# CHAPTER 3

## Sleep disturbances and reduced work functioning in depressive or anxiety disorders

Josine G. van Mill
Nicole Vogelzangs
Witte J.G. Hoogendijk
Brenda W.J.H. Penninx

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## Abstract

**Objectives**

To examine associations between sleep disturbances and work functioning in a epidemiological cohort study, in both subjects with and without depressive or anxiety disorders.

**Methods**

Included were 707 subjects with and 728 without current depressive or anxiety disorders. Insomnia was defined as a score ≥9 using the Insomnia Rating Scale. Self-reported sleep duration was categorized in short, normal and long (≤6, 7-9, ≥10 hours). Work absenteeism was defined as none, short (≤ 2 weeks) or long (>2 weeks). Work performance was defined as not impaired, reduced or impaired. Logistic regression analyses were performed to examine the associations of sleep disturbances with work functioning.

**Results**

In subjects with psychopathology, insomnia and short sleep duration were significantly associated with impaired work performance (OR insomnia=2.20; 95%CI=1.50-3.22, OR short sleep=2.54; 95%CI=1.66-3.88 compared to normal sleep duration). Insomnia (OR=2.48; 95%CI=1.67-3.69) and short sleep duration (OR=1.85; 95%CI=1.23-2.78) were also associated with long absenteeism. These findings remained after considering clinical characteristics, including medication use and symptom severity.

In subjects without psychopathology, no significant associations were found between insomnia and short sleep duration on work functioning after considering sub threshold depression symptoms.

**Conclusions**

In subjects with psychopathology, sleep disturbances are negatively associated with work functioning, independent of disorder severity and use of psychotropic medication. Further research is needed to determine if treatment of sleep disturbances in subjects with psychopathology improves work functioning.

## Introduction

Sleep disturbances, such as insomnia, are suggested to have a significant impact on work functioning (1). Individuals with insomnia more often report difficulties working or carrying out daily activities (2). An earlier large study (n=6892) found insomnia to be predictive of absenteeism (3). Also, subjects with insomnia have been found to be less productive than non-insomniacs when working (4,5). The annual (both direct and indirect) costs of insomnia-related absence and impaired work productivity are very difficult to estimate (6), but are considered to be substantial and have a large societal impact (1). Estimations of the annual costs of insomnia in the US labor force range from $15.0-17.7 billion (7). Total costs of insomnia in the US (direct, indirect and related costs) have also been estimated at $30-35 billion (8).

Sleep disturbances frequently occur in the presence of psychopathology, such as depressive or anxiety disorders (9). Insomnia and fatigue are two of the symptoms mostly interfering with work functioning, according to individuals with major depressive disorder (n=164) (10). Among individuals suffering from self-reported depressive and anxiety symptoms, subjects with insomnia more often report decreased productivity and more often report absenteeism (11). Insomnia has been associated with absenteeism, but this association disappeared after controlling for depressive symptoms (12).

Clearly, there is an association between sleep disturbances, psychopathology and work functioning. However, not all aspects of this association have been extensively studied. For example, it is still unknown what the role of psychopathology is in the link between sleep disturbances and work functioning, and if the associations between sleep disturbances and work functioning are the same for subjects with and subjects without psychopathology. There are various reasons to assume that differences might exist. First, sleep disturbances may reflect a (partly) different phenomenon in persons with psychopathology, with sleep disturbances being an indicator of the severity of the underlying psychiatric disorder in these subjects. Second, persons with psychopathology may have lower responsibility feelings (13) and could therefore theoretically give up earlier on work when facing sleep problems. Subjects with psychopathology are also more prone to negative thought distortions (14), possibly affecting both sleep and work functioning. Third, persons with psychopathology are already more at risk for reduced work functioning (15), and the addition of sleep problems could simply have more impact in an already at risk population. On the other hand, it is also possible that for subjects with already many psychopathology symptoms, the addition of one extra risk factor (sleep disturbances), might not have a substantial extra impact on work functioning. Consequently, the impact of sleep disturbance could therefore be relatively larger among persons without psychopathology.

The large socio-economic impact of insomnia-related absenteeism and work performance (1,5) poses a clear need for research aimed at unraveling the link between sleep problems and work functioning. The aim of the current study is to investigate the association between insomnia and sleep duration with absenteeism and work performance in a large sample of subjects with and without depressive and anxiety disorders, taking into account the presence and severity of psychopathology.

## Methods

For this study, data were analyzed from the baseline assessment of the Netherlands Study of Depression and Anxiety (NESDA). NESDA is an ongoing eight-year longitudinal cohort study designed to investigate the long-term course of depressive and anxiety disorders in individuals ranging from 18 through 65 years. The research protocol was approved by the Ethical Committee of participating universities and all respondents provided written informed consent. NESDA respondents were recruited from three different settings: the general population, primary health care and secondary mental health care. Individuals from the general population had previously participated in the NEMESIS study (Netherlands Mental Health Survey and Incidence Study) (16) or the ARIADNE study (Adolescents at Risk for Anxiety and Depression) (17). Individuals from primary care were recruited through a three-stage screening procedure, including the Kessler-10 (18) and a short-form Composite International Diagnostic Interview by phone (CIDI) (19). Individuals from secondary care were recruited after they were newly enrolled for anxiety or depressive disorders at one of the participating mental health clinics. Exclusion criteria for the NESDA study were not speaking Dutch, a known primary clinical diagnosis of bipolar disorder, obsessive compulsive disorder, severe addiction disorder, psychotic disorder or organic psychiatric disorder. A more detailed description about the study's sampling procedures is given elsewhere (20). The final sample size of NESDA consisted of 2981 subjects (18.9% from the community, 54.0% from primary care and 27.0% from secondary mental health care).

For the purpose of the present study, we selected the 1720 currently working participants, defined as having a paid job of ≥8 hours per week. Subsequently, 285 individuals were excluded due to missing data on work functioning or sleep, resulting in a total sample size of 1435 subjects. Because our selection criteria was 'currently working', subjects with longstanding absence (> 6 months) were not included in our analyses. Excluded individuals (n=285) were significantly younger (38.5 years versus 41.5, $p<.001$), did not differ with respect to gender, but suffered more frequently from a current depressive or anxiety disorder (67.7% versus 49.3%, $p<.001$) than included individuals.

Our final sample consisted of 511 males and 924 females with a mean age of 41.5 years.

**Measurements**

Between September 2004 and February 2007, participants visited one of the seven interview locations for the baseline assessment. This assessment consisted amongst others of a standardized diagnostic psychiatric interview, a medical assessment, computer tasks and a written questionnaire.

**Work performance and work absenteeism**

Work functioning was conceptualized in terms of impaired work performance and absenteeism. This was assessed with the TiC-P (Trimbos/iMTA Questionnaire for costs associated with Psychiatric Illness) which contains the Health and Labour Questionnaire Short Form (SF-HLQ) and has been used in other epidemiological studies (21). Work performance was based on :

a) how many days (in the past 6 months) subjects had been hindered at work by health problems
b) subjects' work efficiency rated on a 10-point scale (0-1, higher scores implied higher efficiency) on days they had been hindered by health problems.

Subsequently, as done before (15), we used the following formula to compute work performance:

$$\frac{\text{\# days hindered} * (1 - \text{efficiency}) * \text{\# work hours per day}}{\text{\# work hours per week}} = \text{Work performance}$$

The outcome ranged from 0-26, indicating the number of inefficient work weeks in the past six months. A higher score indicated more impairment. Because this variable did not meet normality assumptions, we created three categories: no impairment, reduced performance (>0 and < 2) and impaired performance (≥ 2, highest quartile).

Work absenteeism was computed by dividing the number of days absent (in the past six months), divided by the number of working days per week. This resulted in the number of weeks absent from work (15). Because this variable was not distributed normally, we created three categories (as done before (15)): no absenteeism (0 weeks absent in the past six months), short absenteeism (≤ 2 weeks absent) and long absenteeism (> 2 weeks). Work performance and absenteeism correlated only weakly ($r=0.17$, $p <.001$). Short term absence might be an indicator of more general conditions, such as the flu or common cold, while long term absenteeism might be attributed to chronic conditions (15).

**Sleep disturbances: insomnia and sleep duration**

We measured both insomnia and sleep duration. Insomnia and sleep duration were part of a questionnaire which subjects filled out during baseline assessment or at home afterwards (median time log=four days). Insomnia was assessed with the Women's Health Initiative Insomnia Rating Scale (IRS). This scale was developed by Levine et al. (22) and consists of five questions concerning sleep in the past month. The five items address trouble falling asleep, waking up during the night, early morning awakenings, trouble getting back to sleep after waking up and sleep quality. Scores on the first four items range from 0 "no" to 4 " ≥ 5 times a week", whereas the fifth item of sleep quality ranges from 0 "very sound or restful" to 4 "very restless". The total summary score ranged from 0 (no insomnia) to 20 (severe insomnia). Validity of the IRS has been evaluated in a study of 66,269 post menopausal women: reported test-retest reliability was 0.96 (same day) and 0.66 (one year later) (23). IRS correlated with other actigraphy derived sleep measures (sleep efficiency, sleep latency, wakefulness after sleep onset), implying that the IRS is capable of signalling differences in these more objective measures (23). In our study Cronbach's alpha was 0.82. Scores on the IRS were dichotomized at a cut off point of nine, which has shown to indicate clinically significant insomnia (22). In this manuscript, we therefore use the term 'insomnia' for an IRS-score ≥9. Both the continuous and dichotomous IRS scores were used in analyses. Sleep duration was assessed by asking subjects to estimate the average hours of sleep per night (in round numbers) during the past month, ranging from less than five hours to more than ten hours. Answers were categorized in sleep duration of ≤6 hours (short sleep duration), 7-9 hours (normal sleep duration) or ≥10 hours (long sleep duration). To study the effects of increasing sleep duration, we also used sleep duration (in hours) as a continuous score. Sleep duration and IRS score were moderately correlated (r= -0.45, p= <.001).

**Covariates**

*Psychopathology*

The presence of psychiatric disorders was determined using the CIDI. The CIDI is a standardized diagnostic psychiatric interview which uses DSM-IV criteria to establish diagnoses (19). Psychopathology was classified as current (past six months) or no current psychopathology. Included disorders were depressive disorder (DEP, including major depressive disorder and dysthymia) and anxiety disorders (AD, including panic disorder with/ without agoraphobia, social phobia and generalized anxiety disorder). (psychopathology in this manuscript therefore refers to depressive and/ or anxiety disorders).

A limited set of other covariates was used, because our main interest was to describe the association between sleep and work functioning. Socio-demographic, health and other characteristics of interest that possibly affect work absenteeism, work performance and/ or sleep included age (in years), gender, education (in years), number of working hours per week, number of chronic diseases (total count of the following diseases, based on self report: lung disease, diabetes, cardiovascular disease, cancer, osteoarthritis, intestinal disorders, liver disease, epilepsy and thyroid gland disease). Severity of (sub-threshold) depressive symptoms was measured with the Inventory of Depressive Symptoms (IDS) (24). The IDS contains four sleep-related items, which were excluded for the present study, resulting in a total sum score ranging from 0 to 59. Based on drug container inspection of all drugs used in the past month, medication use was classified according to the WHO Anatomical Therapeutic Chemical (ATC) classification (25). Psychotropic medication included antidepressants and benzodiazepines. Antidepressant use was categorized as selective serotonin reuptake inhibitors (SSRI, NO6AB), tricyclic antidepressants (TCA, NO6AA), other antidepressants (N05BA, N05CF, N05CD, N03AE) or no antidepressants. Benzodiazepines included ATC- codes N05BA, N05CD, N03AE (benzodiazepine derivatives) and N05CF (benzodiazepine related drugs).

*Statistical analyses*

Data were analyzed using SPSS 15.0. To compare characteristics across work performance and absenteeism categories, analysis of variance (ANOVA) and chi-square statistics were used.

Subsequently, multinomial logistic regression analyses were performed with work performance or work absenteeism as the outcome variable and sleep variables as the predictors. Interaction terms (psychopathology status*sleep variable) were tested with work performance/ work absenteeism as outcome variables in order to explore whether the effects of sleep on work functioning differed significantly between subjects with and without current depressive or anxiety disorders or not. If interaction existed, analyses were conducted separately for subjects with and without psychopathology.

Multinomial logistic regression analyses were performed in two different models. The first model (model 1) was adjusted for gender, age, education, chronic diseases and number of working hours per week, since working load may in itself affect performance. To check whether possibly found associations between sleep disturbances and work functioning did not merely reflect severity of depressive and anxiety disorders or were due to medication use, a second adjusted model (model 2) included all before mentioned predictors while adding severity of depressive symptoms and use of antidepressants and benzodiazepines.

Throughout the manuscript, we consider a p of 0.05 significant, and a p <.10 as a trend towards significance (however, due to rounding of numbers it is possible that a confidence interval which includes the number 1, is actually a significant value).

## Results

Table 1 shows the main sample characteristics, according to work performance and absenteeism categories. Subjects with impaired work performance were less educated, had more chronic diseases, more current depressive and anxiety disorders, a higher IDS score, more use of antidepressants and benzodiazepines, more presence of insomnia and both more short as well as long sleep duration compared to subjects who were not impaired or had reduced work performance. Subjects with reduced work performance were significantly younger compared to persons with no or impaired work performance. As for work absenteeism, subjects with long absenteeism were less educated, had more chronic diseases, more current psychiatric diagnoses, a higher IDS score, more use of antidepressants and benzodiazepines, more insomnia and both a shorter as well as a longer sleep duration. Subjects with short absenteeism were significantly younger and more often female. In order to examine whether the effects of sleep measures were independent of psychopathology or not, we tested interaction effects for current psychopathology*sleep measures with either work performance or work absenteeism as the outcome variable in model 1. Interaction effects were present for current psychopathology*sleep duration (continuous) for impaired performance (p= .03) and for long absenteeism (p= .004). However, interaction effects for current psychopathology *IRS-score (continuous) were not significantly present (p= 0.37 for impaired performance, p= 0.27 for long absenteeism). Because we found a significant interaction effect for psychopathology*sleep duration (continuous), we further stratified all analyses for psychopathology status at baseline.

Figure 1 shows that within persons with current psychopathology, subjects with insomnia (IRS≥9) reported more impaired work performance compared to subjects without insomnia (IRS<9). Also, subjects with both a shorter and longer sleep duration reported significantly more impaired work performance, compared to normal sleepers. For subjects without psychopathology, less pronounced differences were found, except that subjects with a long sleep duration reported more long absence than subjects with a normal or short sleep duration.
Figure 2 shows that within persons with current psychopathology, subjects with insomnia reported more long absence, compared to subjects without insomnia. Both short and long sleepers were more absent compared to subjects with a normal sleep duration. For subjects without psychopathology, no differences were found.

**Table 1:** Baseline characteristics in total sample according to work performance and work absenteeism in 1435 currently working individuals

| | Work performance | | | | Work absenteeism | | | |
|---|---|---|---|---|---|---|---|---|
| | *Not impaired (n=644)* | *Reduced (n=431)* | *Impaired (n=360)* | *p-value* | *No (n=745)* | *Short (n=423)* | *Long (n=267)* | *p-value* |
| *Work characteristics* | | | | | | | | |
| Regular working hours per week (mean±SD) | 30.8±10.5 | 32.2±10.1 | 30.9±10.8 | .09 | 31.0±11.7 | 31.8±9.0 | 31.0±9.0 | 0.38 |
| Work performance rate (mean±SD) | 0.0±0.0 | 0.7±0.5 | 6.7±4.8 | <.001 | 1.4±3.6 | 1.8±3.4 | 3.6±4.5 | <.001 |
| Absence in weeks (mean±IQR) | 0.8±2.7 | 1.7±3.7 | 3.8±5.8 | <.001 | 0.0 | 0.9±0.6 | 8.4±6.2 | <.001 |
| *General & somatic health characteristics* | | | | | | | | |
| Age (mean ±SD) | 42.6±11.9 | 39.1±11.5 | 42.4±11.1 | <.001 | 42.9±12.1 | 39.5±11.5 | 42.0±10.7 | <.001 |
| Female % | 64.1 | 66.8 | 61.9 | 0.36 | 60.4 | 70.0 | 66.7 | .003 |
| Education in years (mean ±SD) | 12.9±3.2 | 13.0±3.0 | 12.3±3.3 | .007 | 12.9±3.2 | 13.1±3.3 | 12.0±3.1 | 0.001 |
| Nr. of chronic diseases (mean ±SD) | 0.6±0.8 | 0.6±0.8 | 1.0±1.0 | <.001 | 0.6±0.9 | 0.6±0.9 | 0.8±1.0 | .001 |
| *Psychiatric characteristics & medication* | | | | | | | | |
| Presence of DEP[a] / AD[b] | | | | | | | | |
| no current diagnosis | 68.8 | 46.6 | 23.3 | | 63.2 | 43.7 | 27.0 | |
| current DEP/AD | 31.2 | 53.4 | 76.7 | <.001 | 36.8 | 56.3 | 73.0 | <.001 |
| IDS[c] score (mean ± SD) | 10.5±10.0 | 16.0±10.4 | 24.6±11.1 | <.001 | 12.3±10.5 | 16.9±11.3 | 23.0±12.7 | <.001 |
| Antidepressants % | | | | | | | | |
| no antidepressant | 86.8 | 84.7 | 66.1 | | 87.4 | 79.4 | 65.5 | |
| SSRI | 9.5 | 10.7 | 24.2 | | 9.3 | 14.2 | 24.3 | <.001 |
| TCA | 0.9 | 0.9 | 2.8 | <.001 | 1.3 | 1.9 | 0.7 | |
| other antidepressant | 2.8 | 3.7 | 6.9 | | 2.0 | 4.5 | 9.4 | |
| Benzodiazepines % | 2.5 | 3.9 | 8.3 | <.001 | 2.1 | 3.8 | 11.6 | <.001 |
| *Sleep* | | | | | | | | |
| IRS[d] score (mean ±SD) | 6.4±4.6 | 7.8±4.7 | 9.6±5.1 | <.001 | 6.9±4.7 | 7.5±4.7 | 9.9±5.2 | <.001 |
| Insomnia % | 29.7 | 41.5 | 57.5 | <.001 | 33.6 | 38.8 | 61.0 | <.001 |
| Sleep duration (hours) (mean ±SD) | 7.2±1.0 | 7.2±1.1 | 7.0±1.3 | .002 | 7.2±1.1 | 7.2±1.1 | 7.0±1.3 | .13 |
| Sleep duration (in categories) % | | | | | | | | |
| short | 21.3 | 21.3 | 39.2 | | 22.8 | 27.7 | 36.7 | |
| normal | 77.2 | 72.2 | 56.7 | | 74.8 | 69.7 | 59.9 | <.001 |
| long | 1.6 | 3.0 | 4.2 | | 2.4 | 2.6 | 3.4 | |

[a] DEP= major depressive disorder or dysthymia

[b] AD= anxiety disorder

[c] IDS= Inventory of depressive symptoms

[d] IRS= Insomnia Rating Scale

p-values based on ANOVA and chi-square statistics

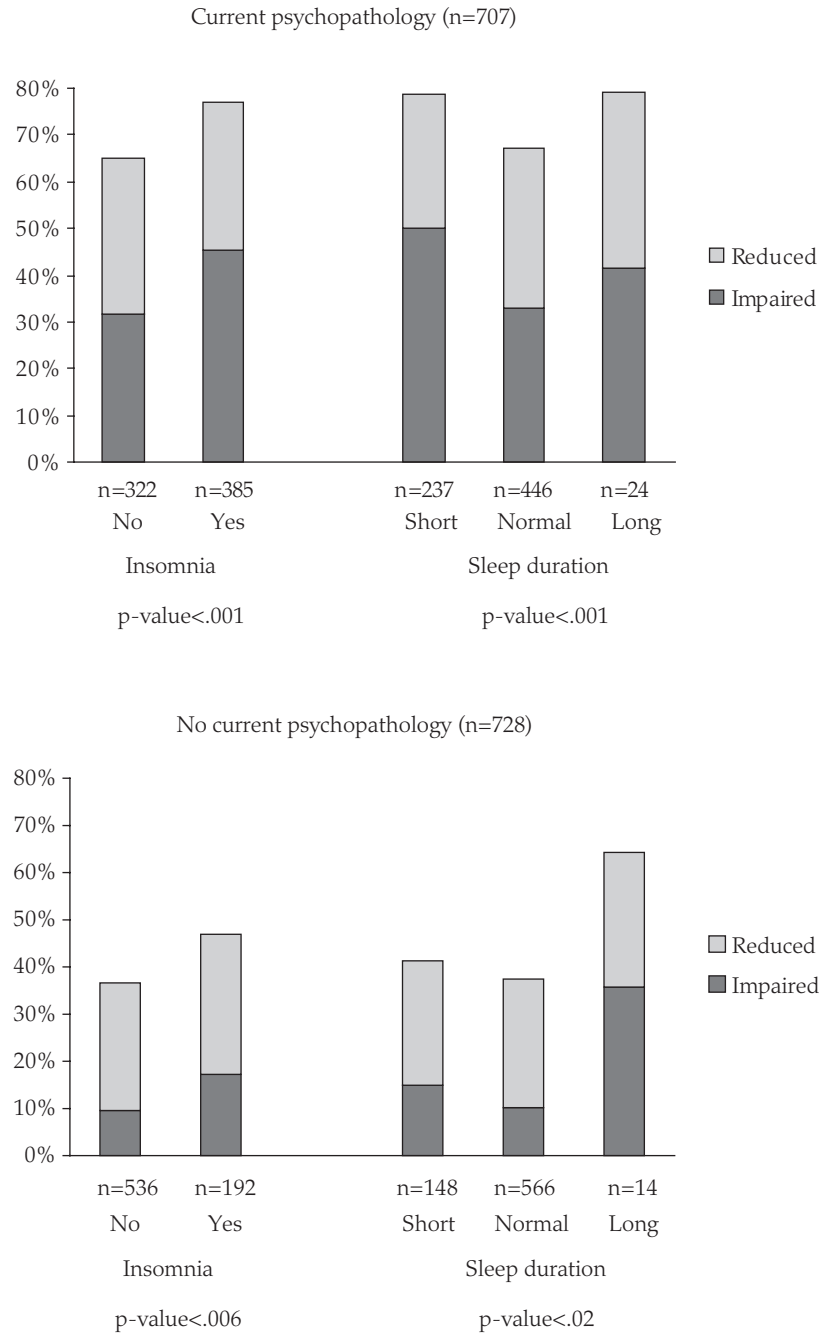
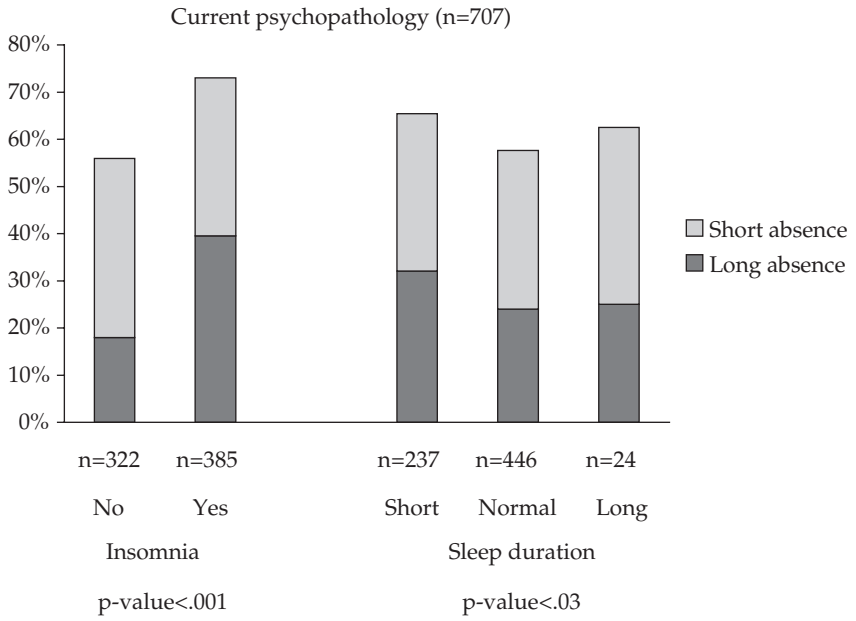



**Figure 1:** Prevalence rates of work performance, based on insomnia or sleep duration for subjects with psychopathology (upper graph) and without psychopathology (lower graph).



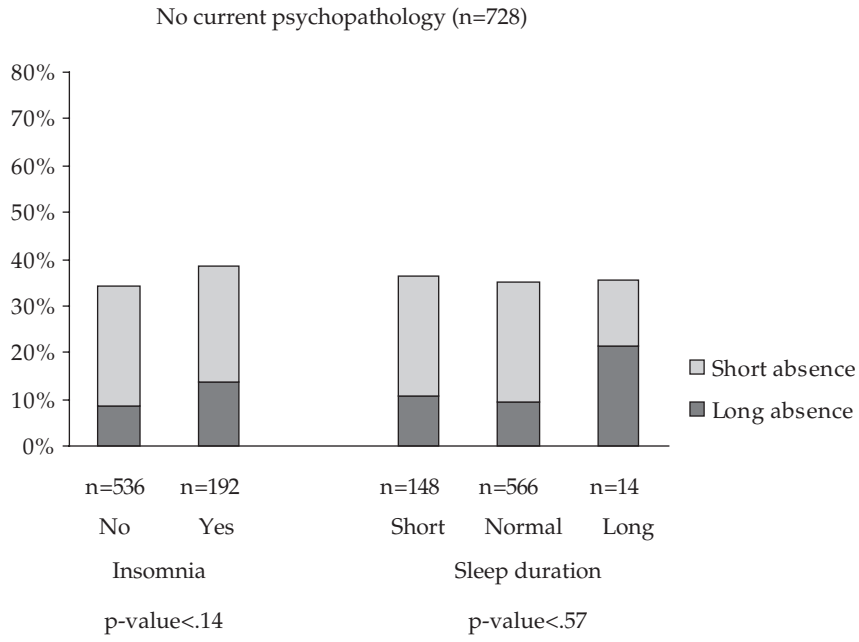




**Figure 2:** Prevalence rates of work absenteeism, based on insomnia or sleep duration for subjects with psychopathology (upper graph) and without psychopathology (lower graph).

*Work performance in subjects with psychopathology (Table 2)*

In subjects with current depressive and/ or anxiety disorders, the continuous IRS score (adjusted OR=1.08, 95% CI=1.04-1.12) as well as insomnia (IRS≥9; adjusted OR=2.20, 95%CI=1.50-3.22) were associated with impaired work performance. A longer sleep duration (in hours) was associated with a lower odds for impaired work performance (adjusted OR= 0.80, 95% CI=0.68-0.93). Also, short sleep duration (categorical) was associated with impaired work performance (OR=2.54, 95% CI=1.66-3.88) (model 1). After adding severity of depressive symptoms and use of psychotropics to the model (model 2), all found associations remained significant. Insomnia was also associated with reduced work performance (adjusted OR=1.56, 95% CI=1.05-2.31), but after adjustment for severity of symptoms and use of psychotropics, this association dropped to borderline significance. When adding insomnia and sleep duration (categories) simultaneously to our model (model 1), both short sleep duration and insomnia were significantly associated with impaired work performance (OR short sleep duration=1.98, 95%CI=1.25-3.15, OR insomnia=1.74, 95%CI=1.14-2.65, results not shown).

*Work performance in subjects without psychopathology (Table 2)*

For subjects without psychopathology, both the IRS-score and a long sleep duration were significantly associated with impaired performance in model 1 (OR IRS-score=1.08, 95%CI=1.01-1.14, OR long sleep duration=4.28, 95%CI=1.13-16.16). After adjustment for severity of depressive symptoms and use of psychotropics (model 2), the association for IRS-score was not present anymore, and the association for long sleep duration dropped to borderline significance (OR=3.67, 95%CI=0.85-15.79).

*Work absenteeism in subjects with psychopathology (Table 3)*

IRS-score (OR 1.10, 95%CI=1.05-1.14), insomnia (OR 2.48, 95%CI=1.67-3.69) and short sleep duration (as compared to normal sleep duration, OR 1.85, 95%CI=1.23-2.78) were associated with more long term work absenteeism (model 1, Table 3) in subjects with current depressive and/ or anxiety disorders. After adjustment for severity of depressive symptoms and use of psychotropics (model 2) associations remained. Longer sleep duration (in hours) was associated with a lower odds of long absenteeism (adjusted OR=0.83, 95%CI=0.71-0.97). Also, short sleep duration was associated with short absence (OR=1.48, 95%CI=1.00-2.21). When adding insomnia and sleep duration (categories) into one model (model 1), only the association with short sleep duration remained (OR=1.56, 95%CI=1.01-2.43, results not shown in table).

**Table 2:** Results of logistic regression analyses on the associations between sleep measures and work performance for subjects with (n=707) and without (n=728) current psychopathology

| **Current psychopathology** | | | | |
|---|---|---|---|---|
| | *Model 1[a] Reduced OR (95% CI)* | *Model 2[b] Reduced OR (95% CI)* | *Model 1[a] Impaired OR (95% CI)* | *Model 2[b] Impaired OR (95% CI)* |
| IRS score | 1.03 (0.99-1.07) | 1.03 (0.98-1.07) | 1.08 (1.04-1.12)* | 1.05 (1.00-1.09)* |
| Insomnia (IRS>9) | 1.56 (1.05-2.31)* | 1.47 (0.97-1.07) # | 2.20 (1.50-3.22)* | 1.63 (1.08-2.48)* |
| Sleep duration in hours | 0.90 (0.77-1.05) | 0.92 (0.78-1.08) | 0.80 (0.68-0.93)* | 0.80 (0.68-0.95)* |
| Sleep duration (categories) | | | | |
| *short ≤ 6 hours* | 1.53 (0.98-2.40) # | 1.43 (0.90-2.27) | 2.54 (1.66-3.88)* | 2.19 (1.39-3.45)* |
| *normal 7-9 hours* | Ref | Ref | Ref | Ref |
| *long ≥ 10 hours* | 1.93 (0.61-6.09) | 1.82 (0.56-5.91) | 2.26 (0.73-6.98) | 1.26 (0.38-4.19) |
| **No current psychopathology** | | | | |
| | *Model 1[a] Reduced OR (95% CI)* | *Model 2[b] Reduced OR (95% CI)* | *Model 1[a] Impaired OR (95% CI)* | *Model 2[a] Impaired OR (95% CI)* |
| IRS score | 1.08 (1.03-1.12)* | 1.03 (0.98-1.08) | 1.08 (1.01-1.14)* | 0.99 (0.93-1.06) |
| Insomnia (IRS>9) | 1.49 (1.00-2.21)* | 1.00 (0.65-1.54) | 1.67 (0.98-2.83) # | 0.89 (0.50-1.59) |
| Sleep duration in hours | 0.99 (0.83-1.18) | 1.06 (0.88-1.27) | 1.14 (0.90-1.45) | 1.26 (0.98-1.61) # |
| Sleep duration (categories) | | | | |
| *short ≤ 6 hours* | 1.18 (0.75-1.83) | 1.00 (0.63-1.58) | 1.20 (0.67-2.15) | 0.86 (0.46-1.62) |
| *normal 7-9 hours* | Ref | Ref | Ref | Ref |
| *long ≥ 10 hours* | 1.42 (0.37-5.55) | 1.34 (0.34-5.26) | 4.28 (1.13-16.16)* | 3.67 (0.85-15.79) # |

[a] adjusted for age, gender, education, chronic diseases, working hours per week

[b] adjusted for age, gender, education, chronic diseases, working hours per week, IDS, use of antidepressants and benzodiazepines

(use of psychotropic medication only included in analyses in persons with current psychopathology)

[#] p-value <.10

[*] p-value<.05

*Work absenteeism in subjects without psychopathology (Table 3)*

In contrast to findings of a negative association in persons with psychopathology, a longer sleep duration (in hours) was significantly associated with more long absenteeism (OR=1.37 95%CI=1.07-1.76) in persons without psychopathology (model 1). None of the other sleep variables were associated with work functioning in persons without psychopathology.

**Table 3:** Results of logistic regression analyses on the associations between sleep measures and work absenteeism for subjects with (n=707) and without (n=728) current psychopathology

| **Current psychopathology** | | | | |
|---|---|---|---|---|
| | *Model 1*[a] *Short* *OR (95% CI)* | *Model 2*[b] *Short* *OR (95% CI)* | *Model 1*[a] *Long* *OR (95% CI)* | *Model 2*[b] *Long* *OR (95% CI)* |
| IRS score | 1.00 (0.97-1.04) | 1.00 (0.96-1.03) | 1.10 (1.05-1.14)* | 1.03 (1.01-1.12)* |
| Insomnia (IRS>9) | 1.06 (0.74-1.52) | 0.98 (0.67-1.43) | 2.48 (1.67-3.69)* | 2.08 (1.36-3.18)* |
| Sleep duration in hours | 0.91 (0.79-1.06) | 0.92 (0.79-1.07) | 0.83 (0.71-0.97)* | 0.84 (0.71-0.99)* |
| Sleep duration (categories) | | | | |
| *short ≤ 6 hours* | 1.48 (1.00-2.21) # | 1.44 (0.95-2.17) # | 1.85 (1.23-2.78)* | 1.61 (1.04-2.49)* |
| *normal 7-9 hours* | Ref. | Ref | Ref | Ref |
| *long ≥ 10 hours* | 1.10 (0.42-2.89) | 1.06 (0.39-2.87) | 1.00 (0.34-2.92) | 0.75 (0.24-2.30) |
| **No current psychopathology** | | | | |
| | *Model 1*[a] *Short* *OR (95% CI)* | *Model 2*[b] *Short* *OR (95% CI)* | *Model 1*[a] *Long* *OR (95% CI)* | *Model 2*[b] *Long* *OR (95% CI)* |
| IRS score | 1.03 (0.98-1.07) | 0.99 (0.95-1.04) | 1.03 (0.97-1.09) | 0.98 (0.91-1.04) |
| Insomnia (IRS>9) | 1.15 (0.77-1.73) | 0.89 (0.588-1.37) | 1.41 (0.81-2.45) | 0.96 (0.53-1.72) |
| Sleep duration in hours | 0.99 (0.83-1.19) | 1.04 (0.86-1.24) | 1.32 (1.03-1.69)* | 1.37 (1.07-1.76)* |
| Sleep duration (categories) | | | | |
| *short ≤ 6 hours* | 1.24 (0.80-1.93) | 1.12 (0.71-1.75) | 1.02 (0.55-1.93) | 0.84 (0.46-1.60) |
| *normal 7-9 hours* | Ref | Ref | Ref | Ref |
| *long ≥ 10 hours* | 0.53 (0.11-2.54) | 0.49 (0.10-2.37) | 1.80 (0.45-7.25) | 1.44 (0.33-6.27) |

[a] adjusted for age, gender, education, chronic diseases, working hours per week

[b] adjusted for age, gender, education, chronic diseases, working hours per week, IDS, use of antidepressants and benzodiazepines

(last two variables only included in analyses in persons with current psychopathology due to low frequencies)

[#] p-value <.10

[*] p-value<.05

## Discussion

Our findings indicate that sleep disturbances are associated with work outcomes, especially in subjects with current psychopathology. Higher insomnia scores and shorter sleep duration are associated with reduced work performance and long absenteeism in depressed/anxious individuals. This is not influenced by severity of the disorder or use of psychotropic medication. For subjects without psychopathology, we found less consistent associations between sleep disturbances and work functioning. In these individuals, found associations between insomnia and impaired work performance disappeared after considering subthreshold depressive symptoms. However, we did find in both subjects with and without psychopathology that a longer sleep duration (in hours) was associated with long absenteeism, even after adjusting for depressive symptoms.

Our study suggests that it is important to consider sleep disturbances in working depressed/ anxious individuals, since it is associated with a greater risk of decreased work performance and absenteeism. An explanation for the fact that the association between sleep disturbances and work functioning almost exclusively occurred in subjects with psychopathology, may be that subjects with psychopathology call in sick earlier, because they find it harder to cope with their sleep disturbances. This might be a decreased (psychological) 'flexibility' due to their underlying depressive or anxiety disorder.

Also, it is possible that sleep in depressed/ anxious individuals is a different phenomenon, with for instance a larger role for ruminating/ worrying subjects with psychopathology (26), thus having a different effect on work functioning.

In subjects without psychopathology, present associations between sleep disturbances and work functioning disappeared after considering sub threshold depressive symptoms. Most studies do find associations between sleep disturbances and work functioning (27), but they have not always assessed psychopathology according to DSM-IV diagnoses (27). Possibly the associations between insomnia/ short sleep duration and work functioning in these studies were (partially) driven by subjects suffering from psychopathology, since psychopathology is tightly linked to sleep disturbances (28). However, after excluding subjects with depressive and anxiety disorders, an earlier large study on the association between insomnia and work functioning did find that insomnia was significantly associated with absenteeism and impaired work functioning (29). But since we used DSM-IV criteria in a structured clinical interview to exclude diagnoses, it is also possible that our sample of subjects without psychopathology consists of 'super-normal' subjects, which may account for differences between our study and the existing literature. It is also possible that the explanation for the fact that found associations

between sleep disturbances and work functioning disappear after considering sub threshold depressive symptoms, is statistical. Differences between odds ratios in the two presented models associating sleep disturbances with work functioning in individuals without current psychopathology are very small. Possibly this is a 'power-issue', and a larger sample of individuals would have resulted in statistical significant associations, also after adjustment for sub threshold depressive symptoms.

We also found an association between a longer sleep duration (in hours) and long absenteeism in subjects without psychopathology. In addition to potential effects of long sleep on absenteeism, it is also likely that a reversed causality is taking place with subjects with long absence being more used to sleeping longer because they are not interrupted by work schedules or alarm clocks anymore.

An important strength of the present study is that our sample consisted of a large sample of both persons with and without DSM-based depressive or anxiety disorders. Furthermore, two different indicators for sleep problems (insomnia and sleep duration) were assessed. There are also a few limitations to be mentioned. First, the reported data on sleep and work functioning are based on self-report only. We can not exclude the possibility that subjects with current psychopathology over- or underestimate their efficiency at work or sleeping quality/ duration. We have no objective data available from employers on for instance absenteeism. Second, we had no information available on specific somatic conditions which may disrupt sleep, such as restless legs syndrome or obstructive sleep apnea, and no information on conditions known to disrupt sleeping patterns, such as shift work (30). Third, the Insomnia Rating Scale has only been validated for women (23) and does not measure insomnia according to DSM-IV criteria. However, the Insomnia Rating Scale has been used in mixed samples before (31).

## Conclusions

Our study stresses the importance of addressing sleep disturbances in individuals suffering from a current depressive or anxiety disorder. Further research will have to determine if treating these symptoms with for example cognitive behavioral therapy (CBT) (32) will have a favorable influence on work performance and absenteeism.

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