A Comparison of Insomnia and Depression as Predictors of Disability Pension: The HUNT Study

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Study Objectives: Depression and insomnia are common and frequently comorbid. Unlike the priority now accorded to depression, insomnia is comparatively ignored as a reason for impaired occupational functioning. The objective of this study was to compare their relative impact upon medically certified disability pension award.

Design: Historical cohort study

Setting: Data from a population-based health survey in Nord-Trøndelag County in Norway (HUNT-2) was linked with a comprehensive national social security database.

Participants: Participants within working age (20-66 years of age) not claiming disability pension (N = 37,302).

Interventions: N/A

Measurements and Results: We compared complaints of insomnia and depression as predictors of disability pension award 18-48 months after a health survey. Insomnia complaints and depression each were similarly associated with disability pension award after adjustment for multiple health and sociodemographic factors, with similar odds ratios (1.66 [1.37-2.01] and 1.56 [1.24-1.96] respectively). Comorbidity did not contribute to disability beyond that expected from each condition. Taking the higher prevalence of insomnia complaints into account, insomnia complaints contributed as much or even more than depression to work-related disability.

Conclusions: Depression is regarded as a major contributor to work disability and is increasingly the primary diagnosis in disability pension award. Our results suggest that although rarely reported in official registries of disability pension causes, insomnia has an equally important and independent role, particularly among the younger group. This suggests that this potentially treatable factor has considerable economic impact and should receive more attention in clinical and public health management.

Keywords: Insomnia, depression, work disability

Citation: Overland S; Glozier N; Sivertsen B; Stewart R; Neckelmann D; Krokstad S; Mykletun A. A Comparison of Insomnia and Depression as Predictors of Disability Pension: The HUNT Study. *SLEEP* 2008;31(6):875-880.

DEPRESSION AND INSOMNIA ARE COMMON CONDITIONS WITH SIMILAR PREVALENCE RATES IN THE GENERAL POPULATION OF ABOUT 10%.[1,2] THEY frequently co-occur, but their individual influences on clinical trajectories and outcomes are uncertain.[3] Although independently recognized as nosologic entities, people experiencing both insomnia and depression are commonly given only one diagnosis; depression usually considered the primary cause. Sleep disturbances including insomnia are traditionally accepted as symptoms of depression, i.e., as "secondary."[4] However, recent evidence suggest that insomnia and depression may also be understood as co-occurring conditions.[5,6] It is estimated that 25% of insomnia is not caused by other medical problems.[7] Both insomnia and depression are associated with a range of negative outcomes, including worse quality of life[8] and increased medical morbidity.[9] Both are associated with impaired occupational functioning. Cost of illness studies have suggested that the economic burden of insomnia in the USA, ranges between US $92-107 billion,[10] while the decline in work performance alone during depressive episodes is estimated to cost US $44 billion per year.[11]

Across developed countries, between 1% and 5% of gross domestic product is spent on disability benefits.[12] In the United States, 10% of all social expenditure is on disability benefits (including veterans' and workers' compensation, employer disability payments, Social Security Disability Insurance, and Supplementary Security Income).[12] According to official statistics, about 1 in 3 benefit awards are for mental disorders,[12] commonly depression. However, these statistics are derived from physician diagnoses; factors such as patient preferences, stigma, and legislative practices may influence what diagnosis is recorded.[13] Thus, the statistics may not necessarily reflect the true underlying cause of disability, and in previous studies, we have suggested that the true effect of anxiety and depression is probably underestimated.[14] But while the role of depression is reflected in the statistics and targeted for public and occupational health interventions, insomnia is relatively ignored. We have previously also found that insomnia is an independent risk factor for occupational disability.[15] However, in allocating resources in a constrained policy environment, it is the comparative contributions of different con-

Disclosure Statement

This was not an industry supported study. Dr. Glozier has consulted for Servier. Dr. Neckelmann has participated in speaking engagements for Eli Lilly. Dr. Stewart has received research support from Pfizer/Eisai. The other authors have indicated no financial conflicts of interest.

Submitted for publication June, 2007
Accepted for publication March, 2008

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ditions that often are of interest, and we know very little about the relative importance of insomnia in the context of medically certified long-term work disability. We therefore aimed to directly compare the magnitude of the impact of this novel risk, insomnia complaints, to that of the well-established role of depression on this outcome in a large surveyed population in Norway. We have illustrated this statistically using odds ratios and also population attributable fractions, taking prevalences of insomnia and depression into account.

METHODS

Summary of Design

By linking exposure data from a large cross-sectional survey with outcome data from routine national statistics, a historical cohort study was constructed. The Health Study of Nord-Trøndelag County (HUNT-2) carried out in Norway between August 1995 and June 1997. Award of a disability pension 18 to 48 months after the survey was obtained from the Norwegian National Insurance Administration and linked using national identity numbers.

Participants and Procedures

All 92,100 inhabitants of Nord-Trøndelag County, Norway, aged 20 to 89 years, were invited to a clinical examination as part of a general health screening program: HUNT-2. Of these, 65,648 (71%) attended a physical examination, where they received a second set of questionnaires, which 52,814 (80%) completed. Participants reaching the retirement age of 67 years during the follow-up (n = 11,123) were excluded for this analysis, as were participants who were receiving a disability pension at baseline (n = 3,970), and those who were awarded a disability pension within 18 months of the baseline interview (n = 419). The analyzed sample comprised 37,302 people: 19,932 women and 17,370 men. In a follow-up study of randomly selected nonparticipants,[16] the most common reasons for not attending the health screening in the working age population were: (1) not finding the time or need for a health examination and (2) serious physical illness.

Insomnia Complaints

DSM-IV diagnostic criteria for insomnia comprise difficulty falling asleep, maintaining sleep, or experiencing nonrestorative sleep for a period no less than one month, resulting in impaired daytime functioning.[4] In this study, insomnia complaints was defined as an answer of "often" or "almost every night" to either of the questions: "Have you had problems in getting to sleep in the last month?" or "During the last month, have you ever woken too early and not been able to get back to sleep?"[15] It is important to state that no information was collected on middle-of-night awakenings and nonrestorative sleep.

Depression

The Hospital Anxiety and Depression scale (HADS) is a self-report questionnaire comprising 14 four-point Likert-scaled items, of which 7 measure depression (HADS-D). Originally intended for use in screening patients in a general hospital setting, no items on somatic complaints or sleeping difficulties are included. A cut-off score of 8 on the depression subscale defines caseness, with a sensitivity and specificity of about 0.80 according to DSM-III and IV and ICD-8 and 9,[17] and has been widely used in previous research.

Outcome: Disability Pension Award

The criterion for awarding disability pensions in Norway is an application stating cause-specific and lasting reduced functional ability due to an acknowledged medical condition. The medical condition is physician certified and further evaluated by specialists when appropriate. Adequate treatment and rehabilitation must have been attempted. In principle, any medical condition that causes >50% lasting reduction of work capability can warrant disability pension award. The Norwegian National Insurance Administration records information on all awards of disability pension. Correct registration is a prerequisite for transfers of payments and the records are thus highly accurate. Using national personal identification numbers, these data were linked to those from the HUNT-2 survey.[14,15] All participants had explicitly consented to such linkages being made. The process leading up to the award can precipitate depressive symptoms and sleep problems. We introduced an 18-month lag between symptom assessment and registration of outcome, in line with previous publications on this issue.[15]

Other Covariates

Selection of other covariates was carried out based on findings from other analyses using the same dataset.[14,15] Information on age and gender was gathered from the national population registry. Since benefits are principally awarded for health reasons, we adjusted for number of self-reported somatic disorders (asthma, angina pectoris, stroke, myocardial infarction, diabetes, goiter, hypo,- and hyperthyroidism, other diseases of the thyroid gland, fibromyalgia, osteoporosis, arthritis, rheumatism, ankylosing spondylitis, cancer, epilepsy, high blood pressure [being treated or monitored], and any other illness [one open item]).[14] Pain was measured by counting numbers of muscles and joints (neck, shoulders, elbow, wrist, chest, spine, lower back, hips, knees, ankles, or feet) where participants had experienced pain or stiffness continuously for 3 months during the last year. Socioeconomic status was identified through 2 variables: social status of current job according to the Erikson, Goldthorpe and Portocarero (EPG) scheme,[18] and education grouped by 3 levels from compulsory level (grade 9) and up. Finally, self-reported health-related behaviors (daily cigarette smoking [yes/no], "have you consumed too much alcohol during the last 14 days?" [yes/no] and physical activity for ≥1 hour the previous week [yes/no]) were included as candidate covariates.

Statistics

By combining the variables measuring depression and insomnia complaints, 4 mutually exclusive categories were defined

Table 1—Sample Characteristics and Outcome Frequency Across Insomnia, Depression and Comorbid Insomnia and Depression. Adults Aged 20-66 in the HUNT Study

	None N = 31 336	Insomnia only N = 2 999	Depression only N = 2 137	Both N = 800
Female gender (%)	16714 (53.3)	1763 (58.8)	1006 (47.1)	449 (56.1)
Age, mean (SD)	41.66 (12.23)	45.19 (12.58)	45.94 (11.24)	45.91 (11.44)
Education (%) Compulsory only[a]	7248 (23.1)	981 (32.7)	773 (36.2)	307 (38.4)
Secondary, non university	15800 (50.4)	1362 (45.4)	968 (45.3)	370 (46.3)
University level	8318 (25.5)	656 (21.9)	396 (18.5)	123 (15.4)
EPG social class (%)[b] I (highest)	2954 (9.4)	276 (9.2)	205 (9.6)	52 (6.5)
II	5551 (17.7)	473 (15.8)	278 (13.0)	102 (12.8)
III	6131 (19.5)	582 (19.4)	368 (17.2)	147 (18.4)
IV	4765 (15.2)	429 (14.3)	479 (22.4)	143 (17.9)
V + VI	3769 (12.0)	304 (10.1)	238 (11.1)	86 (10.8)
VII (lowest)	4911 (15.7)	552 (18.4)	361 (16.9)	154 (19.3)
Not working or not applicable	3285 (10.5)	383 (12.8)	208 (9.7)	116 (14.5)
Consumption of too much alcohol during the last 14 days (%)	3427 (10.9)	448 (14.9)	396 (18.5)	138 (17.3)
Daily cigarette smoking (%)	5739 (18.3)	664 (22.1)	555 (26.0)	213 (26.6)
Physically active ≥1 hour the last week (%)	24208 (77.2)	2225 (74.2)	1373 (64.2)	497 (62.1)
Mean (SD) number of somatic diagnoses	0.25 (0.54)	0.42 (0.71)	0.36 (0.65)	0.52 (0.77)
Numbers of pain areas (SD)	0.86 (1.52)	1.67 (2.09)	1.54 (2.01)	2.22 (2.37)
Disability pension award (%)	584 (1.9)	152 (5.1)	97 (4.5)	76 (9.5)
Years between health survey and disability pension award (SD)	2.66 (0.73)	2.59 (0.70)	2.45 (0.63)	2.67 (0.76)

[a]Compulsory school lasts until grade 9.
[b]Social class derived from current job according to the Erikson, Goldthorpe and Portocareros scheme (EGP).

for comparison: insomnia complaints alone; depression alone; comorbid insomnia complaints and depression; and a reference category of neither depression nor insomnia complaints. Logistic regression analyses were used to investigate the relative associations of depression and/or insomnia complaints and award of a disability pension. All reported confidence intervals are at the 95% level. Potential confounders were cumulatively added to the model in the order they are presented above, until the fully adjusted model where all confounders are adjusted for. Finally, using regression models for interactions,[19] we tested if the association with disability pension award with comorbid depression and insomnia is higher (or lower) than the sum of the associations with depression and insomnia separately: First, all confounding variables (age, gender, educational level, smoking, alcohol, physical activity, subjective symptoms, physical diagnoses, pain, and socioeconomic status) were included in the model along with depression and insomnia. In the second step, the product of insomnia and depression (both encoded 0 for no-case and 1 for case) was entered into the model. The applied test of significance was the increase in *F*-value in the regression model following addition of the interaction term to this model. Since disability pension award is associated with increased age and female gender, we also tested whether these factors modified main associations of interest (using interaction tests).

Population attributable fractions (PAF) generally refer to the proportion of disease risk in a population that can be attributed to the causal effect of a risk factor or set of factors.[20,21] In this context, we do not use them as an attempt of estimating etiologic fractions, but only as a means to compare the relative importance of depression and insomnia complaints taking prevalence into account. PAF was estimated using the formula: *pd((OR-1)/OR)*, where *pd* equals proportion of cases exposed.[21,22] Corresponding confidence intervals were estimated as described by Greenland.[23]

Results

Of the 37,302 participants, 2,999 (8.0%) were defined as having insomnia complaints alone; 2,137 (5.7%) had depression only; and 800 (2.1%) were defined as having comorbid insomnia complaints and depression (Table 1). Those with depression or insomnia complaints shared baseline associations with higher age, lower education, and lower socioeconomic status than the reference group. Adverse health behaviors (smoking, high alcohol consumption, and physical inactivity) were increased in groups with either insomnia complaints or depression compared to the reference group: more so for depression than insomnia complaints. In contrast, somatic diseases were more common in the group with insomnia complaints alone (of these, 31.4% reported having ≥1 of the included somatic diagnoses), than in those with depression alone.

In total, 909 (2.4%) of the participants were awarded disability pension during the follow-up period. Approximately 1 in 20 participants with either insomnia complaints (5.1%) or depression (4.5%) alone received a disability pension over the subsequent 4 years, excluding the 18 months immediately after the health survey. The presence of both conditions doubled this likelihood to 9.5%. Both conditions predicted disability pension award during the follow-up period, with unadjusted odds ratios of 2.81 (2.35-3.38) for insomnia complaints alone, 2.51 (2.01-3.12) for depres-

Table 2—Odd Ratios (95% CI) for Disability Pension During Follow Up in Logistic Regression Analysis with Cumulative Adjustments, and Population Attributable Fractions (PAF) for Crude and Fully Adjusted Estimates (95% CI)

	None	Insomnia only	Depression only	Both
Crude	Ref	2.81 (2.35-3.38)	2.51 (2.01-3.12)	5.53 (4.31-7.11)
+ Adj. Gender, age	Ref	2.23 (1.85-2.68)	2.05 (1.64-2.56)	4.52 (3.50-5.85)
+ Adj. Somatic disease	Ref	2.03 (1.68-2.45)	1.94 (1.55-2.43)	3.95 (3.04-5.12)
+ Adj. Pain	Ref	1.68 (1.38-2.03)	1.66 (1.32-2.08)	2.96 (2.27-3.86)
+ Adj. Education and SES	Ref	1.67 (1.38-2.02)	1.60 (1.28-2.01)	2.85 (2.18-3.72)
+ Adj. Health behavior	Ref	1.66 (1.37-2.01)	1.56 (1.24-1.96)	2.76 (2.11-3.61)
PAF, crude model		10.85 (8.18-13.44)	6.41 (4.27-8.51)	6.85 (5.00-8.67)
PAF, fully adjusted model		6.69 (3.80-9.50)	3.79 (1.51-6.01)	5.33 (3.41-7.21)

sion alone, and 5.53 (4.31-7.11) for both (Table 2). In the fully adjusted model, both insomnia complaints alone and depression alone predicted disability pension, while comorbidity again doubled this risk. There was no statistically significant interaction between insomnia complaints and depression in predicting disability pension award (step chi-square = 0.11, $df = 1$, P = 0.74). The associations were stronger for those under the age of 45 than over 45 in insomnia complaints (step chi-square = 23.13, $df = 1$, $P < 0.001$), depression (step chi-square = 19.67, $df = 1$, $P < 0.001$) and comorbid insomnia complaints and depression (step chi-square = 14.89, $df = 1$, $P < 0.001$). Gender did not modify the associations of interest (insomnia complaints: step chi-square = 0.21, $df = 1$, P = 0.64, depression: step chi-square = 0.00, $df = 1$, P = 0.99 and comorbid insomnia complaints and depression: step chi-square = 0.31, $df = 1$, P = 0.58).

In the fully adjusted model, the relative contribution from insomnia complaints alone towards disability pension (PAF 6.69% [3.80-9.50]) was larger than that from depression (PAF 3.79% [1.51-6.01]) and also that from comorbid insomnia complaints and depression (PAF 5.33% [3.41-7.21]), the latter not statistically significant as confidence intervals overlap the estimates[24] (Table 2).

Of those with only insomnia complaints that went on to award of disability pension, more than half (51.3% [43.4-59.3]) ultimately received a musculoskeletal diagnosis as the certified cause of disability. Only 15.8% (10.0% to 21.6%) of those with previous insomnia who were awarded a disability pension did so for a mental diagnosis, in contrast to 29.9% (20.6% to 39.0%) of those with depression (Table 3).

DISCUSSION

In a large well-characterized population, we investigated the comparative contribution of depression and insomnia complaints towards disability pension award 18-48 months later. These 2 conditions had a slightly lower prevalence to that found in other studies,[5-7] and co-occurrence was less common than that suggested.[6,7] We found that insomnia complaints was as strong a risk factor for disability pension award as depression, after full adjustment for a range of confounders. The two risk factors were effectively independent and additive. Using PAF as an estimate for the relative population impact, insomnia complaints account for more work-related disability than depression does, predominantly because of a greater prevalence. We were therefore able to advance our own prior research in this field which has examined the independent effects of anxiety and depression,[14] and of insomnia (adjusting for depressive symptoms)[15] upon disability pension award, but not the relative impact of insomnia and depression with respect to this outcome.

Strengths and Limitations

The main strength of the study is the historical cohort design, conducted on a large sample representative of the working age population, with a reasonable participation rate for a study of this kind. Our measures of disability pension stem from routinely collected official registries, whose accuracy is high (even following participants who migrate) and unlikely to be influenced by being exposed to insomnia complaints, depression or both. At baseline, neither participants nor administrators were aware of the hypothesis tested here, reducing the possibility of influencing subsequent behavior through participation.

The overall response rate in the study was 57% and the most important limitation of the study concerns our lack of data on the non-attendees. Higher rates of disability pension award and serious illness among non-attendees than participants has been reported for this population.[24,25] Health selection might lead to an underestimation of the prevalences and the associations of interest, and of confounding by health status. Many of the measures in this survey relied on self-reported information. The HADS was developed for use in general hospital settings and biological symptoms are excluded to avoid identification of false positive cases. Since many other depression inventories include sleep items, the HADS was particularly suitable for this analysis. The case finding properties of the HADS have been found to be comparable to, or even outperforming, general practitioners in primary care settings.[25] Our measure of insomnia complaints has been employed in previous relevant publications.[15] Although our measure enquired about problems over the last month, we did not have a specific item on duration, middle-of-night awakenings or nonrestorative sleep.[26] Inclusion of such items would likely result in a more accurate measure, and increase the strength of the associations. There was also no question on functional limitation relating to insomnia. However, inclusion of items on daytime impairment from poor sleep would introduce circularity to the association of interest, and bias the comparison with our depression measure. Including those in the "comorbid" group, who by definition also have insomnia complaints, the overall prevalence (10.2%) is in the lower end of previously prevalence estimates of insomnia symptoms.[27] Considering the curvilinear age-insomnia association, this could reflect the restricted age span

Table 3—The Official Diagnoses Stated as the Reason for Disability Pension Award During Follow Up for Those with Underlying Insomnia, Depression and Both. Percents (95% Confidence Intervals)

	Mental[a]	Musculoskeletal[b]	Other Diagnosis[c]
Insomnia only	15.8	51.3	32.9
	(10.0-21.6)	(43.4-59.3)	(25.4-40.4)
Depression only	29.9	36.1	34.0
	(20.6-39.0)	(26.5-45.6)	(24.6-43.4)
Both	25.0	42.1	32.9
	(15.3-34.7)	(31.0-53.2)	(22.3-43.5)

[a]Broad ICD diagnosis category; mostly nonpsychotic
[b]Broad ICD diagnosis category; majority is nonspecific musculoskeletal disorders
[c]All other ICD diagnoses causing work disability; highest incidence here from cancer, disorders of the nervous system, and circulatory organs.

in the present study. Also, our exclusion of nearly 4,000 with previous disability pension award, known to have higher psychiatric morbidity and insomnia symptoms, is likely to have contributed to the lower prevalence.[28] Prevalence rates are part of the PAF function [*pd((OR-1)/OR)*] and a low prevalence rate for insomnia, whatever the reason, will consequently make the PAF estimate for insomnia complaints (and comorbid insomnia complaints and depression) smaller. Finally, despite controlling for a number of somatic disorders and symptoms, we cannot adjust for their severity, and we did not have information on use of hypnotics or antidepressants or presence of other treatment modalities used between exposure and outcome.

As with any single observational study, a causal relationship cannot be inferred between exposure and outcome. An eighteen month interval was imposed between exposure and outcome ascertainment to reduce the likelihood of impending retirement having an influence on reported mental state. However cognitive changes, financial insecurity, loss of role functioning and social integration associated with temporary sickness absence at the time of the survey cannot be absolutely ruled out as underlying factors.

Interpretation

After taking these limitations into account, the results of this study indicate that insomnia is an as important prequel to work-related disability as depression. In public policy, insomnia is rarely, if ever, identified as a factor in occupational disability. Depression is frequently so, and this is often used to argue for major health initiatives to tackle this.[29] There are several possible explanations for the underestimation and under-reporting of insomnia in official statistics.

Insomnia is usually considered as secondary to other conditions.[3] In this population based sample 25% of those with insomnia reported no other health condition (depression or any somatic disorder) at baseline in line with previous reports.[30] According to a National Institutes of Health consensus paper, the most common comorbidities with insomnia are psychiatric disorders (particularly depression), cardiopulmonary disorders, and conditions associated with pain (e.g., musculoskeletal syndromes).[3] Previous investigations of the public health impact of insomnia have been criticized for not addressing this comorbidity.[31] Comorbidity with health conditions was adjusted for in the analyses, and did indeed reduce the estimates for insomnia, but still left a doubled risk of disability pension award. As many more of the pensions (50%) awarded to those with insomnia complaints were for musculoskeletal disorders than among those with depression (35%), it is surprising that adjustment for pain had a very similar impact on the odds ratios in the 2 groups. Further attenuation following adjustment for health behaviors and demographic factors was trivial for insomnia and limited for depression, indicating that reported health conditions and pain are the most important confounding factors. Pain could however in some cases be a mediator, suggesting possible overadjustment. In our study, we cannot rule out that insomnia is a symptom of unreported disease in remission or at prodromal stages at baseline, but do not believe that this is likely to completely account for the findings.

Another possible explanation is the uncertain extent to which depression and insomnia can be considered as separable conditions.[5] Some authors have suggested that the concept of secondary insomnia has been exaggerated beyond empirical support and that insomnia should rather be understood as a separate comorbid condition.[6] We, too, believe it is unlikely that insomnia is simply acting as a marker of depression severity, since 3,000 people with insomnia complaints did not meet case levels, set at a relatively low threshold, across a range of other depressive symptoms. The stronger impact of comorbid insomnia complaints and depression compared to either condition alone might however reflect underlying severity. The lack of a statistical interaction between insomnia complaints and depression indicate that the combination of the individual associations from these variables is no greater than expected from their individual contributions. Still, as the combined presence of the 2 factors does increase the odds of disability pension, successful treatment of either in comorbid cases should reduce the risk of disability. Treatment of either condition may even reduce disability related to both.[32,33]

Insomnia complaints, depression and comorbidity between them were relatively stronger predictors of disability pension awards in those younger than 45 years. Compared to many other illnesses, age of onset is lower in most mental illness. This is also reflected in the official statistics for disability pensions; mental illness is by far the most common cause for disability pensions in younger people. This means that for those under 45 years of age, insomnia complaints and depression are more likely to be (part of) the health problem leading to work disability, whereas among those over 45, more people leave the work force because of medical problems not necessarily accompanied by insomnia and depression, reducing the relative importance of these factors in this age group.

Finally, when taking prevalence into account as indicated by the population attributable fractions, insomnia complaints appear to have a greater contribution to pension awards than depression. This comparison further underlines the possible importance of insomnia in the context of work-related disability. Successful screening and treatment of insomnia might theoretically achieve more in terms of reducing disability pension

awards than the equivalent programs for depression. To achieve this, a first step could be to improve recognition of insomnia and improve access to effective interventions. There are several studies pointing to a potential improvement in how insomnia generally is treated,[34] and improved use of better treatment modalities may thus represent a potential means for preventing or reducing work-related disability. The significantly greater risk of disability pension for both insomnia and depression among those younger than age 45 suggests these factors are even more important if receiving adequate and effective treatment could increase the likelihood of continuing wage earning capacity.

ACKNOWLEDGMENTS

The data for the present study was obtained from the National Office for Social Insurance and The Nord-Trøndelag Health Study (The HUNT Study). The HUNT Study is a collaboration between HUNT Research Centre, Faculty of Medicine, Norwegian University of Science and Technology (NTNU, Verdal), Norwegian Institute of Public Health, and Nord-Trøndelag County Council. We acknowledge Michael Dewey, Stein Atle Lie, and the anonymous reviewers for valuable advice in the revision of this manuscript. The first author had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

The work was performed at the University of Bergen and at Institute of Psychiatry, Kings College London

Ethical approval

HUNT-2 was approved by the National Data Inspectorate and the Board of Research Ethics in Health Region IV of Norway. Written informed consent was obtained from all subjects included in this study.

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