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Relationship of anxiety disorders, sleep quality, and functional impairment in a community sample

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ABSTRACT

Background: Anxiety disorders and insomnia are each prevalent, impairing, and highly comorbid. However, little is known about whether specific types of sleep complaints are associated with specific anxiety disorders, and whether poor sleep has an additive effect on functional impairment in anxiety disorders.
Method: Data from the German Health Survey (GHS; $N = 4181$; ages 18–65) were utilized to examine relationships among anxiety disorders, sleep quality (assessed by the Pittsburgh Sleep Quality Inventory; PSQI), and functional impairment (assessed by the Medical Outcomes Scale Short Form; SF-36; and past-month disability days due to physical and emotional problems, respectively).
Results: Most anxiety disorders were significantly associated with global PSQI scores. Social phobia (AOR 3.95, 95% CI 1.73–9.04) and GAD (AOR 3.94, 95% CI 1.66–9.34) had the strongest relationships with global PSQI scores. Daytime dysfunction was the PSQI subscale most strongly associated with anxiety disorders, particularly GAD. Having a comorbid anxiety disorder and poor sleep was associated with significantly lower Mental Component Scores on the SF-36 than having an anxiety disorder alone (40.87 versus 43.87, $p = .011$) and with increased odds of one or more disability days due to emotional problems (AOR 2.72, 95% CI 1.35–5.48), even after controlling for sociodemographic factors and past-month mood and substance use disorders.
Conclusions: Most anxiety disorders are moderately associated with reduced sleep quality. Individuals with anxiety disorders and poor sleep experience significantly worse mental health-related quality of life and increased disability relative to those with anxiety disorders alone.

1. Introduction

Anxiety disorders are the most common class of psychiatric disorders in the United States, affecting as many as 28.8% of Americans over the lifetime (Kessler et al., 2005). They are also costly (Rice and Miller, 1998; Smit et al., 2006), with associated medical expenditures, lost productivity, and functional impairment estimated at $42.3–$46.6 billion annually (Dupont et al., 1996; Stein et al., 2005; Greenberg et al., 1999; Rice and Miller, 1998).

Insomnia is also a widespread problem, reported by up to one-third of the population (Ancoli-Israel and Roth, 1999). It is often comorbid with medical and psychiatric conditions (Ohayon et al., 1998; Katz and McHorney, 1998; Ohayon, 2008; Martikainen et al., 2003; Taylor et al., 2007), and has been linked to increased disability and use of health services in individuals with these conditions (Ozminkowski et al., 2007; Novak et al., 2004; Stein et al., 2008; Roth et al., 2006). Insomnia is frequently associated with anxiety disorders, and may precede, co-occur with, or follow the onset of a comorbid anxiety disorder (Jansson-Frojmark and Lindblom, 2008; Johnson et al., 2006; Ohayon and Roth, 2003).

In recent years, increased attention has been given to specific types of sleep complaints and their correlates, versus more general complaints of poor sleep (Ohayon, 2008; Roth et al., 2006). Some sleep problems have been found to be associated with certain demographic characteristics; for example, difficulty maintaining sleep (i.e., middle insomnia) and early morning awakenings (late insomnia) each appear to be more common in older age groups (Newman et al., 1997; Schubert et al., 2002; Quan et al., 2005). However, there is a paucity of information regarding whether certain types of sleep complaints are associated with specific psychiatric conditions, including anxiety disorders. In addition, few studies of this nature have taken comorbid depression or substance disorders into account when investigating the anxiety–insomnia relationship. Both mood disorders and substance use-related disorders have consistently been linked with sleep complaints and disruption (Ford and Kamerow, 1989; Chang et al., 1997; Brower et al., 2001; Wetter and Young, 1994). This allows for the possibility that

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some or all of the sleep–anxiety relationship may be partially or completely explained by these factors. Accordingly, one aim of the current study is to examine the relationship between anxiety disorders and specific types of sleep complaints, while adjusting for these factors.

Another aim of the current study is to examine the relationship between sleep quality and functional impairment in anxiety disorders. To date, few studies have examined this association (Mohr et al., 2003; Alfano et al., 2007). The question of whether poor sleep has any unique impact on quality of life, over and beyond the effects of anxiety disorders, has been addressed in only one study we could find in the extant literature. In this study, Mohr and colleagues found that the association between posttraumatic stress disorder (PTSD) and health-related quality of life was fully explained (mediated) by self-reported sleep disturbance (Mohr et al., 2003). However, to our knowledge, the relationship between sleep quality and functioning has not been investigated in anxiety disorders other than PTSD. Given the frequent comorbidity of anxiety disorders and sleep problems, and the well-documented deleterious effects of each problem on functioning, determining the joint effects of anxiety disorders and poor sleep on functional impairment would clarify the public health significance of this problem.

Using well-validated measures of sleep quality and functioning, and while adjusting for the presence of comorbid depression and substance disorders, the current study seeks to address the following questions:

(1) What is the relationship between anxiety disorders and specific types of sleep quality complaints in a large epidemiological sample?
(2) Is poor sleep associated with increased functional impairment beyond that explained by anxiety disorders?

2. Materials and methods

2.1. Participants

The current investigation utilized data from the German Health Survey (GHS), a stratified, cross-sectional, multistage nationally representative sample of individuals aged 18–79 from the non-institutionalized population of Germany. A full description of the study's methodology is provided elsewhere (Jacobi et al., 2002, 2004). Data for the core survey were collected between 1997 and 1999. In a second stage of data collection, the GHS Mental Health Supplement (MHS) was conducted with a subgroup of GHS participants between the ages of 18 and 65 ($N = 4181$; 87.6% response rate). Because the MHS included oversampling of participants who screened positive for a mental disorder in the core survey, data are weighted in all current analyses. In addition, data were weighted for age, sex, and region, such that it is representative of the German population (Stolzenberg, 2000). The GHS MHS is novel in its use of the highly reliable DSM-IV-based Composite International Diagnostic Interview (WHO, 1997), and trained psychologist and physician clinical interviewers to assign clinical diagnoses.

2.2. Measures

2.2.1. Sleep quality

A validated German version of the *Pittsburgh Sleep Quality Index* (PSQI) (Buysse et al., 1989; Backhaus et al., 2002) was used to assess sleep quality. The PSQI is a well-validated, widely used 19-item self-report measure of sleep quality. It contains seven subscales measuring domains such as subjective sleep quality, sleep latency, sleep duration, and sleep disturbance, which combine to yield a global composite score of sleep quality and quantity over the past month. Global sleep quality scores are continuous (range 0-21) with high scores reflecting poorer sleep quality, and scores less than 6 indicating good sleep, per recommendations by the scale developers (Buysse et al., 1989). For some analyses, individuals were categorized as "good sleepers" or "poor sleepers" using these guidelines. The PSQI has been demonstrated to have high internal consistency (Cronbach's alpha = 0.83), test–retest reliability (0.85–0.87) and convergent validity (Backhaus et al., 2002; Buysse et al., 1989).

2.2.2. Mental disorders

The computerized Munich Composite International Diagnostic Interview (DIA-X/M-CIDI) (Wittchen and Pfister, 1997)—a modified version of the CIDI—was used by clinicians to assess lifetime, past-year, and past-month DSM-IV diagnoses. Since the PSQI assesses past-month sleep problems, for consistency we examined only past-month mental disorder diagnoses for the current analysis. The following anxiety disorders were assessed: panic disorder (PD), agoraphobia (AG), social phobia (SP), generalized anxiety disorder (GAD), obsessive compulsive disorder (OCD), and specific phobia (posttraumatic stress disorder was not examined). With regard to mood disorders, major depressive disorder, dysthymia, and bipolar disorders were included in an aggregate mood disorder variable (i.e., any past-month mood disorder). An aggregate variable for any past-month substance use disorder (dependence or abuse of alcohol, nicotine, or illicit substances) was also included.

2.2.3. Functional impairment

A validated German version of the Short Form 36 (SF-36) was utilized to measure health-related quality of life (McHorney et al., 1993; Bullinger, 1995). Eight subscales—physical functioning, role limitations due to physical problems, social functioning, bodily pain, mental health, role limitations due to emotional problems, general health, and vitality—were assessed within the past month. The reliability of the SF-36 is high with alpha coefficients ranging from 0.68 to 0.96. In the current study, we also utilized the principal summary dimensions of the SF-36: the Physical Component Score (PCS) and the Mental Component Score (MCS) (Ware et al., 1998, 1994). Lower scores indicated worse functioning.

Disability was assessed by asking respondents to indicate the number of days in the past month that they were completely unable to do the things they normally did. Questions were asked separately for number of days of disability due to physical problems, and disability days due to emotional problems or use of alcohol or drugs. Responses ranged from 0 to 30 days. Due to the skewed nature of the responses, with most people in the community reporting zero days of disability in both domains, dichotomous variables were created: zero days versus one or more days of disability.

2.3. Statistical analysis

All statistical analyses were weighted as appropriate to ensure that the data were representative of the German population. The Taylor Series Linearization method in the SUDAAN program (Shah et al., 1992) (Research Triangle Park, NC) was used to calculate standard errors based on stratification information provided specifically for calculating design-based standard errors. Age, gender, marital status, and education were entered as covariates in all analyses to adjust for different base distributions of prevalence and comorbidity within the sample.

Multiple logistic regression was used to determine associations between anxiety disorders and sleep quality. In addition to sociodemographic factors, any past-month mood disorder and any past-month substance disorder were also entered as covariates.

Separate regressions were conducted for PSQI global score and subscales.

To assess relationships with functional impairment, multiple linear and logistic regression analyses were conducted. Multiple linear regression was used to determine whether comorbidity of poor sleep and anxiety disorder was associated with greater impairment than anxiety disorder alone, with separate analyses run for PCS and MCS, respectively. Multiple logistic regression was utilized to examine the impact of comorbid poor sleep and anxiety disorder on disability days due to physical problems and disability days related to emotional problems, respectively.

3. Results

Demographic and clinical characteristics for the entire sample are provided in Table 1. Overall, 35% of the total sample were poor sleepers as indicated by a PSQI global score >5. More women were classified as poor sleepers (40%) than men (30%). Almost two-thirds (64%) of individuals with anxiety disorders were classified as poor sleepers.

PSQI global and subscale scores are displayed in Table 2. The mean (adjusted) global score in the total sample was 5.01 (SD = 3.04). In females, the mean global score was higher at 5.41 (SD = 3.78), while males had a mean score of 4.60 (SD = 3.02). Individuals with anxiety disorders had a mean global score of 7.57 (SD = 4.03).

The association between PSQI global and subscale scores and anxiety disorders is shown in Table 3. In models adjusting for age, sex, marital status, and education, most anxiety disorders had a moderately strong association with global PSQI; no anxiety disorders were associated with a significantly *reduced* likelihood of being a poor sleeper. The presence of GAD or SP in particular were each associated with 7–8 times the likelihood of being a poor sleeper, which was greater than the odds of poor sleep associated with the presence of any past-month mood disorder (OR = 5.87; 95% CI = 4.38–7.87). Several PSQI subscales were significantly associated with anxiety disorders. The daytime dysfunction and sleep disturbances subscales were each significantly associated with all of the anxiety disorders assessed, and the sleep latency subscale was significantly related to most anxiety disorders (with the exception of OCD). For GAD, the odds of having daytime dysfunction were particularly high, relative to the other disorders assessed.

Table 4 shows the relationship between anxiety disorders and sleep quality adjusting for the presence of a past-month mood or substance use disorder. Excluding OCD, all anxiety disorders significantly associated with global PSQI in the previous model remained so in this model. The relationships between anxiety disorders and the various PSQI subscales were significantly attenuated in most cases, although daytime dysfunction remained significant for all anxiety disorders except agoraphobia. Having *any* anxiety disorder was significantly related to all sleep indices except use of sleeping medications.

Tables 5a and 5b show the unique and joint effects of sleep disturbance and anxiety disorders on health-related quality of life (PCS and MCS scores, respectively). In comparison to anxiety disorders alone, the combination of anxiety disorders and sleep disturbance was not significantly associated with lower PCS scores (Table 5a). However, the combination of *any* anxiety disorder and poor sleep was associated with lower MCS scores (Table 5b). In addition, poor sleep had an additive effect on MCS in individuals with OCD and specific phobia before adjustments, and in OCD and social phobia after past-month mood or substance use disorders were added to the model as covariates.

Tables 6a and 6b provide the proportion of respondents who indicated one or more days of disability in the past month due to physical and emotional problems, respectively. Similarly, respondents with an anxiety disorder and poor sleep did not report more disability days due to physical problems (Table 6a). However, 24.5% of those with an anxiety disorder alone reported one or more disability days due to emotional or substance problems, versus 33% of participants with comorbid anxiety disorder and poor sleep (6b). Overall, having poor sleep in addition to an anxiety disorder was associated with a significantly increased likelihood (172–189%) of having one or more disability days due to emotional or substance problems in the past month.

Table 1
Past-month demographic and clinical characteristics of the sample.

	Total no. of participants (%) (N = 4181)
Age (mean)	41.70
Gender	
Female (%)	2268 (49.72)
Educational level (%)	
Grade 10 (high school equivalent)	2314 (61.03)
More than high school	1790 (38.97)
Marital status (%)	
Married	2617 (64.06)
Single (never married)	493 (11.04)
Separated/divorced/widowed	991 (24.90)
Panic disorder (%)	60 (1.12)
Agoraphobia (%)	68 (1.32)
Social phobia (%)	58 (1.24)
Generalized anxiety disorder (%)	56 (1.19)
Obsessive compulsive disorder (%)	26 (0.44)
Specific phobia (%)	249 (4.75)
Any anxiety disorder (%)	429 (8.44)
% Poor sleepers (PSQI > 5)	35.17
% Females who are poor sleepers	40.09
% Males who are poor sleepers	30.32
% with anxiety disorders who are poor sleepers	64.14
SF-36 Physical Component Score (mean)	49.19
SF-36 Mental Component Score (mean)	50.50

Note. Mean scores and percentages are weighted. *Ns* are unweighted values.

4. Discussion

The current study sought to (1) determine the relationship between anxiety disorders and specific types of sleep quality complaints in a large epidemiological sample and (2) determine whether the joint effects of anxiety disorder and poor sleep have a greater impact on functional impairment than anxiety disorders alone. Advantages of the current design include assessment of DSM-IV diagnoses by trained clinicians instead of self-report as in most previous studies, inclusion of a well-validated sleep quality measure, and an examination of the unique contribution of poor sleep to functional impairment in individuals with anxiety disorders.

Among the various anxiety disorders assessed in the current study, most had a moderately strong relationship with sleep problems, with the exception of OCD. Although these relationships were attenuated after adjustments for the presence of any past-month mood or substance use disorder, several remained significant. GAD and SP had the strongest relationships with global sleep quality. Sleep difficulties are included in the diagnostic criteria for GAD (although not requisite for diagnosis), and several reports in the literature show increased subjective and objective sleep complaints among individuals with GAD (Roth et al., 2006; Ohayon, 1997; Fuller et al., 1997). Thus, the overlap between GAD diagnostic criteria and the PSQI with regard to sleep problems may explain

Table 2
PSQI global and subscale scores. Mean scores for the entire sample ($N = 4173$) and participants with anxiety disorders ($n = 429$) on PSQI subscales and global score.

	Overall mean (SD)	Female	Male	Anxiety disorders
Global PSQI score	5.01 (3.44)	5.41 (3.78)	4.60 (3.02)	7.57 (4.03)
Subjective sleep quality	0.89 (0.70)	0.96 (0.75)	0.83 (0.64)	1.28 (0.83)
Sleep latency	0.75 (0.89)	0.84 (0.96)	0.66 (0.81)	1.21 (1.06)
Sleep duration	1.01 (0.96)	0.95 (0.97)	1.06 (0.95)	1.23 (1.07)
Habitual sleep efficiency	0.66 (0.94)	0.73 (0.98)	0.58 (0.88)	0.94 (1.07)
Sleep disturbance	0.96 (0.92)	1.11 (0.97)	0.82 (0.84)	1.55 (1.03)
Use of sleeping medications	0.07 (0.42)	0.11 (0.51)	0.04 (0.31)	0.17 (0.67)
Daytime dysfunction	0.80 (0.73)	0.84 (0.73)	0.76 (0.72)	1.29 (0.78)

Note. Mean scores are weighted.

Table 3
Multiple logistic regression estimating the association between anxiety disorders and PSQI subscale scores.

	Global PSQI	Sleep quality	Sleep latency	Sleep duration	Sleep efficiency	Sleep disturbances	Use of medications	Daytime dysfunction
Panic disorder	3.79** (2.10–6.83)	3.92** (1.50–10.28)	4.00** (1.98–8.10)	1.18 (0.63–2.19)	1.61 (0.85–3.02)	4.77** (1.80–12.61)	3.24* (1.03–10.17)	5.64** (2.45–13.02)
Obsessive compulsive disorder	2.67* (1.05–6.78)	1.60 (0.52–4.88)	2.15 (0.83–5.54)	1.43 (0.59–3.44)	1.51 (0.52–4.41)	5.62* (1.26–25.00)	2.00 (0.24–16.47)	16.21** (2.18–120.72)
Social phobia	7.05** (3.49–14.25)	4.42** (1.53–12.81)	3.48** (1.77–6.86)	2.49** (1.25–4.93)	2.44** (1.26–4.73)	3.76** (1.59–8.89)	3.11* (1.22–7.90)	9.41** (2.84–31.15)
Generalized anxiety disorder	8.28** (3.78–18.13)	3.53* (1.17–10.66)	2.46* (1.19–5.09)	1.89 (0.94–3.80)	1.50 (0.80–2.80)	3.92** (1.54–9.99)	1.34 (0.41–4.41)	35.33** (8.45–147.73)
Agoraphobia	4.51** (2.49–8.18)	1.37 (0.71–2.64)	2.08** (1.19–3.64)	1.58 (0.90–2.77)	2.51** (1.39–4.52)	4.50** (1.76–11.51)	2.43* (1.01–5.81)	2.01* (1.06–3.81)
Specific phobia	2.53** (1.87–3.43)	1.69** (1.16–2.48)	1.60** (1.18–2.17)	1.39* (1.01–1.93)	1.51* (1.08–2.12)	2.32** (1.58–3.42)	1.31 (0.64–2.68)	2.85** (1.91–4.24)
Any anxiety disorder	3.47** (2.74–4.39)	2.12** (1.56–2.88)	2.11** (1.66–2.70)	1.49** (1.16–1.92)	1.65** (1.27–2.14)	2.88** (2.12–3.90)	2.58** (1.57–4.24)	3.90** (2.82–5.39)
Any mood disorder	5.80** (4.18–8.04)	3.83** (2.37–6.19)	3.22** (2.35–4.40)	1.59** (1.16–2.18)	1.99** (1.46–2.72)	5.02** (3.18–7.94)	3.30** (2.00–5.43)	4.59** (2.83–7.43)
Any substance use disorder	1.87** (1.25–2.79)	1.40 (0.84–2.35)	1.41 (0.93–2.15)	1.37 (0.89–2.11)	1.47 (0.92–2.34)	1.28 (0.81–2.01)	0.61 (0.08–4.69)	2.38** (1.44–3.92)

Note. Odds ratios (95% confidence interval) adjusted for sex, age, marital status, and education. All disorders are past-month.
* $p < .05$.
** $p < .01$.

Table 4
Multiple logistic regression estimating the association between anxiety disorders and PSQI subscale scores adjusting for mood and substance use disorder comorbidity.

	Global PSQI	Sleep quality	Sleep latency	Sleep duration	Sleep efficiency	Sleep disturbances	Use of medications	Daytime dysfunction
Panic disorder	2.22* (1.10–4.47)	2.71* (1.04–7.09)	2.88** (1.40–5.90)	0.97 (0.52–1.81)	1.21 (0.61–2.36)	3.14* (1.19–8.29)	2.17 (0.66–7.16)	3.74** (1.60–8.77)
Obsessive compulsive disorder	1.21 (0.44–3.36)	0.92 (0.29–2.93)	1.28 (0.44–3.70)	1.15 (0.45–2.89)	1.13 (0.39–3.27)	3.13 (0.59–16.49)	0.92 (0.08–10.57)	9.02* (1.11–73.44)
Social phobia	3.95** (1.73–9.04)	2.82 (0.93–8.58)	2.24* (1.07–4.67)	2.08* (1.03–4.21)	1.78 (0.87–3.63)	2.17 (0.87–5.39)	1.81 (0.59–5.52)	5.83** (1.75–19.46)
Generalized anxiety disorder	3.94** (1.66–9.34)	1.95 (0.63–6.03)	1.35 (0.63–2.88)	1.49 (0.72–3.08)	0.97 (0.48–1.94)	1.95 (0.75–5.04)	0.61 (0.18–2.09)	19.00** (4.43–81.41)
Agoraphobia	3.37** (1.81–6.27)	1.06 (0.54–2.09)	1.63 (0.90–2.95)	1.40 (0.80–2.45)	2.07* (1.13–3.78)	3.51** (1.33–9.22)	1.52 (0.58–3.99)	1.45 (0.77–2.76)
Specific phobia	1.96** (1.43–2.68)	1.41 (0.96–2.07)	1.32 (0.97–1.81)	1.28 (0.92–1.77)	1.32 (0.94–1.86)	1.91** (1.29–2.84)	0.92 (0.40–2.10)	2.33** (1.56–3.49)
Any anxiety disorder	2.50** (1.95–3.22)	1.67** (1.22–2.30)	1.68** (1.30–2.17)	1.35* (1.04–1.75)	1.39* (1.05–1.83)	2.21** (1.61–3.04)	1.86 (1.01–3.41)	3.01** (2.15–4.21)

Note. Odds ratios (95% confidence interval) adjusted for sex, age, education, marital status, any past-month mood disorder and any past-month substance use disorder. All disorders are past-month.
* $p < .05$.
** $p < .01$.

much of this association. On the other hand, the moderately strong association found here between SP and sleep difficulties was somewhat surprising. The paucity of published data on sleep difficulties in SP might suggest that sleep complaints in this disorder are largely absent or transient (Stein et al., 1993; Buckner et al., 2008); yet the current findings suggest that further examination of sleep in this population may be warranted.

Among the PSQI subscales, daytime dysfunction, which assesses the daytime consequences of poor sleep, appeared to have the strongest relationship with anxiety disorders. Daytime dysfunction

Table 5a
The association of comorbidity of anxiety disorders and sleep problems on Physical Component Score of the SF-36[a].

Anxiety disorders	Adjusted for sociodemographic factors[b]			Adjusted for sociodemographic factors and comorbid mental disorders[c]		
	Anxiety disorder only (n = 151)	Sleep problem and anxiety disorder (n = 276)	p-Value	Anxiety disorder only (n = 151)	Sleep problem and anxiety disorder (n = 276)	p-Value
Panic disorder	47.07	44.62	.433	48.22	44.06	.262
Obsessive compulsive disorder	44.67	44.98	.921	46.82	43.72	.325
Social phobia	48.75	46.20	.400	47.10	46.64	.864
Generalized anxiety disorder	47.96	45.64	.584	47.97	45.63	.574
Agoraphobia	45.43	42.06	.192	46.86	42.65	.637
Specific phobia	46.52	44.62	.149	45.66	45.26	.751
Any anxiety disorder	47.09	45.31	.080	46.80	45.47	.193

[a] Effects are shown as adjusted means from a multiple linear regression analysis.
[b] Adjusted for sociodemographic factors only (age, sex, marital status and education).
[c] Adjusted for sociodemographic factors and presence of past-month mood or substance use disorder.

Table 5b
The association of comorbidity of anxiety disorders and sleep problems on Mental Component Score of the SF-36[a].

Anxiety disorders	Adjusted for sociodemographic factors[b]			Adjusted for sociodemographic factors and comorbid mental disorders[c]		
	Anxiety disorder only (n = 151)	Sleep problem and anxiety disorder (n = 276)	p-Value	Anxiety disorder only (n = 151)	Sleep problem and anxiety disorder (n = 276)	p-Value
Panic disorder	37.62	34.30	.500	37.14	34.53	.446
Obsessive compulsive disorder	48.59	33.78	.005	48.36	33.91	.012
Social phobia	35.51	33.49	.714	39.93	32.32	.017
Generalized anxiety disorder	35.86	32.67	.154	35.66	32.71	.180
Agoraphobia	41.37	36.76	.175	39.95	37.29	.453
Specific phobia	47.00	43.95	.045	45.20	45.29	.951
Any anxiety disorder	45.29	40.05	<.001	43.87	40.87	.011

[a] Effects are shown as adjusted means (SE) from a multiple linear regression analysis.
[b] Adjusted for sociodemographic factors only (age, sex, marital status and education).
[c] Adjusted for sociodemographic factors and presence of past-month mood or substance use disorder.

was the only subscale that remained significantly associated with most anxiety disorders after adjustments for past-month mood and substance use disorders. The items that comprise the daytime dysfunction subscale refer to excessive daytime sleepiness and difficulty keeping up enough enthusiasm to get things done. Although one might assume that these difficulties could be accounted for by comorbid depression, the relationship between daytime dysfunction and various anxiety disorders remained strong even after adjustment for the presence of any past-month mood disorders. It is unclear why this subscale in particular appears to be associated with anxiety disorders—this finding awaits replication. Of the anxiety disorders, GAD had a particularly robust association with daytime dysfunction. There were no additional associations detected between specific anxiety disorders and sleep complaints, despite some reports of certain sleep complaints co-segregating with specific anxiety disorders in the literature (Sheikh et al., 2003).

An especially compelling finding in the current study is that poor sleep had a significant impact on functional impairment as measured by health-related quality of life and disability days, over and beyond the unique effects attributable to anxiety disorders alone. Specifically, comorbid anxiety disorders and poor sleep were associated with greater likelihood of poor mental health-related quality of life than anxiety disorders alone. In addition, one-third of those with comorbid anxiety disorders and poor sleep indicated that they had experienced at least one day during the past month when they were completely unable to function due to emotional or substance use problems; this is in contrast with one-quarter of those who had anxiety disorders without poor sleep. After adjustment for sociodemographic variables and the presence of any past-

Table 6a
Multiple logistic regression analyses estimating the association of comorbidity of past-month anxiety disorders and sleep problems with disability due to physical problems in the German Health Survey (N = 429).

Anxiety disorder	One or more disability days		AOR[a] (95% CI)	AOR[b] (95% CI)
	Anxiety disorder only (n = 151) n (%)	Sleep problem and anxiety disorder (n = 276) n (%)		
Panic disorder	19 (2.5)	15 (4.2)	3.46 (0.86–13.97)	4.25 (0.68–26.51)
Obsessive compulsive disorder	5 (0.7)	5 (1.5)	–	–
Social phobia	19 (2.9)	15 (4.9)	1.23 (0.25–6.12)	1.27 (0.26–6.27)
Generalized anxiety disorder	10 (1.3)	8 (2.3)	0.58 (0.08–4.04)	0.71 (0.10–5.01)
Agoraphobia	17 (2.3)	15 (4.2)	3.27 (0.61–17.61)	2.13 (0.40–11.37)
Specific phobia	62 (9.2)	38 (10.7)	1.06 (0.54–2.07)	0.90 (0.45–1.80)
Any anxiety disorder	106 (15.3)	73 (21.2)	1.23 (0.73–2.06)	1.18 (0.69–2.01)

–: cannot be calculated.
Note. *Ns* are unweighted values. Percentages are weighted.
[a] AOR – adjusted odds ratios controlling for sociodemographic factors (age, sex, marital status and education).
[b] AOR – adjusted odds ratios controlling for sociodemographic factors and presence of past-month mood or substance use disorder.

Table 6b
Multiple logistic regression analyses estimating the association of comorbidity of past-month anxiety disorders and sleep problems with disability due to emotional or substance use problems in the German Health Survey ($N = 429$).

Anxiety disorder	One or more disability days		AOR[a] (95% CI)	AOR[b] (95% CI)
	Anxiety disorder only ($n = 151$) n (%)	Sleep problem and anxiety disorder ($n = 276$) n (%)		
Panic disorder	15 (6.1)	13 (8.4)	6.04 (0.73–49.95)	8.83 (0.37–210.72)
Obsessive compulsive disorder	6 (1.9)	4 (2.2)	12.88 (0.29–569.01)	13.63 (0.43–428.54)
Social phobia	17 (8.0)	17 (13.3)	–	–
Generalized anxiety disorder	12 (5.4)	11 (8.3)	2.21 (0.32–15.43)	2.67 (0.56–12.60)
Agoraphobia	12 (4.7)	11 (7.3)	7.15* (1.29–39.51)	6.35* (1.03–39.02)
Specific phobia	25 (10.6)	18 (13.2)	2.77 (0.99–7.73)	2.01 (0.71–5.70)
Any anxiety disorder	57 (24.5)	45 (33.0)	2.89** (1.43–5.83)	2.72** (1.35–5.48)

–: cannot be calculated.
Note. *Ns* are unweighted values. Percentages are weighted.
[a] AOR – adjusted odds ratios controlling for sociodemographic factors (age, sex, marital status and education).
[b] AOR – adjusted odds ratios controlling for sociodemographic factors and presence of past-month mood or substance use disorder.
* $p < .05$.
** $p < .01$.

month mood or substance disorder, these relationships remained significant for several individual anxiety disorders. Previous research has demonstrated that anxiety disorders (Stein et al., 2005; Greenberg et al., 1999; Dupont et al., 1996) and sleep problems (Ozminkowski et al., 2007; Novak et al., 2004; Stein et al., 2008; Roth et al., 2006) are each associated with functional impairment in community studies. However, while sleep disturbance has long been studied and recognized as a significant problem in mood disorders, less attention has been given to the consequences of poor sleep in anxiety disorders, particularly anxiety disorders other than PTSD. To our knowledge, the current investigation is the first study to systematically examine the unique contribution of sleep problems to functional impairment in individuals with anxiety disorders.

What explains the increased functional impairment associated with comorbid anxiety disorders and poor sleep? Although the current study was not designed to investigate the precise mechanism(s) involved in this relationship, a number of explanations are possible. First, it is possible that poor sleep exacerbates anxiety disorders, leading to worse anxiety symptoms and more impaired functioning. Previous studies on panic disorder support this hypothesis—acute sleep deprivation is followed by worsening of anxiety symptoms including increased panic attacks in individuals with panic disorder (Roy-Byrne et al., 1986). Another possibility is that poor sleep is simply a marker for more severe anxiety disorders. It may be that most symptoms, including sleep complaints, are worse in individuals with more severe anxiety. The literature is somewhat mixed with regard to whether more severe anxiety disorders are associated with increased likelihood of sleep problems—one study with a relatively small sample ($N = 44$) does not support this contention (Belanger et al., 2004), while two larger studies did find a positive correlation between sleep symptoms and anxiety disorder severity (Alfano et al., 2007; Storch et al., 2008). However, these latter studies had methodological limitations (e.g., many participants were taking psychotropic medications). Consequently, it is yet unclear whether poor sleep may be a marker for more severe anxiety, thereby explaining the relationship between poor sleep and increased functional impairment. A final possibility is that an unknown variable not assessed in the current study design is associated with both sleep problems and worse functioning. For example, if many of the participants with poor sleep also have PTSD, this confounding association might explain much of the variance in the relationship between sleep and functional impairment.

These findings likely have clinical significance. On average, individuals with comorbid anxiety disorders and poor sleep had a 3–5 point decrement in mental health-related quality of life (MCS), although this includes up to a 15-point drop in functioning for those with comorbid OCD and sleep problems. To put these data in perspective, previous research in both healthy and medical populations suggests that a 10-point drop in MCS is associated with a significantly increased risk of hospitalization and up to a 16% increase in risk of mortality (Mapes et al., 2003; Tsai et al., 2007; Rodriguez-Artalejo et al., 2005). Individuals in the lowest quintile of MCS (i.e., lowest functioning) had a 45% increase in risk of mortality (Mapes et al., 2003). Based on these data and the current findings, one would expect individuals suffering from both poor sleep and anxiety disorders to experience a moderate decrease in mental health-related quality of life and an increase in disability days beyond what would be expected with anxiety disorders alone, along with increased risk of health consequences.

The increased individual and societal burden associated with poor sleep highlights the need for better screening for sleep problems in anxiety disorders by treating clinicians, both initially and throughout treatment. Emerging evidence suggesting that sleep problems do not necessarily resolve after treatment of anxiety disorders (Cervena et al., 2005; Zayfert and Deviva, 2004). Clinicians may wish to modify their treatment regimen for a given patient if sleep complaints are detected; for example, this could entail relaxation techniques for a patient who has occasional difficulty falling asleep at night, or the addition of a hypnotic or cognitive behavioral treatment for insomnia (CBT-I) for patients with moderate to severe sleep complaints. While there are no formal recommendations for treatment of comorbid sleep problems in individuals with anxiety disorders at this time, recent data suggest that sleep-focused interventions may lead to improvement in anxiety disorder symptoms (Pollack et al., 2008; Perlman et al., 2008).

Strengths of the current study include the large epidemiological sample, the use of clinical experts to make psychiatric diagnoses, inclusion of well-validated measures to examine sleep quality and functioning, and the use of past-month diagnoses and ratings which limit retrospective recall bias. The current study is also noteworthy in its assessment of several anxiety disorders within the same analysis, and the examination of each anxiety disorder in relation to specific domains of sleep quality complaints. Previous investigations have typically relied on a broad definition of poor sleep instead of examining specific sleep quality complaints that may occur with anxiety disorders. Finally, no previous studies have attempted to gauge the unique impact of poor sleep on functioning in anxiety disorders other than PTSD.

There are several significant limitations to the current findings. First, as already mentioned, PTSD was not assessed in the current study. There is substantial evidence that PTSD is associated with sleep disturbances (Ross et al., 1989; Breslau et al., 2004; Habukawa et al., 2007), and thus it is possible that some of the significant relationships observed here would be diminished should PTSD have been measured. Second, while the PSQI is a well-validated measure of sleep quality, it is not a measure of insomnia *per se*, and it does not assess all commonly reported subtypes of insomnia equally (i.e., sleep latency is measured via a sleep latency subscale, but middle and late insomnia, two other commonly reported insomnia subtypes, are included in a single item of the sleep disturbance subscale). Thus, individuals with anxiety disorders may be experiencing insomnia complaints not fully captured by the current measure. If that is the case, then the current findings should be considered a conservative estimate of the strength of association between anxiety disorders and poor sleep. Third, the current survey only assessed adults aged 18–65. Since insomnia complaints are known to be elevated in older adults (Ohayon and Roth, 2003; Foley et al., 1995), the current survey may not capture the full societal burden of sleep disturbance associated with anxiety disorders. Fourth, lack of adjustment for multiple comparisons increases the risk of Type I error. However, given that some analyses were performed with very limited sample sizes, and stringent statistical models were employed that included adjustments for a number of demographic and clinical variables, the present findings are still notable, although they require replication. Finally, the current data does not provide evidence for a causal relationship between anxiety disorders and sleep complaints.

In conclusion, the current study suggests that most anxiety disorders are moderately associated with sleep disturbance in the general population, even after adjusting for comorbid mood and substance use disorders. GAD and SP have particularly robust associations with poor sleep, and GAD is strongly linked to the daytime dysfunction component of sleep quality. The presence of poor sleep has a unique impact on health-related quality of life and disability over and beyond the effect of anxiety disorders alone. Future research should incorporate more detailed examination of middle and late insomnia, PTSD, and older age groups into analyses of anxiety disorder and sleep relationships. Clinicians should routinely screen for sleep problems in patients with anxiety disorders, as they may signify worse functioning and warrant treatment augmentation.

Conflict of Interest

All authors declare that they have no conflicts of interest.

Contributors

Dr. Jacobi designed the study and wrote the protocol. Ms. Belik and Dr. Sareen undertook the statistical analyses. Dr. Ramsawh wrote the first draft of the manuscript with significant contributions from Dr. Stein. All authors contributed to and have approved the final manuscript.

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References

Alfano CA, Ginsburg GS, Kingery JN. Sleep-related problems among children and adolescents with anxiety disorders. Journal of the American Academy of Child and Adolescent Psychiatry 2007;46:224–32.

Ancoli-Israel S, Roth T. Characteristics of insomnia in the United States: results of the 1991 National Sleep Foundation survey. Sleep 1999;22:S347–53.

Backhaus J, Junghanns K, Broocks A, Riemann D, Hohagen F. Test–retest reliability and validity of the Pittsburgh Sleep Quality Index in primary insomnia. Journal of Psychosomatic Research 2002;53:737–40.

Belanger L, Morin CA, Langlois F, Ladouceur R. Insomnia and generalized anxiety disorder: effects of cognitive behavior therapy for gad on insomnia symptoms. Journal of Anxiety Disorders 2004;18:561–71.

Breslau N, Roth T, Burduvali E, Kapke A, Schultz L, Roehrs T. Sleep in lifetime posttraumatic stress disorder – a community-based polysomnographic study. Archives of General Psychiatry 2004;61:508–16.

Brower KJ, Aldrich MS, Robinson EAR, Zucker RA, Greden JF. Insomnia, self-medication, and relapse to alcoholism. American Journal of Psychiatry 2001;158:399–404.

Buckner JD, Bcrnert RA, Cromer KR, Joiner TE, Schmidt NB. Social anxiety and insomnia: the mediating role of depressive symptoms. Depression and Anxiety 2008;25:124–30.

Bullinger M. German translation and psychometric testing of the Sf-36 health survey – preliminary-results from the Iqola Project. Social Science and Medicine 1995;41:1359–66.

Buysse DJ, Reynolds CF, Monk TH, Berman SR, Kupfer DJ. The Pittsburgh sleep quality index – a new instrument for psychiatric practice and research. Psychiatry Research 1989;28:193–213.

Cervena K, Matousek M, Prasko J, Brunovsky M, Paskova B. Sleep disturbances in patients treated for panic disorder. Sleep Medicine 2005;6:149–53.

Chang PP, Ford DE, Mead LA, CooperPatrick L, Klag MJ. Insomnia in young men and subsequent depression – the Johns Hopkins precursors study. American Journal of Epidemiology 1997;146:105–14.

Dupont RL, Rice DP, Miller LS, Shiraki SS, Rowland CR, Harwood HJ. Economic costs of anxiety disorders. Anxiety 1996;2:167–72.

Foley DJ, Monjan AA, Brown SL, Simonsick EM, Wallace RB, Blazer DG. Sleep complaints among elderly persons - an epidemiologic-study of 3 communities. Sleep 1995;18:425–32.

Ford DE, Kamerow DB. Epidemiologic-study of sleep disturbances and psychiatric-disorders – an opportunity for prevention. Jama-Journal of the American Medical Association 1989;262:1479–84.

Fuller KH, Waters WF, Binks PG, Anderson T. Generalized anxiety and sleep architecture: a polysomnographic investigation. Sleep 1997;20:370–6.

Greenberg PE, Sisitsky T, Kessler RC, Finkelstein SN, Berndt ER, Davidson JRT, et al. The economic burden of anxiety disorders in the 1990s. Journal of Clinical Psychiatry 1999;60:427–35.

Habukawa M, Uchimura N, Maeda M, Kotorii N, Maeda H. Sleep findings in young adult patients with Posttraumatic stress disorder. Biological Psychiatry 2007;62:1179–82.

Jacobi F, Wittchen HU, Holting C, Sommer S, Lieb R, Hofler M, et al. Estimating the prevalence of mental and somatic disorders in the community: aims and methods of the German National Health Interview and Examination Survey. International Journal of Methods in Psychiatric Research 2002;11:1–18.

Jacobi F, Wittchen HU, Holting C, Hofler M, Pfister H, Muller N, et al. Prevalence, co-morbidity and correlates of mental disorders in the general population: results from the German Health Interview and Examination Survey (GHS). Psychological Medicine 2004;34:597–611.

Jansson-Frojmark M, Lindblom K. A bidirectional relationship between anxiety and depression, and insomnia? A prospective study in the general population. Journal of Psychosomatic Research 2008;64:443–9.

Johnson EO, Roth T, Breslau N. The association of insomnia with anxiety disorders and depression: exploration of the direction of risk. Journal of Psychiatric Research 2006;40:700–8.

Katz DA, McHorney CA. Clinical correlates of insomnia in patients with chronic illness. Archives of Internal Medicine 1998;158:1099–107.

Kessler RC, Berglund P, Demler O, Jin R, Walters EE. Lifetime prevalence and age-of-onset distributions' of DSM-IV disorders in the national comorbidity survey replication. Archives of General Psychiatry 2005;62:593–602.

Mapes DL, Lopes AA, Satayathum S, McCullough KP, Goodkin DA, Locatelli F, et al. Health-related quality of life as a predictor of mortality and hospitalization: the Dialysis Outcomes and Practice Patterns Study (DOPPS). Kidney International 2003;64:339–49.

Martikainen K, Partinen M, Hasan J, Laippala P, Urponen H, Vuori I. The impact of somatic health problems on insomnia in middle age. Sleep Medicine 2003;4:201–6.

McHorney CA, Ware JE, Raczek AE. The Mos 36-Item Short-Form Health Survey (Sf-36). 2. Psychometric and clinical-tests of validity in measuring physical and mental-health constructs.. Medical Care 1993;31:247–63.
Mohr D, Vedantham K, Neylan T, Metzler TJ, Best S, Marmar CR. The mediating effects of sleep in the relationship between traumatic stress and health symptoms in urban police officers. Psychosomatic Medicine 2003;65:485–9.
Newman AB, Enright PL, Manolio TA, Haponik EF, Wahl PW. Sleep disturbance, psychosocial correlates, and cardiovascular disease in 5201 older adults: the cardiovascular health study. Journal of the American Geriatrics Society 1997;45:1–7.
Novak M, Mucsi I, Shapiro CM, Rethelyi J, Kopp MS. Increased utilization of health services by insomniacs – an epidemiological perspective. Journal of Psychosomatic Research 2004;56:527–36.
Ohayon MM. Prevalence of DSM-IV diagnostic criteria of insomnia: distinguishing insomnia related to mental disorders from sleep disorders. Journal of Psychiatric Research 1997;31:333–46.
Ohayon MM. Nocturnal awakenings and comorbid disorders in the American general population. Journal of Psychiatric Research 2009;43:48–54.
Ohayon MM, Roth T. Place of chronic insomnia in the course of depressive and anxiety disorders. Journal of Psychiatric Research 2003;37:9–15.
Ohayon MM, Caulet M, Lemoine P. Comorbidity of mental and insomnia disorders in the general population. Comprehensive Psychiatry 1998;39:185–97.
Ozminkowski RJ, Wang SH, Walsh JK. The direct and indirect costs of untreated insomnia in adults in the United States. Sleep 2007;30:263–73.
Perlman LM, Arnedt JT, Earnheart KL, Gorman AA, Shirley KG. Group cognitive–behavioral therapy for insomnia in a VA mental health clinic. Cognitive and Behavioral Practice 2008;15:426–34.
Pollack M, Kinrys G, Krystal A, McCall WV, Roth T, Schaefer K, et al. Eszopiclone coadministered with escitalopram in patients with insomnia and comorbid generalized anxiety disorder. Archives of General Psychiatry 2008;65:551–62.
Quan SF, Katz R, Olson J, Bonekat W, Enright PL, Young T, et al. Factors associated with incidence and persistence of symptoms of disturbed sleep in an elderly cohort: the cardiovascular health study. American Journal of the Medical Sciences 2005;329:163–72.
Rice DP, Miller LS. Health economics and cost implications of anxiety and other mental disorders in the United States. British Journal of Psychiatry 1998;173:4–9.
Rodriguez-Artalejo F, Guallar-Castillon P, Pascual CR, Otero CM, Montes AO, Garcia AN, et al. Health-related quality of life as a predictor of hospital readmission and death among patients with heart failure. Archives of Internal Medicine 2005;165:1274–9.
Ross RJ, Ball WA, Sullivan KA, Caroff SN. Sleep disturbance as the hallmark of posttraumatic stress disorder. American Journal of Psychiatry 1989;146:697–707.
Roth T, Jaeger S, Jin R, Kalsekar A, Stang PE, Kessler RC. Sleep problems, comorbid mental disorders, and role functioning in the National Comorbidity Survey Replication. Biological Psychiatry 2006;60:1364–71.
Roy-Byrne PP, Uhde TW, Post RM. Effects of one nights sleep-deprivation on mood and behavior in panic disorder – patients with panic disorder compared with depressed-patients and normal controls. Archives of General Psychiatry 1986;43:895–9.
Schubert CR, Cruickshanks KJ, Dalton DS, Klein BEK, Klein R, Nondahl DM. Prevalence of sleep problems and quality of life in an older population. Sleep 2002;25:889–93.
Shah BV, Barnwell BG, Hunt PN, Lavange LM. SUDAAN User's Manual, Release 6.0; 1992.
Sheikh JI, Woodward SH, Leskin GA. Sleep in post-traumatic stress disorder and panic: convergence and divergence. Depression and Anxiety 2003;18:187–97.
Smit F, Cuijpers P, Oostenbrink J, Batelaan N, de Graaf R, Beekman A. Costs of nine common mental disorders: implications for curative and preventive psychiatry. Journal of Mental Health Policy and Economics 2006;9:193–200.
Stein MB, Kroft CDL, Walker JR. Sleep impairment in patients with social phobia. Psychiatry Research 1993;49:251–6.
Stein MB, Roy-Byrne PP, Craske MG, Bystritsky L, Sullivan G, Pyne JM, et al. Functional impact and health utility of anxiety disorders in primary care outpatients. Medical Care 2005;43:1164–70.
Stein MB, Belik S, Jacobi F, Sareen J. Impairment associated with sleep problems in the community: relationship to physical and mental health comorbidity. Psychosomatic Medicine 2008;70:913–9.
Stolzenberg H. Bundes-Gesundheitsurvey 1998: Dokumentation des Datensatzes. Berlin: Robert Koch Institut; 2000.
Storch EA, Murphy TK, Lack CW, Geffken GR, Jacob ML, Goodman WK. Sleep-related problems in pediatric obsessive-compulsive disorder. Journal of Anxiety Disorders 2008;22:877–85.
Taylor DJ, Mallory LJ, Lichstein KL, Durrence HH, Riedel BW, Bush AJ. Comorbidity of chronic insomnia with medical problems. Sleep 2007;30:213–8.
Tsai SY, Chi LY, Lee CH, Chou P. Health-related quality of life as a predictor of mortality among community-dwelling older persons. European Journal of Epidemiology 2007;22:19–26.
Ware JE, Kosinski M, Keller S. SF-36 Physical and mental health summary scales: a users manual. Boston, Mass: Health Institute, New England Medical Center; 1994.
Ware JE, Kosinski M, Gandek B, Aaronson NK, Apolone G, Bech P, et al. The factor structure of the SF-36 Health Survey in 10 countries: results from the IQOLA Project. Journal of Clinical Epidemiology 1998;51:1159–65.
Wetter DW, Young TB. The relation between cigarette-smoking and sleep disturbance. Preventive Medicine 1994;23:328–34.
WHO. Composite International Diagnostic Interview (CIDI, Version 2.1). Geneva: World Health Organization; 1997.
Wittchen HU, Pfister H. DIA-X-Interviews: Manual und PC-Programm. Frankfurt: Swets & Zeitlinger; 1997.
Zayfert C, Deviva JC. Residual insomnia following cognitive behavioral therapy for PTSD. Journal of Traumatic Stress 2004;17:69–73.