Insomnia and long sleep duration are risk factors for later work disability. The Hordaland Health Study

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SUMMARY Both insomnia and sleep duration have previously been linked with a range of adverse outcomes, but no studies have explored their relative effect on subsequent work disability. The aim of the present study was to investigate the contribution of insomnia versus sleep duration to later long-term work disability. Using a historical cohort design with 4-year follow-up, data on insomnia, sleep duration and potential confounders were gathered from 6599 working persons (40–45 years). The outcome was award of disability pension, as registered in the National Insurance Administration. After controlling for baseline exposure to disability and sick leave, insomnia was a strong predictor of permanent work disability [odds ratio (OR) = 4.56], and this effect remained significant after controlling for sleep duration, as well as for other possible confounders (OR = 1.88). Short sleep duration was not significantly associated with subsequent work disability, while long sleep duration (>8.5 h) did predict work disability (OR = 2.96), also in the fully adjusted model (OR = 2.14). The present study demonstrates that both insomnia and long sleep duration are strong and independent risk factors for subsequent work disability.

KEYWORDS cohort studies, disability, historical, insomnia, logistic regression, risk factors, sleep, work

INTRODUCTION

People with insomnia (PWI) typically complain about difficulty initiating or maintaining sleep or of non-restorative sleep, which result in some form of daytime impairment (Edinger et al., 2004; Lichstein et al., 2003). Compared with polysomnographic recordings, however, PWI tend to overestimate their time awake and consequently underestimate the amount of time they actually sleep (Carskadon et al., 1976; Coates et al., 1982). Still, studies based upon self-reports do not consistently show a linear relationship between sleep duration and insomnia. In one study, it was found that symptoms of insomnia were more frequently reported by both short sleepers (4–6 h) and long sleepers (9–10 h), compared with sleepers who reported sleep duration in the intermediate range (7–8 h) (Grandner and Kripke, 2004). Based upon such data, we argue that one should distinguish between insomnia and sleep duration when studying possible outcomes of these sleep variables.

The many adverse individual correlates of impaired sleep are well documented. Insomnia is associated with both cognitive and intellectual impairment (Pilcher and Huffcutt, 1996; Simon and Vonkorff, 1997; Szelenberger and Niemcewicz, 2000), as well as current and subsequent affective disorders (Mellinger et al., 1985; Vollrath et al., 1989). Patients suffering from insomnia also commonly report significant reduction in
quality of life (Zammit et al., 1999) and impaired coping abilities (Morin et al., 2003; Sadeh et al., 2004). Short sleep duration, on the other hand, is associated with reduced immune function (Savard et al., 2003; Wright et al., 2006), elevated body-mass index (Bjorvatn et al., 2006; Kohatsu et al., 2006), and obesity (Yaggi et al., 2006). Long sleep onset latency as registered by polysomnography has been found to predict mortality 13 years later (Dew et al., 2003), and in a study by Kripke and colleagues (Kripke et al., 2002), both too much and too little sleep were found to predict mortality. The effect of insomnia on mortality is more ambiguous. The study by Kripke found no such effect (Kripke et al., 2002) while another recent study found that complaints of insomnia did predict subsequent mortality (Neckelmann et al., 2006).

Although there is substantial evidence on the individual correlates of insomnia and sleep duration, little is known about the relationship between insomnia and sleep length on social outcomes. While impaired sleep, in general, has been shown to represent an enormous economic burden, both directly and indirectly (Stoller, 1994; Walsh and Engelhardt, 1999), less attention has been paid to the relation between sleep problems and the individual's ability to work. This is surprising, as work compensation expenditures account for an increasingly larger proportion of the national income across Organization for Economic Cooperation and Development (OECD) countries (OECD, 2004). A few studies have shown that sleep problems are significantly associated with self-reported sickness absence (Akerstedt et al., 2007; Eriksen et al., 2001; Leigh, 1991), and in a previous study, we demonstrated that complaint of insomnia was a significant risk factor for subsequent work disability in rural Norway (Sivertsen et al., 2006), even after adjusting for mental and physical conditions, as well as other possible confounders.

The aim of the present study was to further explore the association between sleep problems and work disability, by using a more constrained cohort in terms of age and urbanicity. We also wanted to explore the effect of sleep duration on subsequent work disability, which to the best of our knowledge has never been performed before.

METHODS

Population and data material

The Hordaland Health Study 1997–1999 (HUSK) was a joint epidemiological research project carried out by the Norwegian Health Screening Service in collaboration with the University of Bergen. The base population included 29,400 individuals in Hordaland County, Western Norway born 1953–57, aged 40–45 at the time of the data collection. Data were collected by questionnaires and clinical examinations. A total of 18,581 (8,598 men and 9,983 women) answered the basic questionnaire and came to the clinical examination, yielding a participation rate of 63% (57% for men and 70% for women).

After the clinical examination, a second questionnaire was distributed to a random subgroup comprising 8,896 individuals. Because of the non-response to one or more of the variables in the second set of questions, 2,209 individuals were excluded. HUSK responders who were receiving disability pension at baseline or who were granted disability pension awards within 12 months after baseline were also excluded (n = 268). Thus, the final population consisted of 6,599 individuals.

Measures

Disability pension award

The National Insurance Administration issue and record all disability pension awards. In Norway, this is in all essence a public responsibility, correct registration is a prerequisite for transfers of payments; thus, the records are highly accurate. The criterion for being awarded a disability pension is at least 50% reduced work ability because of an acknowledged medical condition as certified by a general practitioner. Examinations from a specialist are undertaken when appropriate, although such an independent examination is not required. In the last decade, approximately 20% of applications were rejected by the insurance case managers, most often because of incomplete attempts to obtain another job and/or complete medical rehabilitation.

In the present study, the outcome variable was award of disability pension 12–48 months after participation in HUSK. By excluding all disability pensions awarded 0–12 months after participation in HUSK, we aimed to exclude subjects in the process of applying for a disability pension while they attended HUSK, thus reducing any possible protopathic bias. In this study, the term work disability is used synonymously with disability pension awards.

Insomnia

The Research Diagnostic Criteria (Edinger et al., 2004) for insomnia include reports of either difficulty initiating sleep, difficulty maintaining sleep, waking up too early, or sleep non-restorative sleep despite adequate opportunity and circumstances for sleep. In addition, some form of day-time impairment related to the night-time sleep difficulty must be reported. In the current study, all subjects were given a modified version of the Karolinska Sleep Questionnaire (Akerstedt et al., 2002, 2008). The response alternatives were (i) always/every day, (ii) mostly/several days per week, (iii) sometimes/several times per month, (iv) seldom/a few times per year, and (v) never. PWI were defined as persons experiencing either difficulties falling asleep, repeated awakenings, premature awakening at least several times per week, in addition to daytime tiredness/sleepiness mostly/several days per week. Previous studies have reported Chronbach's alpha for the derived insomnia index to be 0.76 (Akerstedt et al., 2008).

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Sleep duration

Sleep duration was defined as time in bed (calculated from self-reported bedtime and rise time) minus self-reported sleep latency. For analyses purposes, sleep duration was split into five groups, with cut-offs based on the following percentiles: 5.5 h = 5th percentile; 6.5 h = 25th percentile; 7.5 h = 75th percentile, 8.5 h = 95th percentile. Sleep duration during the workweek and weekends was analyzed separately. In this present study, we focus only on the workweek; these data are more stable and comprise most days during the week (Ursin et al., 2005).

Confounders

Mental health. Anxiety and depression symptoms were measured with the Hospital Anxiety and Depression Scale (HADS), which contain seven items each on cognitive symptoms of anxiety and depression, respectively (Zigmond and Snaith, 1983). In a recent literature review, HADS showed good case-finding properties for anxiety and depression in primary care patient populations and hospital settings (Bjelland et al., 2002). The HADS-scores are used as continuous variables, with higher scores reflecting increasing anxiety and depression symptom load. Both the anxiety and depression subscales have previously been found to be internally consistent, with values of Cronbach’s alpha of 0.80 and 0.76, respectively (Mykletun et al., 2001).

Somatic health. Questions on somatic diagnoses were framed in the form of: ‘Do you have or have you had (one of the following)’, coronary infarction, stroke, diabetes, asthma, multiple sclerosis, chronic bronchitis, osteoporosis, or fibromyalgia. A positive response on one or more of these items was considered as a positive self-reported diagnosis. In addition, subjects were asked if they used any medication the previous day, and if so, for which condition. From these responses, a team of physicians appointed appropriate diagnoses according to Anatomical Therapeutical Chemical-classifications, producing a continuous variable indicating the number of conditions for which the person was taking medication.

Somatic symptoms. Subjects were also asked about frequency of 16 common symptoms from different organ systems in accordance with the International Classification of Diseases-10 Research Criteria for F45 Somatoform Disorders (World Health Organization, 1993) on a five-point (0–4) Likert scale labeled: ‘almost never, rarely, sometimes, often and almost always’. The items were summed and comprise the variable organ system symptoms that are used as a continuous variable, with increasing levels reflecting higher symptom load. Total symptom scores are often used in both research and clinical practice to determine severity levels, especially for mental health conditions. In addition, subjects were asked if they had been troubled with muscle pain and/or stiffness in muscles or joints continuously for over 3 months during the last year. If positive, they were further asked to reply to which of 10 suggested joints or body areas that were affected. This was included as the continuous variable muscle pain, ranging from 0 to 10, where increasing numbers indicate increasing severity.

Socio-demographic and lifestyle factors. Level of education was reported in four categories from less than 7 years of schooling up to at least 4 years of higher education in college/university. Self-reported weekly consumption of alcohol units was entered as a continuous variable. Body-mass index (BMI) was calculated based upon data from clinical examinations and was subsequently entered as a continuous variable.

Statistical analysis and models

sss for Mac, version 16.0 (SPSS Inc., Chicago, IL, USA), was used for all statistical analyses. Logistic regression analysis was used to examine the relation between the sleep variables and award of a disability pension, with results presented as odds ratios with 95% confidence intervals (CI).

The effect of sleep duration was initially analyzed with sleep duration as a continuous variable and curve-linearity was investigated by adding its squared product in blockwise analyses. We also present analyses of sleep duration as a categorical variable, using the five ranges described above. Pearson chi-squared tests were used to examine differences between baseline demographic and clinical characteristics in 1997–1999 and permanent work disability at follow-up.

Ethics

The study protocol was cleared by the Regional Committee for Medical Research Ethics of Western Norway and approved by the Norwegian Data Inspectorate. Informed consent in writing was obtained from all subjects included in this study.

RESULTS

Sample characteristics

The prevalence rate for insomnia was 4.1%, and insomnia was more prevalent among subjects with lower income. PWI reported greater cigarette use, and less exercise compared with people without insomnia (PWOI) (all P < 0.05). There were no differences on gender, BMI, education level, alcohol use, and number of somatic diagnoses at baseline, whereas both anxiety and depression, as well as self-reported somatic symptoms, and pain were strongly associated with insomnia at baseline (all P < 0.001).

Subjects who reported sleeping between 6.5–7.5 h had higher education and income, and lower BMI compared with both short and long sleepers (all P < 0.001). Furthermore, short sleep duration (<5.5 h) was associated with being a current smoker, as well as with higher alcohol consumption, and less physical exercise. A comparable effect was found for long sleep duration, with subjects sleeping longer than 8.5 h reporting higher levels of both anxiety, depression, somatic symptoms and pain (all P < 0.05).
People with insomnia had an average sleep duration of 6 h and 29 min, which was significantly less compared with PWOI (7 h and 5 min); \( P < 0.001 \). Also, a larger proportion of PWI reported sleeping less than 5.5 h compared with PWOI (14.5% versus 3.8%; \( \chi^2 = 110.5 \), degrees of freedom (df) = 4, \( P < 0.001 \); Fig. 1).

Predictors of disability pension award

In all, 116 subjects (1.8%) were granted permanent disability pension between 12 and 48 months after baseline assessment. Female gender, low education and income, and the health-related behaviors of smoking, alcohol abstinence and being physically inactive were associated with a greater likelihood of receiving a subsequent disability pension, as were self-reported symptoms, pain, somatic diagnoses, anxiety and depression (all \( P < 0.001 \)).

The predictive effect of insomnia on disability pension

People with insomnia had a strongly elevated risk for subsequent award of disability pension during follow-up compared with PWOI [odds ratio (OR) = 4.56; 95% CI 2.72–7.66, Table 1]. This effect was not reduced when adjusting for age and gender, sleep duration, BMI, or somatic diagnoses, whereas education, income, and health behaviors had only marginally attenuating effect. Adjusting for anxiety and depression explained a substantial part of the effect (OR = 2.45; 95% CI 1.38–4.38), as did also somatic symptoms (OR = 2.41; 95% CI 1.39–4.16), as well as pain (OR = 2.32; 95% CI 1.34–4.03). However, insomnia remained a significant risk factor for work disability also in the fully adjusted model (OR = 1.88; 95% CI 1.00–3.55, \( P = 0.048 \)).

The predictive effect of sleep duration on disability pension

The analyses of sleep duration as a continuous variable showed no significant effect (OR = 0.49; 95% CI 0.14–1.79), and we also found no significant curve-linear association between sleep duration and work disability (OR = 1.06; 95% CI 1.97–1.16). Table 2 describes the risk for disability pension stratified by sleep duration when using it as a categorical variable. In the crude model, only sleeping more than 8.5 h (above the 95th percentile) was significantly associated with subsequent disability pension compared with sleeping 6.5–7.5 h (OR = 2.96; 95% CI 1.55–5.66). The effect was reduced when adjusting for all of the confounding factors, but long sleep duration remained an independent risk factor for disability award in the fully adjusted model (OR = 2.14; 95% CI 1.07–4.29). Short sleep duration was not associated with increased risk of disability pension.

**DISCUSSION**

In this present study, we found insomnia and long sleep duration at baseline to be strong risk factors for subsequent work disability. A substantial part of this association was explained by other variables such as somatic conditions and symptoms, anxiety and depression. Still, when controlling for all these factors both insomnia and long sleep duration remained a significant risk factor for award of disability pensions.
Table 2 Effect of sleep duration on risk of disability pension award in the HUSK-study, Norway, 1997–1999

<table>
<thead>
<tr>
<th>Adjustment variables</th>
<th>&lt;5.5 h (n = 279)</th>
<th>5.5–6.5 h (n = 1130)</th>
<th>7.5–8.5 h (n = 1795)</th>
<th>&gt;8.5 h (n = 282)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OR</td>
<td>95% CI</td>
<td>OR</td>
<td>95% CI</td>
</tr>
<tr>
<td>Crude</td>
<td>0.97</td>
<td>0.35–2.71</td>
<td>1.39</td>
<td>0.84–2.30</td>
</tr>
<tr>
<td>A) Insomnia</td>
<td>0.72</td>
<td>0.25–2.05</td>
<td>1.25</td>
<td>0.75–2.08</td>
</tr>
<tr>
<td>B) Age and gender</td>
<td>1.05</td>
<td>0.37–2.94</td>
<td>1.48</td>
<td>0.89–2.46</td>
</tr>
<tr>
<td>C) Education and income</td>
<td>0.78</td>
<td>0.28–2.19</td>
<td>1.28</td>
<td>0.77–2.12</td>
</tr>
<tr>
<td>D) Heath behaviors</td>
<td>0.79</td>
<td>0.28–2.23</td>
<td>1.23</td>
<td>0.74–2.05</td>
</tr>
<tr>
<td>E) Body-mass index</td>
<td>0.92</td>
<td>0.33–2.59</td>
<td>1.36</td>
<td>0.82–2.25</td>
</tr>
<tr>
<td>F) Anxiety and depression</td>
<td>0.78</td>
<td>0.28–2.19</td>
<td>1.23</td>
<td>0.74–2.05</td>
</tr>
<tr>
<td>G) Somatic diagnoses</td>
<td>0.96</td>
<td>0.34–2.70</td>
<td>1.39</td>
<td>0.84–2.31</td>
</tr>
<tr>
<td>H) Somatic symptoms</td>
<td>0.76</td>
<td>0.27–2.14</td>
<td>1.25</td>
<td>0.75–2.09</td>
</tr>
<tr>
<td>I) Pain</td>
<td>0.75</td>
<td>0.26–2.12</td>
<td>1.25</td>
<td>0.75–2.10</td>
</tr>
<tr>
<td>Fully adjusted model*</td>
<td>0.45</td>
<td>0.15–1.33</td>
<td>0.99</td>
<td>0.58–1.71</td>
</tr>
</tbody>
</table>

OR, odds ratio; CI, confidence interval.
*Adjusting for all the confounders listed above (A + B + C + D + E + F + G + H + I).

While complaints of insomnia previously have been found to predict later work disability (Sivertsen et al., 2006), this study is the first to examine the unique contribution of both insomnia and short versus long sleep duration. This distinction is important both in terms of future research on the consequences of sleep disturbances, but it also has important clinical implications. It may for example be helpful to communicate to a patient that sleeping only around 5 h per night may not be problematic, if he or she otherwise is functioning adequately during the daytime. This emphasizes the clinical importance of the individuals’ experience of restorative sleep. And indeed, compared with good sleepers, PWI have previously demonstrated no substantial deficits in actual nocturnal sleep duration (Cambers and Keller, 1993). Although objective recorded sleep duration normally is longer than subjectively reported sleep duration (Edinger and Fins, 1995), our study demonstrates that even subjectively reported short sleep duration may not be harmful in terms of risk of later work disability, as long as it remains unaccompanied by complaints of insomnia. Still, we find it somewhat surprising that short sleep duration appears to represent no independent risk for subsequent work disability, as numerous studies have linked short sleep duration with other adverse outcomes, including reduced immune function (Savard et al., 2003; Wright et al., 2006), type-2 diabetes and obesity (Bjorvatn et al., 2007; Kohatsu et al., 2006; Yaggi et al., 2006), in addition to mortality (Kripke et al., 2002; Neckelmann et al., 2006). Excessive sleep, on the other hand, remained an almost equally strong risk factor for work disability as insomnia in the fully adjusted model. This corroborates previous findings of excessive sleep being associated with a range of harmful consequences, including all-cause mortality (Minino et al., 2002; Tamakoshi and Ohno, 2004), as well as impaired physical, psychological and cognitive functioning (Brassington et al., 2005; Goldman et al., 2007; Harris et al., 2005).

When exploring the consequences of poor sleep, controlling for possible confounders is critical, as poor sleep commonly coexist with a range of somatic and psychiatric conditions. For example, in addition to being linked to various medical conditions (Shapiro et al., 1993), impaired sleep often is a core symptom of several psychiatric disorders (American Psychiatric Association, 1994), and has been shown to precede both depression and anxiety (Ford and Kamerow, 1989; Vgontzas and Kales, 1999). Psychological morbidity, in turn, has been shown to play a considerable role in explaining permanent work disability (Mykletun et al., 2006). Thus, a significant strength of the present study is the relatively long list of confounders. Episodes of sick leave is associated with both the exposure (Akerstedt et al., 2007; Sivertsen et al., in press) and the outcome (Kivimaki et al., 2007), and is therefore a candidate confounding factor. It has also been suggested that the process leading up to disability pension award may cause stress and increase sleep problems (Overland et al., in press). But, adjusting for sick leave is conceptually problematic for the vast majority of individuals, the pathway to disability pension includes several spells of sick leave and longer periods of long term sickness absence. Sick leave can as such be considered as a ‘sub-threshold’ condition in relation to disability pension award, and we have therefore not adjusted for this factor, in line with previous publications employing disability pension award as the outcome (Mykletun et al., 2006; Overland et al., 2008; Sivertsen et al., 2006).

A possible explanation for the finding that short sleep duration is not harmful, whereas excessive sleep is, may be that individuals’ perceptions of sleep-related strain are important in relation to disability pensioning (Overland et al., 2006). Thus, if a person has short habitual sleep duration, this may be
unproblematic given that this is in accordance with the person’s own preferences and that the person does not experience the short sleep duration as insomnia. The constrained age span in our study might also explain some of the findings. The age cohort (40-45 years) is at a stage in life where demands on their time can be tight, which may result in shortened sleep duration. This shortened sleep might be fully voluntary, in line with personal preferences, and thus to a lesser degree be experienced as exhaustive. Moreover, in line with our findings, a recent study showed that long sleepers were much more likely not to work the day before an interview, or, if they did, to work shorter hours than short sleepers (Basner et al., 2007). As such, one might argue that short sleep duration is more compatible with being at work, and that people with a larger sleep need (longer sleep duration) find it more difficult to work. A limitation of the present study is our measure of sleep duration, which did not include reports of wake time after sleep onset. As such, there is a risk that we may have overestimated the sleep duration, especially in persons with maintenance insomnia. The use of official records of disability pensions as the measure of work disability is a significant strength of the present study. Self-reported work disability may, instead of de facto work disability, measure a person’s subjective experience of work. Thus, self-reported data are not as accurate as official records.

In conclusion, although we cannot rule out the possibility of residual confounding, our study suggests that both insomnia and long sleep duration are independently associated with subsequent work disability, and that these relationships remain significant even after adjustment for a range of clinical and demographic confounders.

CONFLICT OF INTEREST

None.

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