.0	0.8-1.3	1.1	0.9-1.3	1.3	1.1-1.5	1.1	1.0-1.3	1.2	1.0-1.3
<b>Voluntary work</b>										
Yes	1		1		1		1		1	
No	1.5	1.1-1.9	1.6	1.3-1.9	1.7	1.4-2.2	1.5	1.2-1.8	1.4	1.2-1.6
<b>Leisure activity</b>										
Yes	1		1		1		1		1	
No	2.2	1.8-2.6	1.7	1.5-2.0	1.7	1.5-2.0	1.9	1.7-2.2	1.7	1.5-1.9

Risk factor	Severe difficulty in falling asleep		Severe difficulty in staying asleep		Severe problem in waking early		Feeling unrefreshed		Insomnia	
	OR	95%CI	OR	95%CI	OR	95%CI	OR	95%CI	OR	95%CI
	<b>Socialising with friends</b>									
Yes	1		1		1		1		1	
No	2.2	1.8-2.8	1.8	1.5-2.2	1.6	1.4-2.0	2.0	1.7-2.4	1.8	1.6-2.1
<b>Home ownership</b>										
Owned/owned with mortgage	1		1		1		1		1	
Other	3.3	2.7-4.1	2.6	2.2-3.0	2.4	2.1-2.9	2.7	2.3-3.2	2.4	2.1-2.8
<b>Managing financially these days</b>										
Doing alright	1		1		1		1		1	
Difficult	5.7	4.6-7.2	3.9	3.2-4.6	3.6	3.0-4.3	5.0	4.2-6.0	4.7	4.1-5.6
<b>Things you can no longer afford</b>										
No/a few things	1		1		1		1		1	
Many things	4.2	3.4-5.3	3.3	2.7-4.0	3.2	2.6-3.8	4.4	3.7-5.2	4.0	3.4-4.7
<b>Pension</b>										
Private pension as well as state	1		1		1		1		1	
Only state pension	2.8	2.3-3.5	2.0	1.7-2.3	1.9	1.7-2.3	2.1	1.8-2.5	2.0	1.7-2.3
<b>BMI (kg/m<sup>2</sup>)</b>										
< 18.5 (Underweight)	3.3	1.7-6.2	1.7	0.9-3.2	2.0	1.1-3.6	2.5	1.5-4.2	2.1	1.3-3.4

Risk factor	Severe difficulty in falling asleep		Severe difficulty in staying asleep		Severe problem in waking early		Feeling unrefreshed		Insomnia	
	OR	95%CI	OR	95%CI	OR	95%CI	OR	95%CI	OR	95%CI
	18.5 - 25 (Normal)	1		1		1		1		1
25 - 30 (Overweight)	1.1	0.9-1.5	1.2	1.0-1.4	1.2	1.0-1.4	1.2	1.0-1.4	1.1	0.9-1.3
> 30 (Obese)	1.8	1.4-2.3	1.9	1.5-2.2	1.7	1.4-2.0	1.9	1.6-2.2	1.7	1.4-1.9
<b>Smoking</b>										
Never/ex-smoker	1		1		1		1		1	
Current smoker	2.3	1.8-2.9	1.4	1.2-1.7	1.4	1.2-1.8	2.1	1.7-2.5	1.7	1.4-1.9

Odds ratios (OR) were adjusted for age and sex; CI – confidence intervals

**Table 2: Associations between sleep disturbance, terms of employment and employment status**

Risk factor	Severe difficulty in falling asleep		Severe difficulty in staying asleep		Severe problem in waking early		Feeling unrefreshed		Insomnia	
	OR	95%CI	OR	95%CI	OR	95%CI	OR	95%CI	OR	95%CI
	<b>All subjects (N= 8067)</b>									
Employed	1		1		1		1		1	
Self-employed	0.9	0.6-1.3	0.8	0.6-1.0	0.7	0.6-1.0	0.8	0.6-1.0	0.9	0.7-1.0
Unemployed	4.2	3.2-5.6	2.6	2.1-3.3	2.3	1.8-2.9	3.2	2.6-4.0	3.1	2.6-3.8
Retired	1.5	1.1-2.0	1.2	1.0-1.5	1.1	0.9-1.4	1.0	0.8-1.2	1.1	0.9-1.2
<b>Those in work (N=5470)</b>										
<b>Employment status</b>										
Self-employed	1		1		1		1		1	
Small employer (<500 staff)	1.1	0.8-1.7	1.3	1.0-1.8	1.4	1.0-1.8	1.3	1.0-1.6	1.1	0.9-1.4
Large employer (≥500 staff)	0.9	0.6-1.4	1.2	0.9-1.6	1.3	1.0-1.7	1.3	1.0-1.7	1.2	0.9-1.4
<b>Weekly working hours</b>										
≤20 hours	1		1		1		1		1	
>20-40	1.0	0.7-1.5	1.0	0.8-1.3	1.0	0.8-1.3	1.1	0.9-1.4	1.0	0.8-1.3
>40	1.3	0.8-2.1	0.9	0.7-1.3	1.0	0.8-1.4	1.0	0.8-1.4	1.0	0.8-1.3
<b>Having a second paid job</b>										

No	1		1		1		1		1	
Yes	0.6	0.3-1.1	0.9	0.6-1.2	1.0	0.7-1.3	0.9	0.7-1.3	1.0	0.7-1.3
<b>Type of contract</b>										
Permanent	1		1		1		1		1	
Temporary/renewable	0.5	0.2-1.1	1	0.7-1.5	0.7	0.4-1.1	0.9	0.6-1.3	0.8	0.6-1.1
Not applicable (self-employed)	1.0	0.6-1.5	0.8	0.6-1.1	0.7	0.5-1.0	0.8	0.6-1.0	0.9	0.7-1.1
<b>Variable/rotating shift work</b>										
Sometimes/rarely/never	1		1		1		1		1	
Often	1.9	1.4-2.6	1.3	1.1-1.7	1.3	1.0-1.6	1.5	1.3-1.9	1.4	1.2-1.7
<b>Night shift work</b>										
Sometimes/rarely/never	1		1		1		1		1	
Often	2.8	1.8-4.3	1.5	1.0-2.1	1.3	0.9-1.9	2.0	1.4-2.7	1.6	1.2-2.1
<b>Holiday entitlement</b>										
Some	1		1		1		1		1	
None	4.7	1.3-16.4	1.8	0.5-6.4	1.7	0.5-5.9	1.5	0.4-5.3	1.7	0.6-4.8

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Odds (OR) ratios were adjusted for age and sex; CI – confidence intervals

**Table 3: Associations between sleep disturbance and feelings about work and its demands, with estimated population attributable fractions**

Risk factor	Severe difficulty falling asleep		Severe difficulty staying asleep		Severe problem waking early		Feeling unrefreshed		Insomnia			
	OR	95%CI	OR	95%CI	OR	95%CI	OR	95%CI	OR	95%CI	PAF%	95%CI
	<b>Choice at work</b>											
Often/sometimes	1		1		1		1		1			
Rarely/never	2.1	1.6-2.9	1.6	1.3-2.0	1.5	1.2-1.8	1.6	1.3-1.9	1.5	1.3-1.8	7.0	3.4-10.5
<b>Support from colleagues</b>												
Often/sometimes	1		1		1		1		1			
Rarely/never	2.3	1.6-3.3	2.1	1.7-2.8	1.8	1.4-2.4	1.9	1.5-2.5	1.9	1.5-2.3	6.9	3.9-9.8
<b>Paid by output</b>												
No	1		1		1		1		1			
Yes	1.1	0.7-1.5	1	0.8-1.3	0.9	0.7-1.2	0.9	0.7-1.1	1	0.8-1.2	-0.5	-3.3-2.1
<b>Overall job satisfaction</b>												
Satisfied	1		1		1		1		1			
Dissatisfied	4.5	3.2-6.4	3.9	3.0-5.1	3.6	2.8-4.6	4.4	3.5-5.6	3.9	3.1-4.9	9.9	7.3-12.3
<b>Feeling of achievement</b>												

Risk factor	Severe difficulty falling asleep		Severe difficulty staying asleep		Severe problem waking early		Feeling unrefreshed		Insomnia			
	OR	95%CI	OR	95%CI	OR	95%CI	OR	95%CI	OR	95%CI	PAF%	95%CI
	Often/sometimes	1		1		1		1		1		
Rarely/never	3.2	2.2-4.6	2.7	2.1-3.6	2.6	2.0-3.4	2.9	2.2-3.7	2.9	2.3-3.6	7.7	5.2-10.0
<b>Feeling of appreciation</b>												
Often/sometimes	1		1		1		1		1			
Rarely/never	3.4	2.5-4.7	2.4	1.8-3.0	2.7	2.1-3.3	2.6	2.1-3.3	2.5	2.1-3.1	9.2	6.4-11.9
<b>Job security</b>												
Secure	1		1		1		1		1			
Insecure	1.5	1.1-2.0	1.6	1.3-1.9	1.5	1.2-1.8	1.7	1.5-2.1	1.6	1.4-1.9	18.4	12.2-24.2
<b>Difficult colleagues</b>												
No	1		1		1		1		1			
Yes	2.2	1.7-2.8	1.7	1.4-2.1	1.8	1.5-2.2	2.2	1.8-2.6	1.9	1.6-2.1	17.3	12.4-21.9
<b>Friendship at work</b>												
Yes	1		1		1		1		1			
No	1.5	1.1-2.0	1.5	1.3-1.8	1.3	1.1-1.6	1.5	1.2-1.7	1.4	1.2-1.7	15.1	8.1-21.5
<b>Being criticised unfairly at work</b>												
Sometimes/rarely/never	1		1		1		1		1			

Risk factor	Severe difficulty falling asleep		Severe difficulty staying asleep		Severe problem waking early		Feeling unrefreshed		Insomnia			
	OR	95%CI	OR	95%CI	OR	95%CI	OR	95%CI	OR	95%CI	PAF%	95%CI
	Often	4.1	2.4-7.0	3.9	2.6-5.9	4.1	2.8-6.1	5.2	3.6-7.7	4.2	3.0-6.1	3.8
<b>Coping with physical demands</b>												
Easily	1		1		1		1		1			
At least some difficulty	4.3	3.3-5.7	3.2	2.7-3.9	3.1	2.6-3.7	3.8	3.2-4.6	3.6	3.1-4.1	33.4	28.8-37.8
<b>Coping with mental demands</b>												
Easily	1		1		1		1		1			
At least some difficulty	3.1	2.4-4.1	2.9	2.4-3.5	3.0	2.5-3.6	3.5	3.0-4.2	3.2	2.8-3.8	33.3	28.4-37.8

Odds ratios (OR) were adjusted for age and sex; CI – confidence intervals; PAF – population attributable fraction



**Table 4: Associations between sleep disturbance and impaired health**

Risk factor	Severe difficulty		Severe difficulty		Severe problem		Feeling unrefreshed		Insomnia	
	falling asleep		staying asleep		waking early					
	OR	95%CI	OR	95%CI	OR	95%CI	OR	95%CI	OR	95%CI
<b>Self-rated health</b>										
At least good	1		1		1		1		1	
Fair/poor	6.5	5.2-8.0	4.7	4.1-5.5	3.9	3.4-4.6	6.4	5.5-7.4	5.1	4.5-5.8
<b>Low mood</b>										
No (CES-D <16)	1		1		1		1		1	
Yes (CES-D ≥16)	7.4	5.9-9.2	5.5	4.7-6.3	5.6	4.8-6.5	9.4	8.0-10.9	6.9	6.1-7.8
<b>Well-being</b>										
Good (WEMWBS ≥32)	1		1		1		1		1	
Poor (WEMWBS <32)	7.6	5.9-9.8	5.6	4.5-6.9	5.2	4.1-6.4	8.5	6.9-10.5	6.7	5.4-8.2
<b>Frailty</b>										
Not frail	1		1		1		1		1	
Pre-frail	2.8	2.3-3.5	2.2	1.9-2.5	2.5	2.2-3.0	3.1	2.6-3.6	2.5	2.2-2.8
Frail	13.3	9.6-18.4	9.2	7.0-12.2	7.1	5.3-9.4	17.1	12.9-22.6	13.2	10.0-17.5
<b>Memory problems</b>										
Other	1		1		1		1		1	

Serious problems/got a lot worse	6.5	4.8-8.7	5.5	4.3-7.0	4.3	3.3-5.6	7.4	5.8-9.4	6.8	5.3-8.7
<b>Somatising tendency</b>										
No	1		1		1		1		1	
Yes	4.4	3.6-5.4	4.4	3.8-5.2	3.7	3.2-4.3	4.7	4.1-5.5	4.2	3.7-4.8
<b>Persistent musculoskeletal pain in past 12 months</b>										
No	1		1		1		1		1	
Yes	4.1	3.4-5.1	3.5	3.0-4.1	3.2	2.7-3.7	3.7	3.2-4.3	3.4	3.0-3.8

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Odds ratios were adjusted for age, sex and social class (in 3 bands); CI – confidence intervals; WEMWBS – Warwick-Edinburgh Mental Well-being Scale; CES-D - Centre for Epidemiologic Studies Depression scale. For definitions, see text.