Insomnia and Impaired Quality of Life in the United States

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ABSTRACT

Objective: This analysis characterizes the individual-level and population-level burden of insomnia in relation to other medical conditions and describes the comorbidity of insomnia with other medical conditions, including the dependence of these comorbidities on pain, life events, and mental disorders.

Methods: Information from 34,712 adults in the National Epidemiologic Survey on Alcohol and Related Conditions-III (2012–2013) was analyzed. Quality-adjusted life-years (QALYs) were measured with the SF-6D, a 6-dimensional health state classification derived from the Short-Form-12, version 2.

Results: In the last 12 months, 27.3% of adults reported insomnia. The US annual loss of QALYs associated with insomnia (5.6 million; 95% CI, 5.33–5.86 million) was significantly larger than that associated with any of the other 18 medical conditions assessed, including arthritis (4.94 million; 95% CI, 4.62–5.26 million), depression (4.02 million; 95% CI, 3.87–4.17 million), and hypertension (3.63 million; 95% CI, 3.32–3.93 million). After control for demographic factors, all conditions examined from obesity (adjusted odds ratio [aOR] = 1.25) to mania (aOR = 5.04) were associated with an increased risk of insomnia. Further controlling for pain, stressful life events, and mental disorders decreased the odds of the co-occurrence of insomnia with these conditions. The decrease in insomnia comorbidity associated with pain was greatest for fibromyalgia (31.8%) and arthritis (20.1%); the decrease in insomnia comorbidity associated with life events was greatest for mania (13.4%) and drug use disorders (11.2%); and the decrease in insomnia comorbidity associated with mental disorders was greatest for peptic ulcer disease (11.2%) and liver diseases (11.1%).

Conclusions: Insomnia is prevalent and associated with substantial population-level burden in self-assessed health. The co-occurrence of insomnia with common medical conditions is differentially related to pain and to a lesser extent to stressful life events and mental disorders.

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Insomnia, which is characterized by difficulty falling asleep or maintaining sleep, is highly prevalent in the general population[1] and is a common clinical complaint.[2] Poor-quality sleep can have negative effects on an individual's subjective well-being,[3] quality of life,[4] and productivity.[5] Within the United States, the direct and indirect costs associated with insomnia have been estimated to exceed $100 billion each year.[6] Another measure of the national burden is the annual number quality-adjusted life-years (QALYs) in the United States that are lost to insomnia. The QALY is a single preference-based measure of burden of various health states on a 0 to 1 scale corresponding to the worst to best possible health outcomes. QALYs integrate quality and quantity of life and account for time in each health state.[7] To our knowledge, QALYs lost each year in the United States to insomnia have not been previously estimated.

The risk of insomnia has been linked to several specific medical conditions.[8–10] Among commercially insured adults, insomnia has been associated with several musculoskeletal, respiratory, digestive, and pain conditions.[11] Because it can be difficult for treating physicians to determine whether a concurrent medical condition causes insomnia or whether insomnia contributes to the risk for the medical condition, the phrase "comorbid insomnia" has been recommended to describe these co-occurrences.[12] One largely unexplored means of probing the co-occurrence of medical conditions and insomnia is to assess the extent to which these associations are statistically mediated or confounded by pain,[13] stressful life events,[14] or common mental disorders[15] that are known to predispose to insomnia. Information concerning the clinical contexts and degree to which pain, psychosocial stressors, and co-occurring mental disorders contribute to risk of insomnia might help guide clinical assessments of underlying causal factors.

We examine the prevalence of insomnia in a nationally representative sample of US adults, estimate its national health burden in relation to other common medical conditions, and assess patterns of comorbidity between insomnia and other conditions as well as dependence of these comorbidities on pain, stressful life events, and mental disorders. Prior to performing these analyses, we anticipated that insomnia would be a leading source of QALY losses in the United States and that pain would partially confound the comorbidity of insomnia with common medical conditions whereas stressful life events would partially confound the comorbidity of insomnia with common mental disorders.

METHODS

Source of Data

The National Epidemiologic Survey on Alcohol and Related Conditions-III (NESARC-III; 2012–2013) was a nationally

Clinical Points

- Insomnia is a common clinical complaint that often co-occurs with medical conditions, pain, mental disorders, and stressful life events, though these relationships are complex.
- The dependency of insomnia on co-occurring pain, mental disorders, and life events varies across common medical conditions.
- The overall burden of insomnia on self-assessed health exceeds that of several common medical and mental disorders.

representative face-to-face interview survey of 36,309 adults residing in households and group quarters conducted by the National Institute on Alcoholism and Alcohol Abuse.[16] Multistage probability sampling was used to randomly select respondents. The household screener response rate was 72.0% with a person-level response rate of 84.0% to yield an overall response of 60.1%, comparable to other current US surveys.[17,18] The samples were weighted to adjust for nonresponse, selection of 1 person per household, and oversampling of young adults, Hispanics, and African Americans. After weighting, the data were adjusted to be representative of the US population for region, age, sex, race, and ethnicity.[19] Informed consent was recorded, and institutional review boards of the National Institutes of Health and Westat approved the survey procedures.

Study Samples

The analytic sample was restricted to persons aged ≥ 18 years who responded to the insomnia item (n = 34,712).

Assessments

Respondents were asked if they had problems falling or staying asleep in the last 12 months ("During the last 12 months did you have problems falling asleep or staying asleep?"). Those who responded affirmatively were further asked, "Did a doctor or other health professional tell you that you had problems falling asleep or staying asleep?" Insomnia was defined by a positive response to the first item, and clinically recognized insomnia was defined by a positive response to both items. A series of similarly structured questions were asked to ascertain several other common medical conditions in the past year. Obesity was defined as self-reported height and weight equal to a body mass index of ≥ 30.0. The Alcohol Use Disorder and Associated Disabilities Interview Schedule–*DSM-5* Version[20] was used to assess mental disorders including past year depressive disorders, anxiety disorders, mania, alcohol use disorder, and drug use disorder (excluding nicotine dependence) (Table 1).

From the Short Form-12 (SF-12), version 2,[22] a 6-dimensional health state classification (SF-6D) was derived to measure QALYs. The SF-6D covers physical functioning, role limitations, social functioning, pain, mental health, and vitality.[23] The SF-6D was developed from a UK general population valuation survey using standard gamble techniques to derive a utility-based algorithm.[23] The SF-6D has discriminative power across several medical conditions that resembles that of other brief preference-based measures,[24] predicts mortality,[25] and does not have significant ceiling effects in the general population.[26] In the analytic sample, the SF-6D had a mean score of 0.80 (SD = 0.15) and a range of 0.34 to 1.00.

Pain was assessed with an item from the SF-12[27] that measures the extent to which pain interfered with daily activities during the past month (not at all, a little bit, moderately, quite a bit, and extremely) and was collapsed into no or little interference ("no pain") or moderate to extreme interference ("pain").[28] A separate variable indexed

Table 1. AUDADIS Modules Used to Assess Mental Disorders and Survey Items Used to Assess Other Medical Conditions in NESARC-III[a]

Condition	Measure
Mental disorders	AUDADIS-5 Modules for *DSM-5*
Depressive disorders	Past-year *DSM-5* major depressive disorder or persistent depressive disorder
Anxiety disorders	Past-year *DSM-5* panic disorder, generalized anxiety disorder, social anxiety disorder, or specific phobia
Mania	Past-year *DSM-5* manic episode
Alcohol use disorder	Past-year *DSM-5* alcohol use disorder
Other medical conditions	Survey Items: During the last 12 months, did you have…
Diabetes mellitus	Diabetes or sugar diabetes?
Angina	Chest pain or angina?
Tachycardia	Rapid heartbeat or tachycardia?
Other cardiac diseases	(1) A heart attack or myocardial infarction? (2) Any other form of heart condition or heart disease?
Hypertension	High blood pressure or hypertension?
Peptic ulcer disease	A stomach ulcer?
Arthritis	Arthritis?
Pulmonary diseases	Lung problems like chronic bronchitis, emphysema, pneumonia, or influenza?
Cancer	(1) Liver cancer? (2) Breast cancer? (3) Cancer of the mouth, tongue, throat or esophagus? (4) Any other cancer?
Fibromyalgia	Fibromyalgia
Liver diseases	(1) Cirrhosis of the liver? (2) Any other form of liver disease?
Dyslipidemia	(1) High cholesterol? (2) High triglycerides?

[a]Based on source documentation of NESARC-III.[21] For other medical conditions with more than 1 item, a condition was coded present if any of the items were endorsed.

Abbreviations: AUDADIS-5 = Alcohol Use Disorder and Associated Disabilities Interview Schedule–*DSM-5* Version, NESARC-III = National Epidemiologic Survey on Alcohol and Related Conditions-III.

Table 2. Prevalence of Past-Year Insomnia and Clinically Recognized Insomnia Among Adults, Overall and Stratified by Sociodemographic Characteristics[a]

Group	Insomnia Prevalence in Total Population, %	Adjusted[b] OR (95% CI)	Clinically Recognized Insomnia Prevalence in Total Population, %	Adjusted[b] OR (95% CI)
Overall	27.3	NA	7.6	NA
Age, y				
18–29	20.8	1.00	3.6	1.00
30–44	24.4	1.22 (1.12 to 1.34)	6.0	1.72 (1.39 to 2.13)
45–64	31.7	1.67 (1.54 to 1.82)	9.7	2.81 (2.36 to 3.33)
65+	30.8	1.50 (1.39 to 1.63)	10.7	2.99 (2.50 to 3.59)
Sex				
Men	22.9	1.00	5.9	1.00
Women	31.3	1.55 (1.44 to 1.66)	9.2	1.59 (1.43 to 1.77)
Race/ethnicity				
Non-Hispanic, white	30.7	1.00	8.5	1.00
Non-Hispanic, black	19.9	0.57 (0.51 to 0.64)	6.0	0.75 (0.64 to 0.87)
Hispanic	20.6	0.63 (0.58 to 0.69)	5.6	0.76 (0.64 to 0.90)
Other	22.0	0.65 (0.58 to 0.73)	6.1	0.77 (0.64 to 0.92)
Marital status				
Married/cohabiting	26.6	1.00	7.2	1.00
Widowed/separated/divorced	33.3	1.26 (1.17 to 1.32)	11.9	1.48 (1.31 to 1.67)
Never married	23.7	1.21 (1.11 to 1.32)	4.8	1.05 (0.89 to 1.23)
Education, highest grade				
High school	25.6	0.99 (0.92 to 1.07)	8.0	1.37 (1.21 to 1.55)
Some college	28.4	1.10 (1.02 to 1.18)	8.1	1.41 (1.25 to 1.59)
College graduate	27.91	1.00	6.5	1.00
Employment				
Employed	24.2	1.00	5.2	1.00
Unemployed	31.6	1.42 (1.33 to 1.53)	11.1	2.22 (1.95 to 2.53)
Annual family income, $				
0–19,999	29.6	1.36 (1.25 to 1.47)	10.2	2.08 (1.82 to 2.38)
20,000–34,999	27.5	1.19 (1.08 to 1.30)	8.2	1.56 (1.35 to 1.79)
35,000–69,999	26.0	1.05 (0.97 to 1.14)	6.7	1.20 (1.04 to 1.38)
70,000+	26.6	1.00	6.1	1.00

[a]Data from NESARC-III.[16] Results are based on weighted sampling. Data for 34,712 individuals were included in the overall analysis.
[b]Adjusted for age, sex, and race/ethnicity.
Abbreviations: NA = not applicable, NESARC-III = National Epidemiologic Survey on Alcohol and Related Conditions-III, OR = odds ratio.

the presence or absence of at least 1 past-year stressful life event (fired/laid off from work, unemployed/looking for work, financial crisis, death of loved one, or problems with neighbor).[29]

Statistical Analysis

Proportions of respondents with past-year insomnia were computed overall and stratified by sociodemographic subgroups. Logistic regressions controlled for age, sex, and race/ethnicity assessed associations of each sociodemographic variable and each medical condition with insomnia and with recognized insomnia.

Age-, sex-, and race/ethnicity–adjusted linear regressions assessed differences in mean QALY scores for respondents with and without insomnia. Total population–level annual QALYs lost from insomnia were estimated by multiplying the adjusted mean QALY difference by the national estimate of number of adults with insomnia. Corresponding calculations were performed for each mental and medical condition.

To assess the incremental confounding effects of pain interference, this covariate was added to the medical condition models, and the percentages of reduction in the adjusted odds ratio of insomnia were determined. Similar models assessed confounding of stressful life events and any mental disorder on associations between each medical condition and insomnia. Bootstrapping was used to obtain 95% confidence intervals.

Statistical analyses were performed with SAS or SUDAAN 11.0 software to accommodate the complex sample design and weighting of observations.

RESULTS

Sociodemographic Correlates of Insomnia

In the adult population, 27.3% reported insomnia in the last year (Table 2). Insomnia was more commonly reported by women than men, older than younger adults, and people who were non-Hispanic white than other racial/ethnic groups. The adjusted odds of insomnia were also increased among adults who were unemployed, had a lower family income, and were not currently married or cohabiting.

A minority of adults with insomnia (27.8%, or 7.6% of the overall adult population) reported clinically recognized insomnia. Associations of sociodemographic characteristics with clinically recognized insomnia generally resembled those observed in the larger group of adults with insomnia. Specifically, the likelihood of clinically recognized insomnia was increased for adults who were older, female, or

Table 3. Prevalence, Mean QALY Scores, and Estimated QALY Loss Associated With Insomnia and Other Common Medical Conditions[a]

Medical Condition	Prevalence Of Condition, %	Mean QALY With Condition	Mean QALY Without Condition	Mean QALY Loss[b]	Estimated Population QALY Loss[b] (95% CI)
Insomnia	27.3	0.72	0.81	0.09	5,597,700 (5,331,500 to 5,864,00)
Mental disorders, past year					
Depressive disorder	12.6	0.67	0.80	0.14	4,023,000 (3,871,700 to 4,174,300)
Anxiety disorder	13.1	0.70	0.80	0.10	3,221,500 (3,026,000 to 3,417,000)
Alcohol use disorder	13.9	0.74	0.79	0.05	1,584,600 (1,417,900 to 1,751,300)
Drug use disorder	3.9	0.67	0.79	0.11	984,900 (906,100 to 1,063,600)
Mania	1.4	0.64	0.79	0.14	463,200 (416,600 to 509,900)
Other medical conditions					
Arthritis	22.0	0.70	0.81	0.10	4,941,000 (4,622,600 to 5,259,500)
Hypertension	25.5	0.74	0.80	0.06	3,625,400 (3,316,100 to 3,934,700)
Dyslipidemia	21.5	0.75	0.80	0.04	2,129,100 (1,903,300 to 2,355,000)
Obesity	29.8	0.76	0.80	0.04	2,504,200 (2,254,100 to 2,754,200)
Angina	7.3	0.68	0.80	0.12	2,124,900 (1,976,00 to 2,273,80)
Tachycardia	7.1	0.68	0.79	0.11	1,874,400 (1,719,700 to 2,029,100)
Pulmonary diseases	5.6	0.69	0.79	0.11	1,417,800 (1,290,400 to 1,545,200)
Diabetes mellitus	9.4	0.73	0.79	0.06	1,379,000 (1,233,800 to 1,524,200)
Other cardiac diseases	5.5	0.69	0.79	0.09	1,148,200 (1,030,000 to 1,266,400)
Fibromyalgia	2.3	0.62	0.79	0.17	896,000 (822,800 to 969,300)
Cancer	4.3	0.70	0.79	0.05	533,000 (414,100 to 651,900)
Peptic ulcer disease	2.8	0.69	0.79	0.11	702,200 (619,800 to 784,500)
Liver diseases	1.4	0.69	0.79	0.10	341,600 (280,900 to 402,300)

[a]Data from NESARC-III.[16] Data for 34,712 individuals were included in the analyses.
[b]Mean QALY loss and estimated population QALY loss are adjusted for age, sex, and race/ethnicity.
Abbreviations: NESARC-III = National Epidemiologic Survey on Alcohol and Related Conditions-III, QALY = quality-adjusted life-year.

non-Hispanic white; had a lower level of formal education; were unemployed; or had a lower family income. As compared to adults aged 18 to 29 years, those who were aged ≥ 65 years had nearly 3 times the adjusted odds of reporting clinically recognized insomnia (Table 2).

Insomnia and Quality of Life

The national public health burden of insomnia was estimated by deriving the mean loss of QALYs associated with insomnia adjusted for age, sex, and race/ethnicity and multiplying this QALY decrement by the number of US adults with insomnia. For example, the mean individual adjusted QALY loss associated with insomnia (0.09) when multiplied by the estimated 27.3% of US adults with insomnia (62,189,000) yielded an estimated population loss of 5,597,700 QALYs (Table 3). The QALY loss associated with adults with insomnia (5.60 million; 95% CI, 5.33–5.86 million) was significantly larger than the corresponding loss associated with adults with every other condition examined. Other conditions with large annual estimated population QALY losses included arthritis (4.94 million; 95% CI, 4.62–5.26 million), depression (4.02 million; 95% CI, 3.87–4.17 million), hypertension (3.63 million; 95% CI, 3.32–3.93 million), and anxiety disorders (3.22 million; 95% CI, 3.03–3.42 million).

Clinical Correlates of Insomnia

Insomnia was reported by nearly two-thirds of adults with fibromyalgia (62.5%) or mania (62.1%) and a slightly lower proportion of those with tachycardia (57.8%) or angina (56.5%) (Table 4). After control for age, sex, and race/ethnicity, each medical condition was associated with significantly increased risk of insomnia, with odds ratios ranging from 5.04 (mania) to 1.25 (obesity) (Table 4, Supplementary Table 1). After further control for the potentially confounding effects of pain, the odds of the co-occurrence of insomnia with fibromyalgia decreased by 31.8% (Table 4). In corresponding analyses, confounding by pain was associated with a decrease in risk of insomnia comorbid with arthritis (20.1%), liver diseases (19.0%), and peptic ulcer disease (18.7%). By contrast, confounding by pain was not associated with a significant change in the odds of insomnia comorbid with alcohol use disorders.

Controlling for potential confounding effects of stressful life events was associated with reductions in the odds of insomnia comorbid with mental disorders, particularly mania (13.4%) and drug use disorders (11.2%). The effects of confounding stressful life events on co-occurrence of insomnia tended to be smaller for the other medical conditions. Stressful life events did not significantly confound associations of insomnia with cancer or liver diseases. The effects of confounding by mental disorders on the risk of insomnia in other medical conditions were most evident for peptic ulcer disease (11.2%), angina (10.2%), liver disease (11.1%), and tachycardia (9.6%) and were not significant for cancer, obesity, or diabetes mellitus (Table 4).

DISCUSSION

Approximately one-quarter of adults (27.3%) in the United States reported problems falling asleep or staying asleep in the last 12 months. Nearly three-quarters of these individuals reported that their insomnia was not recognized by a health care professional. The annual national health

Table 4. Prevalence of Past-Year Insomnia Among Adults Stratified by Common Medical Conditions and Reductions in Insomnia Risk Associated With Pain, Stressful Life Events, and Mental Disorder Confounding[a]

	Insomnia Prevalence		Reduction With Confounding by Pain		Reduction With Confounding by Stressful Life Events		Reduction With Confounding by Mental Disorders	
Medical Condition	%	aOR[b]	%	95% CI[c]	%	95% CI[d]	%	95% CI[e]
Mental disorders								
Depressive disorder	52.7	3.64	12.4	11.0 to 13.7	8.0	7.0 to 9.1		NA
Anxiety disorder	51.7	3.31	11.0	9.9 to 12.1	6.4	5.3 to 7.5		NA
Mania	62.1	5.04	15.3	12.0 to 18.7	13.4	10.9 to 16.0		NA
Alcohol use disorder	34.6	1.91	1.2	−0.3 to 2.7	7.6	6.4 to 8.8		NA
Drug use disorder	44.4	2.87	13.4	10.9 to 15.9	11.2	9.6 to 12.9		NA
Other medical conditions								
Diabetes mellitus	33.8	1.31	13.5	11.6 to 15.5	2.3	0.8 to 3.8	−0.2	−2.2 to 1.8
Angina	56.5	3.84	17.6	15.7 to 19.6	6.1	4.8 to 7.4	10.2	8.3 to 12.1
Tachycardia	57.8	3.75	14.9	13.1 to 16.8	6.0	4.8 to 7.3	9.6	7.2 to 12.0
Other cardiac diseases	44.5	2.01	15.4	13.1 to 17.7	5.6	4.0 to 7.1	3.6	1.1 to 6.0
Hypertension	35.8	1.65	12.1	10.6 to 13.7	2.5	1.7 to 3.3	1.6	0.2 to 3.0
Peptic ulcer disease	51.9	2.90	18.7	15.6 to 21.8	5.0	3.0 to 7.1	11.2	8.2 to 14.1
Arthritis	42.8	2.36	20.1	18.2 to 22.0	3.3	2.4 to 4.1	2.5	0.8 to 4.2
Pulmonary diseases	46.4	2.15	17.6	14.8 to 20.3	4.9	3.5 to 6.3	7.3	5.1 to 9.4
Obesity	30.6	1.25	9.3	7.9 to 10.7	2.4	1.7 to 3.0	−0.5	−1.7 to 0.8
Cancer	37.7	1.37	9.0	5.7 to 12.4	1.4	−0.5 to 3.4	1.5	−0.9 to 3.8
Fibromyalgia	62.5	3.60	31.8	28.7 to 35.0	4.6	2.1 to 7.1	7.7	3.5 to 11.9
Liver diseases	46.8	2.28	19.0	14.8 to 23.2	3.0	−0.2 to 6.1	11.1	6.1 to 16.0
Dyslipidemia	37.2	1.65	7.2	5.7 to 8.7	2.0	1.2 to 2.7	1.8	0.3 to 3.3

[a]Data from NESARC-III.[16] Results are based on weighted sampling. Data for 34,712 individuals were included in the analyses.
[b]Adjusted for age, sex, race/ethnicity.
[c]Adjusted for age, sex, race/ethnicity, and pain.
[d]Adjusted for age, sex, race/ethnicity, and stressful life events.
[e]Adjusted for age, sex, race/ethnicity, and mental disorders.
Abbreviations: aOR = adjusted odds ratio, NA = not applicable, NESARC-III = National Epidemiologic Survey on Alcohol and Related Conditions-III.

burden associated with insomnia, a loss of approximately 5.6 million quality-of-life years, exceeded the burden associated with each of the other medical conditions examined. The risk of insomnia was related to several medical conditions, particularly fibromyalgia, peptic ulcer disease, cardiac symptoms and diseases, mood disorders, and anxiety disorders. Insomnia comorbidity with the medical conditions was more strongly linked to pain than to stressful life events or mental disorders. These findings highlight the considerable degree to which insomnia adversely affects the lives of US adults, particularly those with common medical conditions, and the extent to which it remains unrecognized and presumably untreated by health care professionals.

The public health burden associated with insomnia, as measured by population QALY loss, exceeded the burden associated with several common medical conditions. This toll was carried by the high prevalence of insomnia combined with a modest individual level–associated loss in self-rated quality of life. At the individual level, 4 of 5 mental disorders and 7 of 13 general medical conditions were associated with numerically greater individual mean QALY losses.

These findings underscore the overall impact of insomnia on self-assessed health. Although the defining symptoms of insomnia are nocturnal complaints, insomnia can result in daytime impairments and distress over daytime functioning related to drowsiness, tiredness, decreased vitality, and diminished physical role functioning.[30,31] Insomnia-related cognitive deficits in attention, concentration, or memory[32] may also lower daily function and perceptions of quality of life. In addition, adverse effects of insomnia on occupational productivity[33] and absenteeism[34] as well as increased risks of accidents[35] might diminish self-assessed quality of life.

Population prevalence estimates of insomnia vary widely with its definition. The US general population estimate of insomnia from the present study (27.3%) is consistent with several prior general population estimates from outside the United States indicating that between 23% and 37% of adults have least 1 nocturnal symptom of insomnia.[36–41] A substantially smaller percentage of adults report daytime fatigue or other daytime impairments[42–44] or meet all criteria for *DSM* sleep disorders.[45,46] A lower previously reported US national estimate from the 2002 National Health Interview Survey (NHIS) (17.4%)[1] was based on whether respondents "regularly had insomnia or trouble sleeping" during the last year, which may be a narrower definition than the item used in the NESARC-III. The 2001–2003 National Comorbidity Survey Replication (n = 5,692)[47] estimated that 36.3% of US adults had any of 4 sleep problems in the past year: difficulty initiating sleep, difficulty maintaining sleep, early morning awakening, or non-restorative sleep.

Consistent with prior research, female sex,[48] older adult age,[49] and lower socioeconomic status[50,51] as measured by education, employment, and income were each associated with increased risk of insomnia. The group with clinically unrecognized insomnia also included a preponderance of women, older adults, unemployed individuals, and those

with lower incomes. Prior research from Canada[46] indicates that only a minority of adults with insomnia seek health care consultations specifically for their sleep symptoms. However, discussions of sleep problems may occur more commonly in the course of visits focused on other medical conditions.[52] In this context, complaints of sleep problems can be easily overshadowed by other medical problems. A lower prevalence of insomnia among Hispanic and black than among white adults, which is consistent with the 2002 NHIS results,[1] may help to account for lower rates of prescribed hypnotics to black and Hispanic than to white patients.[53,54]

Strong correlations were evident between insomnia and several medical conditions, particularly angina, tachycardia, and fibromyalgia, and between insomnia and mental disorders, particularly mania, depression, and anxiety disorders. High rates of comorbid insomnia with common medical conditions and mental disorders help to explain why insomnia is so prevalent in primary care and specialty health care settings. The extent to which these comorbidities are confounded by pain and to a lesser degree by mental disorders and stressful life events may offer clues to assessment and management of comorbid insomnia in clinical practice. The persistent course of some medical conditions may also interfere with successful treatment of insomnia.

Pain accounted for a substantial proportion of the comorbidity of insomnia with fibromyalgia and a modest proportion of the comorbidity of insomnia with peptic ulcer disease, angina, and arthritis. In these clinical situations, careful clinical assessment may reveal that insomnia is related to incomplete control of pain associated with a primary medical condition. For these patients, improving the management of the underlying medical condition may help to relieve symptoms of insomnia. The co-occurrence of mental disorders tended to have only a weak or insignificant relationship with the co-occurrence of insomnia and several medical conditions, though modest confounding was evident with angina, tachycardia, peptic ulcer, and liver diseases. A careful mental health assessment may be particularly important in the evaluation of insomnia when it occurs in the setting of these medical conditions.

Stressful life events were not strong confounders of insomnia comorbid with several medical conditions. Although prospective research indicates that stressful life events increase vulnerability to incident and persistent insomnia,[43,55] these risks may not be differentially associated with the medical conditions in this study. Stressful life events were, however, more strongly related to insomnia comorbid with some of the mental disorders, particularly mania. Because past-year interpersonal and financial stressful events have been associated with an increased risk of incident and recurrent mania[56] and because sleep disturbances are central to manic episodes,[57] it is not surprising that stressful life events partially accounted for the high risk of insomnia among people with manic episodes. Insomnia is often an early warning sign of an impending manic episode.

Improving the management of insomnia offers opportunities to reduce its public health burden. Brief validated screening tools exist to detect and assess insomnia.[58,59] Substantial empirical evidence also supports the sustained efficacy of cognitive-behavioral therapy for insomnia delivered either in person[60] or over the Internet[61] to reduce insomnia severity and improve sleep quality, sleep onset latency, and overall sleep time. Brief behavioral therapy for insomnia, delivered in 4 weekly sessions by paraprofessionals, has also yielded promising results in older adults with chronic insomnia.[62]

This study has several limitations. First, because the survey measures of medical conditions relied on self-report rather than independent medical evaluations, surveillance bias is possible. Second, insomnia was assessed with a single item that very likely captured a wide range of sleep disturbances and limits comparisons with prior related epidemiologic research. A narrower definition of the insomnia syndrome analogous to the formal anxiety and depression diagnoses would have yielded a lower estimate of population QALY losses associated with insomnia. In a Canadian epidemiologic study,[46] for example, 19.8% of adults reported that they were dissatisfied with their sleep in the past month, but only 13.4% reported full criteria for an insomnia syndrome with daytime consequences or significant distress. Third, the NESARC-III is a cross-sectional survey, which is not designed to make temporal or causal inferences about associations. Longitudinal research, for example, provides evidence that insomnia is a risk factor for cardiovascular disease,[63] while high rates of insomnia have been reported following myocardial infarction.[64] Fourth, the estimated population-level QALY losses associated with insomnia and with other selected medical conditions were not adjusted for other comorbid medical conditions. Adjusting these analyses for other comorbid conditions would have most likely decreased the QALY loss estimates. Adjusting for other co-occurring medical conditions might also have affected associations of pain, stressful life events, and mental disorders with insomnia. Fifth, NESARC-III does not survey homeless or incarcerated adults, who may have high rates of insomnia.[65,66] Finally, some groups of relevance to the epidemiology of insomnia, such as shift workers and first-degree family members of individuals with insomnia,[67] could not be identified in the survey.

Despite the considerable health burden of insomnia, it is often not recognized by health care professionals. A vulnerability to insomnia is concentrated among people with common medical conditions, and pain meaningfully contributes to the risk of insomnia in several of these conditions. General prevention approaches, such as maintaining a regular sleep schedule, reducing intake of stimulants, and lowering the noise level in the sleeping environment, would very likely have a significant impact on insomnia risk in the general population. Within clinical populations, attention should further be given to disorder-specific clinical considerations that may increase vulnerability to insomnia.

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Supplementary Material

Article Title: Insomnia and Impaired Quality of Life in the United States

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List of Supplementary Material for the article

1. **Table 1** Prevalence of past year insomnia among adults stratified by general medical and mental health conditions and reductions in insomnia risk associated with pain, stressful life events, and mental disorder confounding

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Supplementary Table 1: Prevalence of past year insomnia among adults stratified by general medical and mental health conditions and reductions in insomnia risk associated with pain, stressful life events, and mental disorder confounding

Conditions	Insomnia Prevalence %	AOR (95% CI)		% Reduction with Pain Confounding (95%CI)[C]		% Reduction with Stressful Life Events Confounding (95%CI)[C]		% Reduction with Mental Disorders Confounding (95%CI)[D]	
Mental disorders									
Depressive disorder	52.7	3.64	3.35-3.95	12.4	11.0-13.7	8.0	7.0-9.1	N/A	
Anxiety use disorder	51.7	3.31	3.02-3.63	11.0	9.9-12.1	6.4	5.3-7.5	N/A	
Mania	62.1	5.04	4.07-6.23	15.3	12.0-18.7	13.4	10.9-16.0	N/A	
Alcohol use disorder	34.6	1.91	1.75-2.10	1.2	-0.3-2.7	7.6	6.4-8.8	N/A	
Drug use disorder	44.4	2.87	2.52-3.27	13.4	10.9-15.9	11.2	9.6-12.9	N/A	
Medical conditions									
Diabetes mellitus	33.8	1.31	1.19-1.44	13.5	11.6-15.5	2.3	0.8-3.8	-0.2	-2.2-1.8
Angina	56.5	3.84	3.48-4.25	17.6	15.7-19.6	6.1	4.8-7.4	10.2	8.3-12.1
Tachycardia	57.8	3.75	3.32-4.23	14.9	13.1-16.8	6.0	4.8-7.3	9.6	7.2-12.0
Other cardiac diseases	44.5	2.01	1.77-2.29	15.4	13.1-17.7	5.6	4.0-7.1	3.6	1.1-6.0
Hypertension	35.8	1.65	1.53-1.78	12.1	10.6-13.7	2.5	1.7-3.3	1.6	0.2-3.0
Peptic ulcer disease	51.9	2.90	2.45-3.43	18.7	15.6-21.8	5.0	3.0-7.1	11.2	8.2-14.1
Arthritis	42.8	2.36	2.18-2.55	20.1	18.2-22.0	3.3	2.4-4.1	2.5	0.8-4.2
Pulmonary diseases	46.4	2.15	1.89-2.45	17.6	14.8-20.3	4.9	3.5-6.3	7.3	5.1-9.4
Obesity	30.6	1.25	1.18-1.33	9.3	7.9-10.7	2.4	1.7-3.0	-0.5	-1.7-0.8
Cancer	37.7	1.37	1.20-1.57	9.0	5.7-12.4	1.4	-0.5-3.4	1.5	-0.9-3.8
Fibromyalgia	62.5	3.60	2.95-4.40	31.8	28.7-35.0	4.6	2.1-7.1	7.7	3.5-11.9
Liver diseases	46.8	2.28	1.85-2.81	19.0	14.8-23.2	3.0	-0.2-6.1	11.1	6.1-16.0
Dyslipidemia	37.2	1.65	1.52-1.78	7.2	5.7-8.7	2.0	1.2-2.7	1.8	0.3-3.3

Data from NESARC-III. Results are based on weighted sampling. AOR denotes adjusted odds ratio.
[A]Adjusted for age, sex, race/ethnicity
[B]Adjusted for age, sex, race/ethnicity, and pain
[C]Adjusted for age, sex, race/ethnicity, and stressful life events
[D]Adjusted for age, sex, race/ethnicity, and mental disorders