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The Effect of Obstructive Sleep Apnoea Syndrome on Sick Leave and Work Disability

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ABSTRACT

The objective of the present study was to examine the independent contribution of symptoms of obstructive sleep apnoea syndrome (OSAS) on long-term sick leave and permanent work disability.

Using a historical cohort design with four years follow-up, information on sick leave and disability benefit recipiency were merged with health information from the Hordaland Health Study in Western Norway, 1997–99. 7028 persons aged 40–45, were assessed for self-reported symptoms of OSAS (snoring, breathing cessations and daytime sleepiness), body-mass index, somatic conditions, and other potential confounders. The outcomes, accumulated sick leave of 8 weeks or more, and permanent work disability were identified in records from the National Insurance Administration.

After excluding participants with work disability at baseline, symptoms of OSAS were found to be a significant predictor of both subsequent long-term sick leave (odds-ratio 1.78) and permanent work disability (odds-ratio 2.40). These effects remained significant after adjustment for a range of possible confounding factors. Daytime sleepiness had the greatest explanatory power, followed by breathing cessations and snoring.

We conclude that self-reported symptoms of OSAS are an independent risk factor for subsequent long-term sick leave and permanent work disability. The findings need to be replicated using objective measures of OSAS.

Keywords: cohort studies; epidemiology; population-based; risk factors; sickness absence; sleep apnoea, obstructive

Abbreviations: CI, confidence interval; DSM-IV, *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition*; HUSK, The Hordaland Health Study; OR, odds ratio.

INTRODUCTION

Obstructive sleep apnoea syndrome (OSAS) is a sleep disorder in which the upper airway closes repeatedly during sleep, leading to sleep fragmentation and decreased levels of oxyhemoglobin saturation [1]. The prevalence of OSAS is estimated to around 5% [2-8], but the at-risk population is likely to be much larger [9]; only 10% of the population are adequately screened for the diagnosis [10]. Clinically characterized by snoring, breathing cessations and extreme daytime somnolence [11], OSAS has been shown to be a risk factor for a range of medical conditions, including glucose intolerance [12], impotence [13], hypertension [14], myocardial infarction [15], and stroke and mortality [16]. Untreated OSAS also increases the risk of automobile accidents [17], leads to poor quality of life [18], and has been linked with several neurocognitive consequences [19, 20].

In addition to such impacts on individual health, an Australian study recently estimated the economic costs of sleep disorders (OSAS and insomnia being the most important) to represent nearly 1 % of the nation's gross domestic product (GDP) [21]. Also, despite previous studies consistently showing self-reported sleep problems in general to be a significant risk factor for both long-term sick leave and permanent work disability determined objectively [22-24], the only recent study looking at OSAS severity and self-reported work limitation found mixed results [25]. To the best of our knowledge, no studies have to date prospectively aimed to study the independent effects of symptoms of OSAS on long-term sick leave or permanent work disability.

Although polysomnography (PSG) is recommended to make the diagnosis of OSAS, the use of PSG is not easily applied in large population-based studies, being intrusive, impractical and expensive to use. Therefore, screening instruments based on self-reported symptoms of OSAS have been necessary to gain information on both prevalence and co-morbidities of OSAS

[3, 4, 9], information that would be hard to obtain without using large-scale surveys.

The aim of the present study was to estimate the effect of self-reported symptoms of OSAS on both long-term sick leave and permanent work disability, using a historical cohort design. And importantly, we also wanted to adjust for the effect of a range of possible confounding and mediating factors known to be associated with OSAS, including demographic factors, lifestyle behaviors, marital/cohabitant status, body-mass index (BMI), blood pressure, as well as other physical diagnoses and conditions.

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) both answered the basic questionnaire and came to the clinical examinations, yielding a participation rate of 63 % (57 % for men and 70 % for women).

After the clinical examinations, a second questionnaire including the OSAS-items was distributed and completed by a random subgroup comprising 8,896 individuals. Due to non-response to one or more of the variables relevant for this study in the second set of questions, 1600 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), as were also individuals on sick leave at the time of HUSK and 14 days after. Thus, the final population consisted of 7,028 individuals.

Measures

Outcome

The National Insurance Administration records all periods of sick leave beyond 14 days, as well as all disability pension awards. In Norway, this is in all respect a public responsibility and because correct registration is a prerequisite for transfers of payments, the records are highly accurate.

In the present study, we defined long-term sick leave as accumulated number of of sick days of 8 or more weeks (56 days). A cut-off of 8 weeks has also been used in similar studies to denote "long-term" [23, 26].

Permanent work disability was defined as award of disability pension 12–48 months after participation in HUSK. By excluding all disability pensions awarded from baseline to 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. The criterion for being awarded a disability pension is at least 50 % permanently reduced work ability due to 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.

Exposure

Symptoms of OSAS were estimated using three items from the Karolinska Sleep Questionnaire [27]. These self-report items were used to identify at-risk individuals based on their own or their partner's reports on "snoring" and "breathing cessation" during sleep. In addition to the requirement of reporting both of these core symptoms either "sometimes (several

times a month)", "often (several times a week)" or "always", participants were only classified as having symptoms of OSAS if they also were "tired or sleepy at work or during their spare time "sometimes", "often" or "always". A similar definition based on the Hawaiian Sleep Questionnaire (the Apnoea Score) has previously been shown to identify 100% of the cases with moderate or severe sleep apnoea (Apnoea-Hypopnea Index [AHI] > 40) and 75% of all sleep apnoea cases with AHI > 5, yielding an overall predictive accuracy of 88 % for AHI > 10 [28].

Potential Confounders

Alcohol consumption was operationalised using four categories based on weekly number of self-reported alcohol units (None, 1-2 units/week, 3-4 units/week, or ≥ 5 units/week). Body mass index (BMI) was calculated from body weight (Kg) divided by squared height (m^2) from the clinical examinations. Level of education was reported in four categories from less than seven years of schooling up to at least 4 years of higher education in college/university. Type of main occupation was manually classified according to Standard Classification of Occupations, ISCO-88(COM) [29] and divided into 10 major groups (eg, professionals). Detailed description of these categories is provided elsewhere [30]. We also collected data on marital/cohabitant status (dichotomized into living alone or with partner), smoking status (current smoker: yes or no) and weekly level of exercise [1] no or easy physical activity 1 hr/week, [2] moderate physical activity 1 to 2 hrs/week, or [3] hard physical activity more than 2 hrs/week. Data on blood pressure was collected during the clinical examinations.

Symptoms of current depression were measured using the depression subscale of Hospital Anxiety and Depression Scale (HADS) [31], which is a self-report questionnaire comprising 14 four-point Likert-scaled items, for which seven are used to construct the depression subscale (HADS-D). No somatic items or items regarding sleeping difficulties are included. The scale was used as continuous variables, reflecting symptom load of depression.

Questions on somatic diagnoses were framed in the form of: “Do you have or have you had (one or more of the following)”, myocardial infarction, stroke, diabetes, and angina. A positive response on one or more of these items was considered self-reported diagnosis positive. In addition, participants 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 ATC (Anatomical Therapeutical Chemical)-classifications, producing a continuous variable indicating the number of conditions for which the person is taking medication.

In the present paper, we do not discriminate between confounding and mediating factors.

Statistical analysis and models

SPSS for Mac 16 was used for all statistical analyses. Pearson Chi-Square Tests were used to examine differences of baseline demographic and clinical characteristics in persons with and without symptoms of OSAS. Multivariate logistic regression analysis was used to examine the relation between symptoms of OSAS and sick leave and award of a disability pension. To avoid double counting, participants who were granted disability pension awards during the follow-up (n=139) were excluded from the sick leave analyses. However, due to the high prevalence of sick leave, participants on sick leave (n = 1790) were not excluded when work disability was the outcome measure. Results are presented as odds ratios with 95 percent confidence intervals. Potential confounders (determined *a priori*) were entered into the model for adjustment in the following order: (1) demographic characteristics (age and education), (2) marital/cohabitant status, (3) health behaviors (smoking, alcohol, physical exercise), (4) body-mass index, (5) systolic blood pressure, (7) somatic diagnoses (angina, stroke, diabetes, myocardial infarction), and (8) prescribed drugs.

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

Baseline characteristics of the 7,028 participants that completed the OSAS questionnaire are shown in Table 1. The prevalence rate for OSAS was found to be 6.3 %. Symptoms of OSAS were more prevalent among men and persons with low education. Being a current smoker, less exercise, higher alcohol use, and high body-mass index were all associated with reported symptoms of OSAS. Higher systolic blood pressure was also associated with reported symptoms of OSAS, while angina, stroke, diabetes, myocardial infarction) were not (table 1).

Please insert table 1 about here

The effect of symptoms of OSAS on sick leave

Persons reporting symptoms of OSAS had an almost doubled odds for subsequent sick leave during follow-up adjusting for gender only (OR=1.78 [95% CI: 1.42– 2.20], Table 2). Adjusting for age and education reduced the odds-ratio to 1.70, whereas controlling for either body-mass index or depression reduced the odds-ratio to 1.71. Health behaviours, including smoking, alcohol and physical exercise, had a slightly larger explanatory effect on the relationship

between OSAS and sick leave, with an adjusted odds-ratio of 1.67 (95% CI: 1.33-2.08). However, even in the fully adjusted model, symptoms of OSAS remained a significant risk factor for long-term sick leave (adjusted OR=1.62 [95% CI: 1.28 – 2.05]).

Please insert table 2 about here

The effect of symptoms of OSAS on disability pension award

Persons reporting symptoms of OSAS had a more than doubled odds of subsequent award of disability pension during follow-up, and adjusting for gender, age and education only slightly attenuated the association (adjusted OR=2.20 [95% CI: 1.26 – 3.85], Table 3). Health behaviours also explained some of this association (adjusted OR=1.99), as did depression (adjusted OR=2.02). As with the case for sick leave, neither occupational type, marital status, prescribed drugs, blood pressure, angina, stroke, diabetes or myocardial infarction, had a significant explanatory effect on the relationship between OSAS and work disability. When adjusting for the entire list of confounders, symptoms of OSAS remained a significant risk factor for permanent work disability (OR=1.92 [95% CI: 1.01 – 3.66]).

Please insert table 3 about here

The separate effects of breathing cessations, snoring, and daytime sleepiness

To examine which of the components (breathing cessation, snoring or daytime sleepiness) had the greatest explanatory power on sick leave and permanent work disability, we conducted

additional analyses on each of the three components included in the OSAS-variable. As detailed in Table 4, daytime sleepiness was a stronger risk factor than snoring and breathing cessations for both sick leave (adjusted OR = 1.36) and work disability (adjusted = 2.03). Snoring was only significantly associated with subsequent sick leave in the crude analyses (OR = 1.15, [95% CI: 1.10 – 1.21]), whereas breathing cessations remained a significant risk factor also in the fully adjusted analyses for sick leave (adjusted OR = 1.08, [95% CI: 1.01 – 1.66]), but not for work disability.

As detailed in figure 1, there was a dose-response relationship between the frequency of symptoms and long-term sick leave. Experiencing each of the symptoms "always" yielded higher odds-ratios compared to "often" or "sometimes." This effect was more evident in terms of daytime sleepiness, followed by breathing cessations and snoring. A similar dose-response relationship was also found when the outcome was permanent work disability.

Please insert figure 1 about here

DISCUSSION

In the present study we found self-reported symptoms of OSAS (measured by symptoms of snoring, breathing cessations, and daytime sleepiness) to be a strong risk factor for both subsequent long-term sick leave and award of disability pensions. Daytime sleepiness had the strongest explanatory effect, but also breathing cessations and snoring contributed to the effect of OSAS on these adverse outcomes. As expected, a range of adverse sociodemographic characteristics and health behaviours and states were associated with OSAS which partly explained this association. However, even controlling for all these factors, OSAS remained a strong risk factor for these poor outcomes.

These findings add to our understanding of OSAS as a sleep disorder with both serious individual and social consequences. In addition to being a risk factor for a range of medical conditions [12-16], OSAS has also been demonstrated to cause variable degrees of cognitive and performance problems. Although the causal mechanisms leading to such deficits remain unclear, postulated mediating conditions (e.g. hypertension, angina, myocardial infarction, diabetes or stroke) of the effect of OSAS had no explanatory power in these models suggesting that the symptoms of OSAS do not lead to these negative outcomes through these mechanisms. OSAS patients have been shown to report problems in both cognitive processing, memory, sustained attention, and executive functioning [32]. As such, untreated OSAS represents a major problem for the patient 24 hours a day, with impaired daytime functioning expressed as forgetfulness, impaired concentration, and slowed thought processes and responses. It comes as no surprise, then, that having symptoms of OSAS are associated with subjective reported problems in work performance [33]. While sleep complaints in general have been found to predict later work disability [24], to our knowledge, only three other studies have examined the relation between OSAS and work performance. In a retrospective Swedish study, self-reported symptoms of OSAS were found to be significantly associated with short-term sick leave and psychosocial

morbidity in a sample of obese persons [34]. In this study, persons with OSAS on average reported 5 weeks more of sick leave over the previous year than those without OSAS, an effect that remained significant after adjusting for the presence of other common disorders such as hypertension and diabetes. In another recent study, Mulgrew and colleagues found no relationship between OSAS severity and self-reported work limitation in white-collar workers, while such an association was present in blue-collar workers [25]. However, these studies did not attempt to adjust for potential confounders that might explain their findings. Finally, Lindberg at al. found self-reported snoring and daytime sleepiness to double the risk for occupational accidents during a 10 year follow-up period [35], an effect that remained significant when also adjusting for other factors that might explain their findings, including body-mass index, smoking, alcohol dependence, years at work, as well as various occupational factors.

Our findings show that among the three symptoms constituting in the OSAS-variable, daytime sleepiness was the strongest risk factor for both sick leave and work disability, followed by breathing cessations and snoring. Also, not surprisingly, we found a dose-response relationship between the frequency of symptoms and the outcomes, with those "always" experiencing daytime sleepiness having the worst work related outcome. However, it is noteworthy that the combination of these symptoms generally yielded higher odds-ratio than any of the separate symptoms alone (except in the fully adjusted analyses on work disability in which the odds-ratio for sleepiness was comparable to that of the OSAS-variable).

There are several strengths in the present study. First, the study sample was relatively large, and the participation rate was high. Second, both exposure and outcome assessments should be relatively unbiased. At baseline measurement, neither participants nor administrators were aware of the specific research hypotheses, reducing the possibility of information being biased by selective symptom presentation in order to gain access to, or avoid, benefits, or bias

the results in the direction of a particular hypothesis. Third, the data obtained from the National Insurance Administration are complete, as people moving to other parts of the country after participating in HUSK are still registered. The main limitation of the present study is the measurement of OSAS. Rather than employing the gold standard of a clinical diagnosis based on polysomnographic recordings, the present study is based on a brief self-report questionnaire used to categorize persons into two groups: symptoms of OSAS or no OSAS. The prevalence estimate (6.3 %) is similar to that found in other epidemiological studies based on the general population in similar age cohorts [2-5, 7]. Nevertheless, the use of self-reported symptoms to measure OSAS remains potentially problematic, because persons are often unaware of their behaviour during sleep [36]. However, polysomnographic data are not easily obtained in epidemiological studies, and the use of self-reports by patients are often the only feasible way of acquiring information about this. One way of improving the validity of such reports is by also including spouse-reported information on snoring and breathing cessations [36]. The Karolinska Sleep Questoinnaire is based on sleep problems also reported by the person's spouse and thus attempts to improve the validity of symptoms. However, as noted by Grunstein et al [34] a potential source of misclassification into OSAS and non-OSAS groups may relate to the presence of a current home partner, and persons sleeping alone may as such be more likely to be misclassified as not having OSAS. In our analysis, adjusting for marital/cohabitant status did not attenuate the effect, and such a misclassification would tend to produce an underestimation in the health differences between the OSAS and non-OSAS groups, given that living alone is characteristically associated with poorer health [34].

Also, previous studies have shown that self report has an acceptable level of accuracy in identifying subjects with and without OSAS [28, 37-40]. In an early study by Kapuniai [28], the same operationalization of OSAS predicted an apnoea index of > 10 with a sensitivity of 83% and a specificity of 63%. Another study found this operationalisation to yield a very high level

of specificity for OSAS (99%), although the sensitivity was somewhat lower [37]. In that study, it was also found that persons never reporting snoring and no observed apnoea were 35 times less likely to have OSAS (as indicated by polysomnography) compared to positive responses on these questions. Nevertheless, under ideal circumstances, self-report data should be validated by polysomnographic readings, although this rarely is performed in such large population studies [41]. A suggestion for further studies including items on sleep apnoea, could be to run PSG on a sub-sample to validate the self reports.

The rate of receipt and later awards of disability pension was higher among the non-attendees than among participants of the HUSK study [42]. Non-participants also have poorer health[43] and much higher mortality rates.[44] Thus, our results might be more accurate for a relatively healthier set of the population. Among the non-respondents there are possibly more comorbidities and complex health problems leading to work disability.

Finally, there are other potential confounders such as work pressures, stress, and other medical conditions (incl. glucose intolerance, impotence and neurocognitive deficits) which have not been captured in our measures yet may be related to both baseline symptoms of OSAS and later sick leave or disability pension.

Conclusions

Our findings suggest that persons with self-reported symptoms of OSAS are more likely to leave the work force, and that this sleep disorder may be a significant independent contributor to increased social security costs and reduced productivity and family income. The findings warrant replication using a better validated measure of OSAS, and suggest that social outcomes become an additional focus of interventions.

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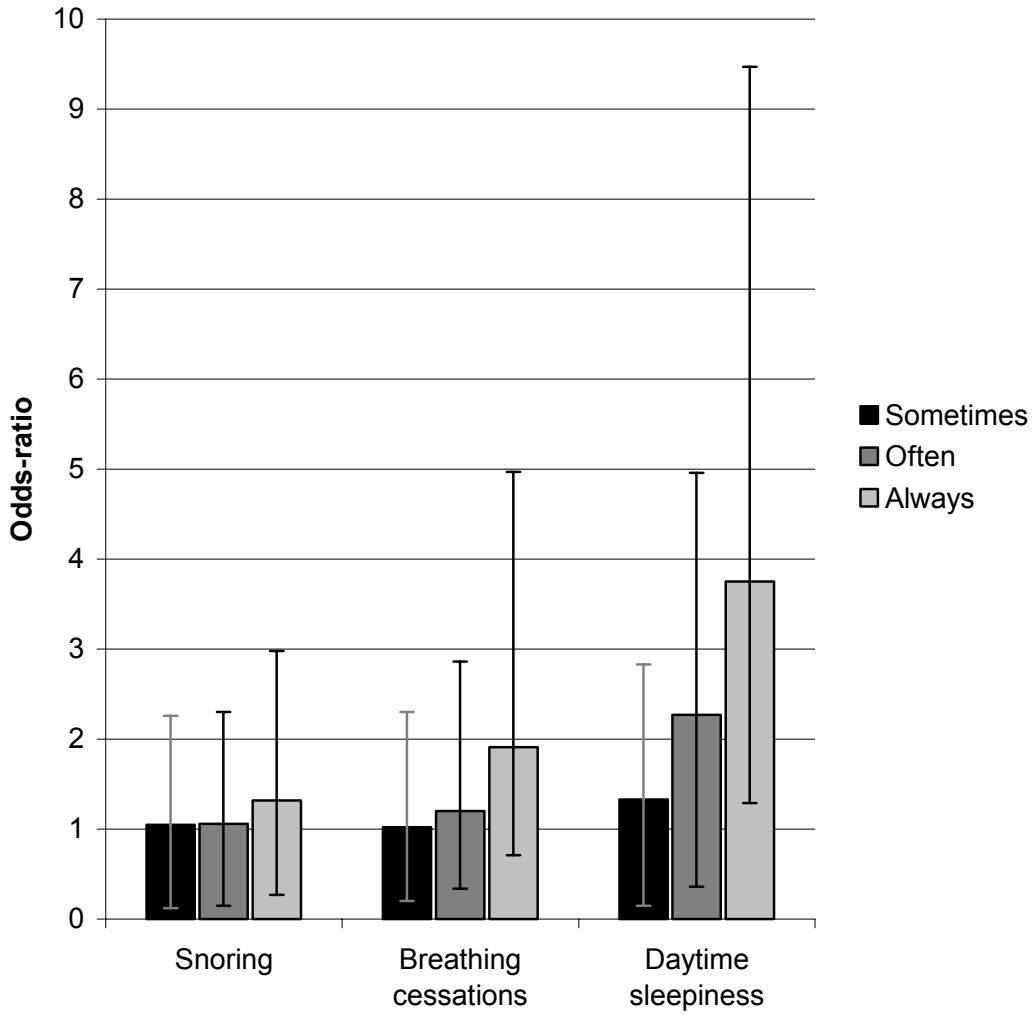

FIGURE 1. Multivariate logistic regression analyses of frequencies of symptoms ("sometimes", "often" or "always") of items comprising the OSAS variable (compared to symptoms reported "rarely" or "never") on risk of long-term sick leave in the HUSK study, Norway. Error bars represent 95 % confidence intervals.

TABLE 1. Baseline demographic and clinical characteristics of participants with and without self-reported symptoms of OSAS in the HUSK study, Norway.

Characteristics	No OSAS	Symptoms of OSAS	*P*-value
N, %	6588, 93.7%	440, 6.3%	
Gender			< 0.001
Male	36.6%	65.2%	
Female	63.4%	34.8%	
Living with partner	76.5%	73.6%	.18
Education			.002
Primary	16.7%	20.7%	
Secondary	45.0%	49.3%	
1–3 yr higher	19.8%	17.5%	
≥ 4 yr higher	18.4%	12.5%	
Occupational type§			< 0.001
Legislators/senior officials/managers	15.1%	18.0%	
Professionals	9.1%	7.3%	
Technicians/associate professionals	22.1%	19.0%	
Clerks	13.8%	14.6%	
Shop/market sales and service workers	20.4%	13.9%	
Agricultural/forestry/fishery workers	2.0%	1.0%	
Craft and related trades workers	7.3%	13.4%	
Plant/machine operators, assemblers	4.7%	7.1%	
Elementary occupations	5.0%	4.4%	
Armed forces	0.4%	1.2%	
Current smoker	32.6%	48.0%	< 0.001
Alcohol consumption†			< 0.001
0 units/week	29.0%	22.7%	
1-2 units/week	41.8%	37.3%	
3-4 units/week	14.6%	12.5%	
≥ 5 units/week	14.6%	27.5%	
Physical exercise			.14
No or easy	29.3%	33.4%	
Moderate	57.0%	55.0%	
Heavy	13.7%	11.6%	
Body-mass index			< 0.001
< 25	55.0%	36.8%	
25-30	35.8%	41.6%	
> 30	9.2%	21.6%	
Angina	0.3%	0.2%	1.00
Stroke	0.3%	0.2%	1.00
Diabetes	0.7%	0.9%	.56
Myocardial Infarction	0.2%	0.5%	.17
Depression*	2.97 (2.90-3.04)	4.26 (3.97-4.55)	< 0.001
Blood pressure (systolic)*	125.9 (125.6-126.3)	129.8 (128.5-131.1)	< 0.001
Prescribed drugs*	0.08 (0.07 – 0.09)	0.07 (0.04 – 0.09)	.87

§ Listed in descending order from "white-" to "blue-collar" occupations (see [30])
* Data presented as mean (95% CI)
† 1 unit equals approximately 12 g ethanol

TABLE 2. Multivariate logistic regression analyses of the effect of self-reported symptoms of OSAS on long-term sick leave (8 weeks+) in the HUSK study, Norway.

		Persons with 8 weeks sick leave (n=1824) Population at risk (n=6,919)	
Adjustment variables		Self-reported symptoms of OSAS	
		OR	95% CI
Crude + Gender		1.78	1.42 – 2.20
A	Age and education	1.70	1.36 – 2.13
B	Occupational type	1.83	1.46 – 2.29
C	Marital/cohabitant status	1.77	1.42 – 2.21
D	Smoking, alcohol and physical exercise	1.67	1.33 – 2.08
E	Body-mass index	1.71	1.36 – 2.13
F	Angina, stroke, diabetes, myocardial infarction	1.79	1.43 – 2.25
G	Depression	1.71	1.37 – 2.14
H	Blood pressure (systolic)	1.78	1.42 – 2.22
I	Prescribed drugs	1.78	1.42 – 2.22
	Fully adjusted model*	1.62	1.28 – 2.05

* Adjusting for all the confounders listed above (A+B+C+D+E+F+G+H+I).

TABLE 3. Multivariate logistic regression analyses of the effect of self-reported symptoms of OSAS on risk of permanent work disability in the HUSK study, Norway.

		All new disability pensions (n=139) Population at risk (n=7,028)	
Adjustment variables		Self-reported symptoms of OSAS	
		OR	95% CI
Crude + Gender		2.40	1.38 – 4.19
A	Age and education	2.20	1.26 – 3.85
B	Occupational type	2.35	1.26 – 4.38
C	Marital/cohabitant status	2.39	1.37 – 4.17
D	Smoking, alcohol and physical exercise	1.99	1.13 – 3.50
E	Body-mass index	2.26	1.29 – 3.97
F	Angina, stroke, diabetes, myocardial infarction	2.40	1.37 – 4.19
G	Depression	2.02	1.15 – 3.56
H	Blood pressure (systolic)	2.30	1.32 – 4.02
I	Prescribed drugs	2.45	1.40 – 4.28
	Fully adjusted model*	1.92	1.01 – 3.66

* Adjusting for all the confounders listed above (A+B+C+D+E+F+G+H+I).

TABLE 4. Multivariate logistic regression analyses of the effect of items comprising the OSAS variable on risk of long-term sick leave (8 weeks+) and permanent work disability in the HUSK study, Norway.

Outcome and model	OSAS (composite score)		Breathing cessations		Snoring		Daytime sleepiness	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Risk of long-term sick leave								
Crude	**1.78**	1.42-2.20	**1.23**	1.15-1.32	**1.15**	1.10-1.21	**1.37**	1.28-1.47
Fully adjusted	**1.62**	1.28-2.05	**1.08**	1.01-1.16	1.03	0.98-1.08	**1.36**	1.27-1.46
Permanent work disability								
Crude	**2.40**	1.38-4.19	**1.32**	1.10-1.60	1.08	0.94-1.25	**2.26**	1.85-2.76
Fully adjusted	**1.92**	1.01-3.66	1.09	0.88-1.35	0.93	0.79-1.10	**2.03**	1.61-2.57