Qual Life Res (2009) 18:415–422
DOI 10.1007/s11136-009-9462-6

Association of insomnia with quality of life, work productivity, and activity impairment

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Accepted: 24 February 2009 / Published online: 14 March 2009

Abstract
Purpose To assess the association of insomnia with health-related quality of life (HRQOL), work productivity, and activity impairment.
Methods Data were obtained from the 2005 US National Health and Wellness Survey. Subjects were assigned to the insomnia group (diagnosed insomnia experienced at least a few times a month) or the noninsomnia group (no insomnia or sleep symptoms). HRQOL was assessed using the short form 8 (SF-8) (mental and physical scores). The work productivity and activity impairment questionnaire (WPAI) assessed absenteeism (work time missed), presenteeism (impairment at work), work productivity loss (overall work impairment), and activity impairment. Linear regression models were used to control for potential confounders.
Results A total of 19,711 adults were evaluated (5,161 insomnia, 14,550 noninsomnia). Subjects in the insomnia group had significantly lower SF-8 physical (−5.40) and mental (−4.39) scores and greater activity impairment scores (+18.04) than subjects in the noninsomnia group ($P < 0.01$ for all). Employed subjects in the insomnia group had greater absenteeism (+6.27), presenteeism (+13.20), and work productivity loss (+10.33) scores than those in the noninsomnia group ($P < 0.01$ for all).
Conclusions Insomnia is significantly associated with poorer physical and mental quality of life and work productivity loss and activity impairment.

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Keywords Insomnia · Health-related quality of life · Work impairment · Absenteeism

Introduction

The Diagnostic and Statistical Manual of Mental Disorders (4th edition, text revision) (DSM-IV-TR) defines primary insomnia as experiencing problems falling asleep, staying asleep, waking too early, and/or not feeling rested even after ample time in bed—associated with impairment in daytime, where these symptoms are not associated with another condition and affect daily life [1]. The National Institutes of Health (NIH) have expanded this definition to include comorbid insomnia, which may occur in the presence of other physical or psychiatric conditions. NIH has also recognized that there is controversy around including nonrestorative sleep or sleep quality as part of the definition of insomnia [2]. Insomnia is the most commonly reported sleep complaint, with estimates indicating that nearly 60 million Americans experience insomnia each year [3, 4]. Epidemiologic studies estimate that one-third of the general population has experienced at least one of the DSM-IV-TR symptoms of insomnia, and that 6% of the general population have been diagnosed with insomnia based on this definition [5]. When considering chronic insomnia, which is often defined as recurring insomnia symptoms for a period of 1–6 months [2], prevalence estimates are 10–15% [6]. Past estimates of the economic burden of insomnia in the US range between US $30 and US $35 billion annually, encompassing both direct and indirect costs [4].

The consequences of insomnia affect several dimensions of an individual's health. The negative impacts of insomnia include fatigue and memory problems [7]. The relationship of insomnia and health-related quality of life (HRQOL) is

multifaceted and extensive, and the literature shows a correlation of experiencing insomnia and decreased quality of life [3, 8]. The literature also shows insomnia to be frequently comorbid with both physical and psychiatric disorders, especially depression [3, 9]. One of the greatest health risks associated with insomnia is the increased occurrence of industrial and vehicle accidents [3, 10].

The adverse effects associated with insomnia extend to decreased work productivity and greater activity impairment. Studies among specific populations have shown an association between insomnia and decreased work productivity, increased absenteeism, and poorer job performance [3, 4, 10]. A study by Linton and Bryngelsson reports not only increased absenteeism, but also decreased ability to concentrate and make decisions [11].

While research has been conducted in the past to assess different aspects of insomnia and its effects, more research is needed with a large sample approximately representative of the US population. With recent advances in treatment options, there is motivation to quantify the unmet need as well as the associated burden. The objective of the current study was to assess the association of insomnia with HRQOL, work productivity, and activity impairment in a large, nationwide sample of adults in the USA.

Methods

Study sampling and data collection

Data were taken from the 2005 US National Health and Wellness Survey (NHWS) (Consumer Health Sciences, Princeton, NJ, USA). NHWS is an annual, cross-sectional study of adults (age 18+ years). The primary objective of NHWS is to provide a comprehensive database of epidemiological and treatment information, healthcare attitudes, behaviors, demographic and disease characteristics, and health-related outcomes. While specific research questions generally are not developed prior to revision of the annual survey, this comprehensive database is used retrospectively as an available data source for hypotheses testing within specific disease categories.

A self-administered, Internet-based questionnaire was administered to a sample population identified through a web-based consumer panel. The consumer panel recruits its panel members through opt-in email, co-registration with panel partners, e-newsletter campaigns, banner placements, and both internal and external affiliate networks. All panelists must explicitly agree to be a panel member, register with the panel through a unique email address, and complete an in-depth demographic registration profile. The sampling frame was stratified by gender, age, and race/ethnicity to be reflective of the demographic composition of the general population with slight overrepresentation of older age groups who are more likely to experience many disease states. Table 1 shows a comparison of the demographic composition of the 2005 US NHWS sample with the US adult population, defined through the March 2004 Current Population Survey of the US Census Bureau. All demographic groups are represented in the 41,184 NHWS respondents, though ethnic minority groups are underrepresented, as are younger adults and those without a college degree and with annual incomes less than US $25,000. When weighting NHWS to the US adult population based on gender, age, and race/ethnicity, prevalence estimates of various conditions from NHWS are consistent with other well-established sources such as the National Health Interview Survey (NHIS) (Table 2).

The 2005 NHWS was not reviewed by an institutional review board (IRB). However, the introduction to the questionnaire included information about confidentiality and the voluntary nature of participation.

Table 1 Comparison of demographic profile of NHWS respondents and the US adult population

	2005 NHWS (%)	March 2004 CPS[a] (%)
Gender		
Male	45	48
Female	55	52
Age (years)		
18–44	43	52
45–64	35	32
65+	22	16
Race		
African-American	4	11
Hispanic	4	12
White	88	70
Other	5	6
Income (US $)		
<25,000	19	29
25,000–49,999	34	27
50,000–74,999	22	18
75,000+	25	26
Education		
No college degree	62	75
College degree	38	25
Region		
Northeast	20	19
Midwest	24	23
South	34	36
West	23	23

[a] Current Population Survey of the US Census Bureau

Table 2 Comparison of disease prevalence estimates from NHWS and National Health Interview Survey (NHIS)

	2003 NHIS (%)		2005 NHWS[a] (%)
Diagnosed angina pectoris	2	Ever experienced angina pectoris	4
Diagnosed arthritis	22	Diagnosed arthritis	20
Diagnosed asthma	10	Diagnosed asthma and experienced in past year	9
Diagnosed and current asthma	6		
Diagnosed cancer	7	Ever experienced cancer	6
Diagnosed congestive heart failure	2	Diagnosed congestive heart failure	2
Self-reported depression	16	Self-reported depression in past year	25
Diagnosed diabetes	7	Diagnosed diabetes	10
Diagnosed heart attack	3	Ever had heart attack	3
Diagnosed high cholesterol	20	Diagnosed high cholesterol	26
Diagnosed hypertension	25	Diagnosed hypertension	28
Self-reported insomnia	18	Self-reported insomnia in past year	19
Diagnosed stroke	2	Ever experienced stroke	2

[a] For comparison, data were weighted by age, gender, and race/ethnicity to the US adult population in the 2004 Current Population Survey of the US Census Bureau

Study measures

Insomnia group versus noninsomnia group

All NHWS respondents were asked, "Which of the following conditions did you experience in the past twelve months?" Insomnia and sleep difficulties were listed within the response set. Respondents who reported experiencing insomnia were then asked, "Has your insomnia been diagnosed by a physician?" and "How often do you experience sleep difficulties/insomnia?" All NHWS respondents were also asked, "In the past year, did you experience any of the following sleep patterns more than 2 times a week (not attributed to a painful condition or the need to use the bathroom)?" The response set included: difficulty falling asleep; difficulty staying asleep—either waking several times during the night *or* waking and not being able to get back to sleep; waking up too early before the alarm clock; and none of these.

Based on the above questions, respondents were classified as experiencing insomnia if they self-reported a physician diagnosis of insomnia that occurs at least a few times each month. Respondents were classified in the noninsomnia group if they did not experience insomnia, sleep difficulties or any symptoms of sleep difficulties in the past year. Respondents experiencing insomnia, sleep difficulties or related symptoms who were not diagnosed or who experienced symptoms once a month or less were excluded from the analysis.

Comorbid conditions

Comorbid conditions were assessed separately for physical and psychiatric conditions. Respondents were asked, "Which of the following conditions have you ever experienced?" Physical condition response options included angina, arrhythmia, arthritis, atrial fibrillation, chronic obstructive pulmonary disease (COPD), congestive heart failure (CHF), deep vein thrombosis (DVT), diabetes, high blood pressure, high cholesterol, gastroesophageal reflux disease (GERD), nasal allergies, osteoporosis, overactive bladder, peripheral arterial disease (PAD), peripheral vascular disease (PVD), psoriasis, and thyroid condition; psychiatric condition response options included bipolar disorder. Respondents were also asked, "Which of the following conditions have you experienced in the past 12 months?" Physical condition response options included asthma, epilepsy, inflammatory bowel disease (IBD), irritable bowel syndrome (IBS), migraine, and pain; psychiatric condition response options included anxiety, depression, generalized anxiety disorder (GAD), obsessive-compulsive disorder (OCD), panic disorder, phobias, posttraumatic stress disorder (PTSD), and social anxiety disorder (SAD). Respondents who experienced pain provided information about pain experienced in the past month caused by back problems. Physical comorbid conditions were assessed as a count of the physical conditions listed above. Psychiatric comorbid conditions were assessed as the presence of any of the psychiatric conditions listed above.

Health-related quality of life

Health-related quality of life referenced to the 4 weeks before survey administration was assessed using the Medical Outcomes Study Short-Form Health Survey (SF-8), a validated metric based on the SF-36. The eight individual items of the SF-8 directly correspond to the SF-36

subscales and include physical functioning, role limitations due to physical health problems, bodily pain, general health, vitality, social functioning, role limitations due to emotional problems, and mental health. A physical component summary score and mental component summary score, which are normative to the US population (mean score 50, standard deviation 10), were computed from the eight individual items. Higher scores indicate better physical or mental HRQOL [12, 13].

Lost work productivity and activity impairment

The general health version of the work productivity and activity impairment (WPAI) questionnaire was used to assess lost work productivity and activity impairment referenced to the 7 days before survey administration. The WPAI is a validated metric that has been used more frequently than any other metric of productivity across various occupations and disease areas. Specific impairment metrics for work productivity include absenteeism (work time missed due to health problems), presenteeism (impairment at work/reduced on-the-job effectiveness), and overall work productivity loss (combination of absenteeism and presenteeism). Lost work productivity measures were assessed only for respondents who were employed. Activity impairment is a single measure of impairment due to health and was assessed for all respondents. The four WPAI metrics are expressed as impairment percentages, with higher values indicating a greater proportion of impairment in work (less productivity) or activities [14, 15].

Statistical analysis

The insomnia group was compared with the noninsomnia group on demographic profiles, comorbid conditions, and outcomes at the bivariate level. Chi-square was used to test for significant differences in categorical variables. *T* tests were used to test for significant differences in continuous variables.

Linear regression models using ordinary least-squares (OLS) regression were developed to assess the independent association of insomnia with HRQOL and work productivity loss and activity impairment. All variables had normal distributions, and linear relationships were confirmed by examination of plots of standardized residuals as a function of standardized predicted values. Separate models were developed for each of the following dependent variables: SF-8 physical component summary score, SF-8 mental component summary score, WPAI absenteeism, WPAI presenteeism, WPAI overall work productivity loss, and WPAI activity impairment. Potential confounders controlled in all the models included gender, age, race, marital status, education, number of physical comorbid conditions, and presence of a psychiatric condition. In the WPAI absenteeism, WPAI presenteeism, and WPAI overall work productivity loss models, two additional covariates were included: employed part-time and self-employed.

Results

Sample characteristics

Of the 41,184 respondents to the 2005 US NHWS, 5,161 (12%) met the criteria for the insomnia group, and 14,550 (35%) met the criteria for the noninsomnia group. Among respondents who were employed, 2,388 met the criteria for the insomnia group, and 8,933 met the criteria for the noninsomnia group.

Among all respondents, as well as among those who were employed, insomnia sufferers were significantly ($P < 0.05$) more likely to be female, older, White, and unmarried than those in the noninsomnia group. Respondents with insomnia also experienced a greater number of physical comorbid conditions and were more likely to experience all individual physical comorbid conditions. Prevalence of psychiatric comorbid conditions was also higher among those with insomnia than those in the noninsomnia group (Table 3).

Health-related quality of life

Respondents in the insomnia group had average SF-8 physical component summary scores of 40.5 and average SF-8 mental component summary scores of 42.9, which were not only significantly poorer than the noninsomnia group but notably lower than the normative means of 50 for the US adult population (Table 4). Adjusting for demographics and comorbid conditions, respondents with insomnia had SF-8 physical component summary scores that were 5.4 points lower and SF-8 mental component summary scores that were 4.4 points lower than the noninsomnia group (Table 5).

Lost work productivity and activity impairment

Among respondents who were employed full-time, those with insomnia experienced significant work productivity loss with 10.7% work time missed (absenteeism), 29.2% productivity impairment at work (presenteeism), and 24.2% overall work impairment (work productivity loss). Based on unadjusted, bivariate analysis, the insomnia group experienced work productivity loss that was more than three times greater than the noninsomnia group

Table 3 Sample characteristics of respondents with insomnia versus respondents without insomnia

	All respondents			Employed respondents		
	Insomnia (n = 5,161)	No insomnia (n = 14,550)	P value[a]	Insomnia (n = 2,388)	No insomnia (n = 8,933)	P value[a]
Female (%)	62	49	<0.01	59	45	<0.01
Age, mean (SD), years	50.5 (13.6)	49.1 (16.6)	<0.01	46.3 (12.0)	43.8 (13.7)	<0.01
Nonwhite (%)	11	13	<0.01	13	15	<0.01
Married/living with partner (%)	61	66	<0.01	62	65	0.02
College degree (%)	31	43	<0.01	40	48	<0.01
Mean no. of nonpsychiatric comorbidities (SD)	4.8 (2.8)	2.0 (1.9)	<0.01	4.1 (2.6)	1.7 (1.7)	<0.01
Ever experienced (%)						
Angina pectoris	10	3	<0.01	8	2	<0.01
Arrhythmia	9	3	<0.01	8	2	<0.01
Arthritis	47	20	<0.01	37	14	<0.01
Atrial fibrillation	3	2	<0.01	2	1	<0.01
COPD	7	2	<0.01	3	1	<0.01
CHF	5	2	<0.01	2	<1	<0.01
DVT	3	1	<0.01	2	<1	<0.01
Diabetes	18	9	<0.01	12	7	<0.01
GERD	30	9	<0.01	26	8	<0.01
Heartburn	49	24	<0.01	48	24	<0.01
High blood pressure	44	27	<0.01	38	21	<0.01
High cholesterol	44	26	<0.01	39	21	<0.01
Nasal allergies	46	24	<0.01	48	26	<0.01
Osteoporosis	10	4	<0.01	6	2	<0.01
Overactive bladder	16	4	<0.01	12	2	<0.01
PAD	4	1	<0.01	2	<1	<0.01
PVD	2	<1	<0.01	1	<1	<0.01
Psoriasis	7	3	<0.01	6	2	<0.01
Thyroid condition	17	7	<0.01	14	5	<0.01
Experienced in past year (%)						
Asthma	17	6	<0.01	15	6	<0.01
Epilepsy	1	<1	<0.01	1	<1	0.05
IBD	3	<1	<0.01	3	<1	<0.01
IBS	21	4	<0.01	20	4	<0.01
Migraine	27	9	<0.01	29	10	<0.01
In past month (%)						
Pain caused by back problems	42	10	<0.01	35	10	<0.01
With psychiatric comorbidities (%)	66	15	<0.01	64	15	<0.01
Bipolar disorder	8	1	<0.01	7	1	<0.01
Anxiety	52	10	<0.01	50	10	<0.01
Depression	54	9	<0.01	50	9	<0.01
GAD	17	2	<0.01	14	1	<0.01
OCD	6	1	<0.01	6	1	<0.01
Panic disorder	13	1	<0.01	10	1	<0.01
Phobias	5	1	<0.01	4	1	<0.01
PTSD	10	<1	<0.01	8	<1	<0.01
SAD	16	2	<0.01	12	2	<0.01

[a] P-values are computed using chi-square for comparison of percentages and T tests for comparison of means

Table 4 HRQOL, lost work productivity, and activity impairment of respondents with insomnia versus respondents without insomnia[a]

	Insomnia	No insomnia	*P* value
SF-8 physical component summary score	40.5 (11.4)	50.9 (8.2)	<0.01
SF-8 mental component summary score	42.9 (11.5)	53.3 (7.1)	<0.01
WPAI absenteeism (work time missed)[b]	10.7 (24.3)	1.7 (10.0)	<0.01
WPAI presenteeism (impairment at work/reduced on-the-job effectiveness)[b]	29.2 (27.2)	7.6 (16.0)	<0.01
WPAI work productivity loss (overall work impairment/combination of absenteeism and presenteeism)[b]	24.2 (23.0)	7.1 (14.6)	<0.01
WPAI activity impairment	47.6 (31.2)	14.0 (23.0)	<0.01

[a] Table shows mean (SD) values for each metric. *P*-values are computed using *T* tests

[b] Among respondents who are employed

Table 5 Summary of adjusted[a] association of insomnia (1) versus no insomnia (0) with HRQOL, lost work productivity, and activity impairment

	Beta	*P*-value	95% CI	
			Low	High
SF-8 physical component summary score	−5.40	<0.01	−5.72	−5.08
SF-8 mental component summary score	−4.39	<0.01	−4.68	−4.10
WPAI absenteeism (work time missed)[b]	6.27	<0.01	5.47	7.08
WPAI presenteeism (impairment at work/reduced on-the-job effectiveness)[b]	13.20	<0.01	12.16	14.24
WPAI work productivity loss (overall work impairment/combination of absenteeism and presenteeism)[b]	10.33	<0.01	9.41	11.25
WPAI activity impairment	18.04	<0.01	17.11	18.98

[a] Linear regression models adjust for gender, age, race, marital status, education, number of physical comorbid conditions, and experiencing a psychiatric comorbidity

[b] Among respondents who are employed. Additional covariates in these models include part-time employment and self-employment

(Table 2). Adjusting for demographics and comorbidities, respondents with insomnia had 6.3% greater work time missed (absenteeism), 13.2% greater impairment at work (presenteeism), and 10.3% greater overall work impairment (work productivity loss) than those in the noninsomnia group (Tables 4, 5).

The insomnia group also experienced significantly greater impairment in daily activities, reporting an average of 47.6% activity impairment, which is more than three times higher than that reported by the noninsomnia group (Table 4). Adjusting for demographic and comorbidity differences, respondents with insomnia had 18.0% greater activity impairment than those in the noninsomnia group (Table 5).

Discussion

The scientific literature indicates that insomnia and its associated symptoms exert a considerable impact on various health-related outcomes. Health-related quality of life has been shown to be decreased among insomniacs, in comparison with those without insomnia [8]. Insomnia has also been shown to impact work productivity [4, 10]. Results of the current analysis in a large naturalistic population were consistent with these previous findings. Data from the current study demonstrated that insomnia is significantly associated with poorer HRQOL and greater work productivity loss.

Study results indicated a negative association of insomnia and HRQOL. A five-point change in the SF-36, and by extension the SF-8, has been illustrated by the scale's developers to be a clinically meaningful difference [13]. Recent literature has shown that even a three-point change is a clinically meaningful difference [16]. After adjusting for demographics and other health conditions, the difference in SF-8 physical (5.4) and mental (4.4) component summary scores between the insomnia and noninsomnia groups may be interpreted as not only statistically significant but also as having meaningful clinical implications, such that the patients with insomnia may have clinically worse HRQOL than those without insomnia. In interpreting these differences consideration may be given to the domains which comprise the SF-8 summary scores, each of which corresponds to a single item in the scale. Insomnia may have differing magnitudes of association on some or all of the following: physical functioning, role limitations due to physical health problems, bodily

pain, general health, vitality, social functioning, role limitations due to emotional problems, and mental health.

Insomnia also had a strong association with indirect costs through loss of work productivity and increased impairment of daily activities. Norman and colleagues have provided guidance for interpreting changes in HRQOL metrics by considering half a standard deviation as the threshold for minimally importance difference (MID) [17]. Among all 2005 US NHWS respondents, the standard deviation was 14.5 (MID = 7.2) for absenteeism, 22.2 (MID = 11.1) for presenteeism, 19.6 (MID = 9.8) for overall work productivity loss, and 28.7 (MID = 14.3) for activity impairment. Therefore, among employed respondents, the greater presenteeism and overall work productivity loss associated with insomnia was larger than the minimally important difference. Difference in absenteeism, though statistically significant, may not be clinically relevant as the difference was less than the MID. Greater activity impairment associated with insomnia was both statistically significant and clinically relevant.

Overall, the insomnia group had 10% greater work productivity loss than the noninsomnia group. This 10% equated to a loss of 4 h of work during a 40-h working week. Assuming a work year of 50 weeks, insomnia was associated with a productivity reduction of 200 h or the equivalent of five full working weeks per year per sufferer compared with the noninsomnia group. Indirect costs can be estimated by applying this 10% work productivity loss to various salary points; for instance, 10% work productivity loss corresponds to a loss of US $2,500 for an employee with a salary of US $25,000, a loss of US $5,000 for an employee with a salary of US $50,000, and a loss of US $10,000 for an employee with a salary of US $100,000. An even greater proportion (18%) of activity impairment was associated with insomnia.

As with all research, this study has several limitations. First, potential respondents were identified through a web-based panel, and data were collected through a web-based questionnaire. For this reason, the sample may not be representative of the total US population. Certain segments of the US population, such as those who have lower socioeconomic status, reside in rural areas, or choose not to use the Internet, may have been excluded from the study [18]. Second, questionnaires were self-administered. Self-reported data were not verified against clinician diagnoses or chart reviews. However, as shown in Table 2, prevalence estimates from NHWS self-reported data were consistent with those in NHIS. Also, internal validation of insomnia status was investigated by assessing the symptoms that those diagnosed with insomnia reported experiencing. Of the respondents in the insomnia group, 97% reported experiencing at least one of the DSM-IV-TR symptoms [1]. There was also the potential for recall bias. Third, NHWS was a cross-sectional study. Therefore, it was not possible to infer causation of the effects of insomnia on HRQOL, work productivity loss, and activity impairment. Reverse causation is a possibility, and poorer HRQOL or greater work productivity loss or activity impairment may increase risk of insomnia. Other comorbid conditions may also affect both likelihood of insomnia and the studied outcomes. Also, these outcomes may have differed had they been measured at a different time.

Insomnia is not only a widely prevalent condition, but also a condition with extensive associated burden of illness. Due to the nature of this condition, its effects may extend to HRQOL as well as impairment at work. Because insomnia is episodic in nature and respondents may not experience insomnia on all days, the associated burden of an episode of insomnia may be greater than these results illustrate. Alleviation of insomnia symptoms through improved sleep hygiene, pharmacologic intervention or other treatments may be associated with reductions in HRQOL impairments, loss of work productivity, and activity impairment. The burden associated with insomnia should be one of many considerations in making insomnia treatment decisions.

Acknowledgements The National Health and Wellness Survey (NHWS) is conducted and wholly owned by Consumer Health Sciences, Princeton, NJ. Takeda Pharmaceutical Company, Ltd., Deerfield, IL licensed access to NHWS and funded the analysis for and preparation of this paper. Assistance with manuscript preparation was provided by Sara Sarkey, PhD, an employee of Takeda Pharmaceuticals North America.

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