Sleep Disturbances in Adults With Arthritis: Prevalence, Mediators, and Subgroups at Greatest Risk. Data From the 2007 National Health Interview Survey

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Abstract

Objective—To examine the prevalence of sleep disturbances in adults with arthritis in a nationally representative sample, mediators of sleep difficulties, and subgroups of individuals with arthritis at greatest risk.

Methods—Using data on US adults ages 18 years participating in the 2007 National Health Interview Survey, we computed the prevalence of 3 measures of sleep disturbance (insomnia, excessive daytime sleepiness, and sleep duration <6 hours) among persons with arthritis. We used logistic regression analysis to examine if the association of arthritis and sleep disturbances was independent of sociodemographic characteristics and comorbidities, and to identify potential mediators. We used classification trees to identify subgroups at higher risk.

Results—The adjusted prevalence of insomnia was higher among adults with arthritis than those without arthritis (23.1% versus 16.4%; $P < 0.0001$), but was similar to those with other chronic diseases. Adults with arthritis were more likely than those without arthritis to report insomnia (unadjusted odds ratio 2.92, 95% confidence interval 2.68 –3.17), but adjustment for sociodemographic characteristics and comorbidities attenuated this association. Joint pain and limitation due to pain mediated the association between arthritis and insomnia. Among adults with arthritis, those with depression and anxiety were at highest risk for sleep disturbance. Results for excessive daytime sleepiness and sleep duration <6 hours were similar.

Conclusion—Sleep disturbance affects up to 10.2 million US adults with arthritis, and is mediated by joint pain and limitation due to pain. Among individuals with arthritis, those with depression and anxiety are at greatest risk.

INTRODUCTION

Sleep disturbance is a common condition that has major influences on quality of life, vocational performance, morbidity, and health care use (1–3). Health conditions, and especially pain and psychological distress, are important contributors to sleep difficulties (4,5). Given the high prevalence of pain in patients with arthritis, we might anticipate that the risk of sleep disturbance would be high in patients with arthritis. Indeed, in the few studies conducted to date, patients with arthritis were found to report sleep disturbances more frequently than those without arthritis (6 –10). However, most of these studies were small, used different methods to assess sleep disturbance, or focused mainly on patients with inflammatory arthritis and especially rheumatoid arthritis (RA). Because inflammatory arthritis affects only a minority of the population, and may have different effects on sleep than noninflammatory arthritis, these studies do not inform us about the extent of sleep disturbances in most individuals with arthritis in the general population.

With the exception of a study using the 2000/2001 Canadian Community Health Survey (11), which reported an increased prevalence of sleep difficulties in adults with arthritis, no information about how arthritis may affect sleep quality in the general population has been published. In addition, it is not known if the prevalence of sleep disturbance among adults with arthritis differs from that of persons with other chronic diseases, and if the risk of sleep disturbances varies among subgroups of individuals with arthritis. To address these questions, we used data from the National Health Interview Survey (NHIS) for 2007, which is the largest US survey that included questions about both sleep disturbances and arthritis. The measures of sleep disturbance examined included insomnia, short sleep duration (less than 6 hours per night), and excessive daytime sleepiness.

The goals of this study were to examine the prevalence of these 3 sleep disturbances in adults with arthritis in a nationally representative sample and to compare these prevalences with those of persons with other chronic diseases, to evaluate if the associations between arthritis and sleep disturbances are independent of sociodemographic characteristics and other chronic health conditions, to examine mediators of the association between arthritis and sleep difficulties, and to identify subgroups of adults with arthritis most at risk for sleep disturbances.

MATERIALS AND METHODS

Data source

We used data from the 2007 NHIS, a national population-based survey of the health of civilian, noninstitutionalized US residents (12). Interviews were conducted in person in English and Spanish. In the family core component, information was collected on sociodemographic characteristics, health status, and conditions for all members of the household. In the sample adult core component, one adult household member was randomly selected to provide more detailed personal health information.

Study sample

Among the 29,266 households sampled, 29,875 adults ages 18 years were eligible for interview. Blacks, Hispanics, and Asians were oversampled, as were adults ages 65 years. Of those eligible in the sample adult core, 23,393 adults were interviewed, yielding a conditional response rate of 78.3% and a final response rate of 67.8% (13). We excluded persons with self-reported physician-diagnosed fibromyalgia (n = 259) because fibromyalgia is a generalized pain syndrome rather than arthritis, and including persons with fibromyalgia may have resulted in an overestimation of sleep disturbance in persons with arthritis, given

its strong association with sleep abnormalities (14). The final sample consisted of 23,134 adults.

Dependent variables

Sleep disturbance was assessed by the following 3 questions: 1) "During the past 12 months, have you regularly had insomnia or trouble sleeping?" 2) "During the past 12 months, have you regularly had excessive sleepiness during the day?" and 3) "On average, how many hours of sleep do you get in a 24-hour period?" Insomnia and excessive daytime sleepiness were coded as present or absent, while sleep duration was categorized as either <6 hours or 6 hours. Less than 6 hours of sleep was chosen as the outcome because it is associated with increased morbidity and mortality (15,16).

Arthritis and other independent variables

Arthritis, along with the other health conditions assessed in the NHIS, was based on the participants' self-report of having ever been told by a doctor that they have the condition. Self-reports of arthritis have been reported to have sufficient validity for surveillance purposes (17).

Included as sociodemographic characteristics were age, sex, race/ethnicity, education, employment status, and marital status. Age was grouped into 7 levels: 18–29, 30–39, 40–49, 50–59, 60–69, 70–79, and 80 years. Self-reported race/ethnicity consisted of non-Hispanic white, non-Hispanic black, Hispanic, non-Hispanic Asian, and non-Hispanic other race. Education was represented as the highest level of school completed: less than high school diploma, high school diploma, some college without degree, or college degree or higher. Employment status was categorized as currently working, retired, formerly worked, or never worked. Marital status was represented as married or living with a partner, widowed, divorced or separated, or never married.

Health behaviors were represented by smoking status (current, former, or never smoker) and alcohol use (current, former, or never drinker). Self-reported exercise (which we expressed as total minutes per week of vigorous or light to moderate leisure-time physical activity) was weakly correlated with insomnia ($r = -0.03$), excessive daytime sleepiness ($r = -0.04$), and short sleep duration ($r = -0.01$), and not included in the analyses. We included as comorbid conditions hypertension, cardiac disease (coronary heart disease, myocardial infarction, or heart condition/disease), stroke, chronic obstructive pulmonary disease (COPD; chronic bronchitis or emphysema), asthma, upper gastrointestinal (GI) tract disease (ulcer or acid reflux/heartburn), urinary or prostate problems, diabetes mellitus, cancer, depression (during the past 12 months), or anxiety (during the past 12 months) because they have been reported to be associated with sleep disturbance (18,19). Body mass index (BMI) was categorized according to the World Health Organization classification of underweight, normal weight, overweight, and obese: <18.5, 18.5–24.9, 25.0–29.9, and 30.0 kg/m^2, respectively (20).

We also included two variables denoting arthritis symptoms: joint symptoms (presence of pain, aching, or stiffness in or around a joint during the past 30 days) and current physical limitations due to joint symptoms. Joint symptoms hereafter are termed "joint pain," and current physical limitations due to joint symptoms are termed "limitations due to joint pain."

Statistical analysis

All of the analyses used sampling weights and procedures to account for the multistage clustered sample design of the NHIS. Since 2003, weights for the NHIS to generate national estimates are based on the 2000 Census projected population for each year. For 2007, the civilian, noninstitutionalized population of adults ages 18 years was estimated to be

223,181,000 (13). We used unpaired *t*-tests to compare continuous variables by arthritis status, and used the chi-square statistic to compare categorical variables. Crude and age-, sex-, race-, and disease-adjusted prevalences of the 3 types of sleep disturbance were estimated for persons with arthritis. Prevalences were standardized to the age, sex, and race distribution of the overall study population. Prevalences of sleep disturbance for persons with arthritis were also disease adjusted, taking into consideration the comorbid conditions assessed in the logistic regression models. To determine if the adjusted prevalences among persons with arthritis differed from those of persons with other chronic diseases, we also computed adjusted prevalences for persons with diabetes mellitus, asthma, hypertension, cardiac disease, and upper GI tract disease.

We used logistic regression models to test the association between arthritis (independent variable) and the presence of sleep disturbance (insomnia, excessive daytime sleepiness, and short sleep duration as separate dependent variables). In the first model, we assessed the association of arthritis and insomnia in a univariate analysis. To test if this association was independent of other factors, we initially adjusted for sociodemographic characteristics and health behaviors (age, sex, race/ethnicity, marital status, education, employment status, smoking status, and alcohol status) in the second model. In the third model, we added comorbid conditions (BMI, hypertension, cardiac disease, stroke, COPD, asthma, upper GI tract disease, urinary/prostate problems, diabetes mellitus, cancer, depression, and anxiety). In the fourth model, we additionally adjusted for joint pain and limitations due to joint pain. We repeated this analysis for the other two measures of sleep disturbance (excessive daytime sleepiness and sleep duration <6 hours). Odds ratios (ORs) and 95% confidence intervals (95% CIs) were computed for each of the covariates in the regression models. All of the analyses were 2-tailed, with a significance level set at *P* values less than or equal to 0.05. SAS, version 9.2 (SAS Institute), was used for the analyses.

We used classification tree analysis, a recursive partitioning statistical technique, to identify subgroups of individuals with arthritis at highest and lowest risk for sleep disturbances (21). This procedure iteratively tests independent variables to identify subgroups that are increasingly pure with respect to the outcome (e.g., insomnia). The independent variables tested were sociodemographic characteristics and comorbid conditions, as were used in the regression analyses. R, version 2.11.0, was used for the analysis.

RESULTS

Characteristics of the sample

The mean ± SEM age of the sample was 45.7 ± 0.2 years (range 18 – 85 years), with the age group of 18 –29 years comprising the largest proportion (22.3%) (Table 1). The sample included more women (51.2%), non-Hispanic whites (69.1%), and those who had attended at least some college (55.4%).

In the sample of 23,134 persons ages ≥ 18 years, 19.9% (representing 44.3 million civilian, noninstitutionalized US adults) reported having physician-diagnosed arthritis. Persons with arthritis were older than those without arthritis (mean ± SEM age 59.6 ± 0.3 years versus 42.2 ± 0.2 years; *P* < 0.0001); were more likely women (58.0% versus 49.5%), non-Hispanic white (79.1% versus 66.7%), overweight or obese (71.8% versus 58.7%), and current or former smokers (52.8% versus 38.3%); had a comorbid condition such as hypertension (53.7% versus 20.3%); had joint pain (69.8% versus 16.3%); and had limitations due to joint pain (42.8% versus 3.7%).

Prevalence of sleep disturbance in arthritis and other chronic health conditions

Crude prevalences of sleep disturbance were higher among persons with arthritis than those without arthritis for insomnia (32.1% versus 13.9%; $P < 0.0001$), excessive daytime sleepiness (17.5% versus 7.9%), and sleep duration <6 hours (10.7% versus 6.3%). Among persons with arthritis reporting insomnia, 35.6% reported also having excessive daytime sleepiness, 21.0% reported also having sleep duration <6 hours, and 8.0% reported having all 3 types of sleep disturbance.

Age-, sex-, race-, and disease-adjusted prevalences of sleep disturbance among adults with arthritis were 23.1% (10.2 million) for insomnia, 11.0% (4.9 million) for excessive daytime sleepiness, and 7.3% (3.5 million) for sleep duration <6 hours. Adjusted prevalences of sleep disturbance in persons with other health conditions such as diabetes mellitus and cardiac disease were generally similar to those of persons with arthritis (Figure 1).

Association of arthritis and sleep disturbance

In univariate logistic regression analysis, persons with arthritis were significantly more likely to report insomnia than persons without arthritis (unadjusted OR 2.92, 95% CI 2.68 – 3.17) (Table 2). Adjustment for sociodemographic characteristics and health behaviors attenuated the association between arthritis and insomnia. Adjustment for comorbid conditions further attenuated this association, but arthritis remained associated with insomnia (adjusted OR 1.53, 95% CI 1.36 –1.71). In the final model, addition of the covariates joint pain and limitation due to joint pain attenuated the association between arthritis and insomnia, such that the association was no longer significant (adjusted OR 1.06, 95% CI 0.93–1.21). Persons with joint pain were more likely than those without joint pain to report insomnia, and persons with limitations due to joint pain were more likely than those without limitations due to joint pain to report insomnia. These findings suggest that joint pain largely mediates the association between arthritis and insomnia.

In addition to joint pain and limitations due to joint pain, insomnia was associated with increasing age, attaining a peak among persons ages 40 – 49 years. Women were more likely than men to report insomnia, and non-Hispanic blacks were less likely than non-Hispanic whites to report insomnia. Persons who were either divorced/separated or never married were more likely than those who were married to report insomnia. The likelihood of reporting insomnia was inversely associated with education level. Current cigarette smoking, current alcohol use, and former alcohol use were significantly associated with insomnia. Among the comorbid conditions, depression and anxiety were most strongly associated with insomnia (adjusted OR 2.94, 95% CI 2.55–3.39 and adjusted OR 2.90, 95% CI 2.51–3.36, respectively).

Similar associations were present between arthritis and excessive daytime sleepiness (Table 3). In univariate analysis, arthritis was strongly associated with excessive daytime sleepiness, and this association was attenuated but remained significant after adjustment for sociodemographic characteristics, health behaviors, and comorbid conditions. However, adjustment for joint pain and limitation due to joint pain resulted in a nonsignificant association between arthritis and excessive daytime sleepiness. Depression, anxiety, joint pain, and limitation due to joint pain were all strongly associated with excessive daytime sleepiness.

Associations between arthritis and sleep duration <6 hours were also closely similar to those for insomnia and excessive daytime sleepiness (Table 4). In univariate regression analysis, arthritis was significantly associated with a short sleep duration, but was no longer significantly associated after adjustment for joint pain and limitation due to joint pain in the final model. Depression and anxiety were again associated with risk of short sleep duration.

Subgroups of persons with arthritis at high risk for sleep disturbance

Among persons with arthritis, the prevalence of insomnia varied most by the presence or absence of depression, anxiety, employment status, upper GI tract disease, limitation due to joint pain, and smoking status in the classification tree analysis (Figure 2A). Among persons with both depression and anxiety and who formerly worked or never worked, 80.1% reported insomnia. Persons with depression, without anxiety, with limitation due to joint pain, and currently smoking also had a high prevalence of insomnia (76.8%). In contrast, the subgroup without depression had a much lower prevalence of insomnia (24.9%).

For excessive daytime sleepiness, depression, anxiety, and upper GI tract disease were most predictive of sleep disturbance (Figure 2B). The subgroup with the highest risk was persons with both depression and upper GI tract disease (48.1%).

Only depression was found to differentiate subgroups with different prevalences of sleep duration <6 hours. Approximately 20% of persons with depression reported a sleep duration <6 hours, compared to 8.5% of those without depression.

DISCUSSION

In this study, 1 in 5 participants, representing 44.3 million civilian, noninstitutionalized US adults, has arthritis diagnosed by a doctor, and by 2030, the number of people affected is projected to increase by 40% (22). Arthritis may substantially reduce the quality of sleep with multiple consequences. Our study of a recent nationally representative sample demonstrated that adults with arthritis have a higher prevalence of sleep disturbances than individuals without arthritis, with insomnia affecting 10.2 million adults with arthritis. Joint pain and physical limitation due to pain were identified as important mediators, indicating that the presence of symptoms was a more important correlate of sleep disturbance than the diagnostic label of arthritis.

Our results are consistent with previous studies that reported that sleep disturbances are prevalent among patients with arthritis (6 –11,23). Most studies included small samples and were focused on inflammatory arthritis, which represents a small proportion of the population with arthritis. Studies of patients with osteoarthritis showed that sleep problems were also common among these patients and correlated with pain, poor physical functioning, depression, or less social support (24,25). In the Johnston County Osteoarthritis project, patients with hip or knee osteoarthritis were 3 times more likely to report sleep problems than people without osteoarthritis (26). We used an epidemiologic approach to extend these observations to the national population level. Because our survey-based sample was representative of the US population, the majority of participants with arthritis in our study likely had noninflammatory arthritis (19,27). A significant association was found between arthritis and all 3 types of sleep disturbance.

Several sociodemographic characteristics and health behaviors were independently associated with sleep disturbance, including age, female sex, white race, less social support (divorced or never married), lower education level, employment status (formerly or never worked), current smoking, and alcohol use. In addition, chronic diseases such as hypertension, heart and lung disease, and upper GI problems were associated with one or more sleep quality problems. These findings are consistent with other epidemiologic studies on representative community-dwelling populations, which also reported that sleep disturbances are more common in women, older people, and persons of lower socioeconomic status (11,28,29). Furthermore, previous studies have reported that patients with COPD or cardiovascular or cerebrovascular diseases have an increased risk of sleep disorders (19,30). We examined not only the relative odds of sleep disturbances associated

with comorbid conditions, but also adjusted prevalences of sleep disturbances in adults with chronic diseases other than arthritis. These adjusted prevalences were generally similar to those of persons with arthritis, indicating that although arthritis is associated with an increased risk of sleep disturbances relative to those without arthritis (including those with no chronic diseases), many chronic diseases are associated with an increased risk of sleep disturbances. This comparison places the arthritis associations in context and provides a clearer understanding of the role of chronic diseases in sleep disturbances.

Depression and anxiety were strongly associated with sleep disturbances. Adults with depression or anxiety were 3 times more likely to report sleep problems than those without depression or anxiety. Similar associations of mood disorders with sleep quality have been previously demonstrated in patients with inflammatory arthritis or osteoarthritis (11,24,26,31), in patients with psychiatric and other chronic diseases (32,33), and in the general population (34). Although the cross-sectional nature of our study precludes making causal inferences, a bidirectional relationship likely exists between sleep disturbance and depression (35,36). In addition, our study provides new information about subgroups of adults with arthritis most at risk for sleep problems. Depression and anxiety were the most important factors identifying subsets of individuals with arthritis affected with all 3 sleep disturbances. Among adults with arthritis but without anxiety or depression, those with upper GI problems had a higher risk of sleep difficulties. This finding has clinical importance, since many medications used for arthritis pain relief can have upper GI symptoms as adverse effects (37). Appropriate use of these medications may limit secondary consequences of worsening sleep.

We found that joint pain and limitation due to joint pain were important mediators of sleep disturbance. Significant associations between sleep disturbance and pain or limitation due to pain have been described in inflammatory arthritis or osteoarthritis (7–11), as well as in patients with chronic pain but without arthritis (38,39). A recent survey demonstrated that sleep disturbance in patients with RA was linked to pain, mood, and disease activity (8). The 2000/2001 Canadian Community Health Survey reported that a substantial amount of the relationship between arthritis and sleep problems was mediated by pain (11). In addition, pain was a significant predictor of insomnia in a large survey of the Canadian population (40). Pain can disrupt sleep, and poor sleep may increase pain intensity (41). Elevation of plasma proinflammatory cytokine levels, especially tumor necrosis factor α (TNFα) and interleukin-6, has been detected in patients with disorders of excessive daytime sleepiness (42). Sleep problems have received increased attention with the recent observation that anti-TNFα treatment may improve sleep and alertness disturbances (43). This increased attention is manifested by inclusion of measures of sleep quality as outcome measures in clinical trials of patients with arthritis (44).

The causes of sleep difficulties in patients with arthritis are likely multifactorial, and treatment may require a multidisciplinary approach. However, only 30% of older Americans with sleep disturbance seek medical care for this problem, relying instead on various self-care strategies (3,45). Patients with arthritis should be encouraged to report sleep quality problems. In the 2005 Sleep in America Poll, only 29% of participants had ever been asked by their doctors about their sleep problems (12,46). Treatment, including cognitive–behavioral therapy, exercise, or complementary methods, may improve both joint pain and sleep quality (47,48).

The strengths of this study include the large nationally representative sample, with a response rate of 78%. We examined 3 different sleep disturbances to have a broad representation of sleep problems. In contrast to other studies where the cause of pain was not described, we included data focused on joint pain, as well as limitations due to joint pain.

We also provided new information about the prevalence of sleep disturbances in persons with arthritis in comparison to those with other chronic diseases, and identified subgroups of individuals with arthritis most at risk for sleep disturbances. There are some limitations in this study. The assessment of sleep disturbances was based on symptoms, rather than using methods such as polysomnography, because diaries or questionnaires are the only feasible way to assess sleep quality in large national samples. Survey data did not allow us to classify insomnia using diagnostic criteria (49,50). Data were also not available to evaluate the duration or severity of insomnia or to differentiate primary and secondary causes of insomnia. Reports of sleep duration may not be accurate, but differential reporting would not be expected between persons with and without arthritis. Data on physician-diagnosed arthritis were also self-reported, but self-reports have been validated previously for surveillance purposes (17). Although certain medications, notably opioid analgesics, which may be used by persons with severe arthritis, can affect sleep, information on medication use was not included in the survey. Finally, because the study was cross-sectional, we could not ascertain the direction of causality between sleep difficulties and pain or depression.

Our results suggest that adults with arthritis are significantly more likely to develop insomnia, excessive daytime sleepiness, or short sleep duration than those without arthritis, and that this difference is mainly related to joint pain and limitation due to pain. These findings suggest that improvement in joint pain may decrease sleep problems. Among individuals with arthritis, those with anxiety and depression are mostly affected by sleep disturbances. Physicians and other health care providers should be aware of these often neglected symptoms. Patients with arthritis, especially those reporting pain or with depression or anxiety, should be regularly screened for sleep quality problems and have the causes of sleep problems treated appropriately.

Acknowledgments

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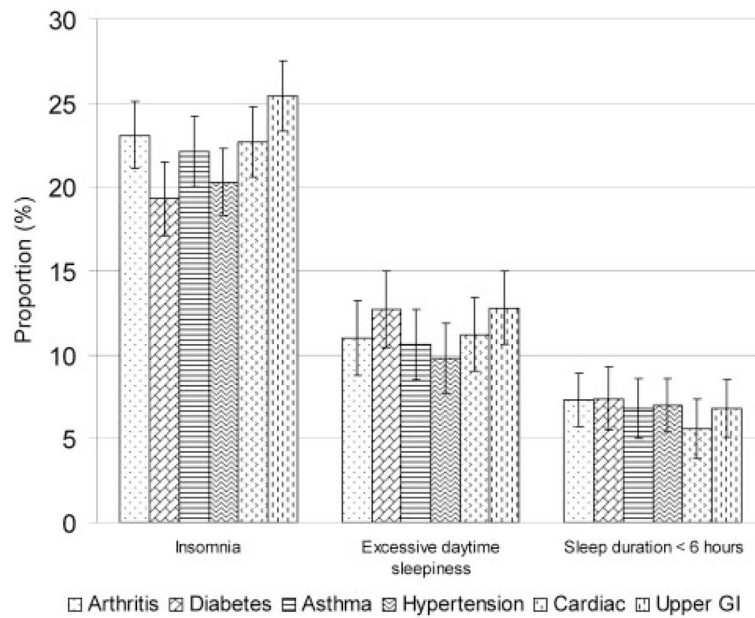
Figure 1.
Age-, sex-, race-, and disease-adjusted prevalences of sleep disturbances in persons with arthritis compared with other chronic health conditions in the 2007 National Health Interview Survey. Bars show the SEM. Cardiac = coronary heart disease, myocardial infarction, or heart condition/disease; GI = gastrointestinal; upper GI = ulcer or acid reflux/heartburn.
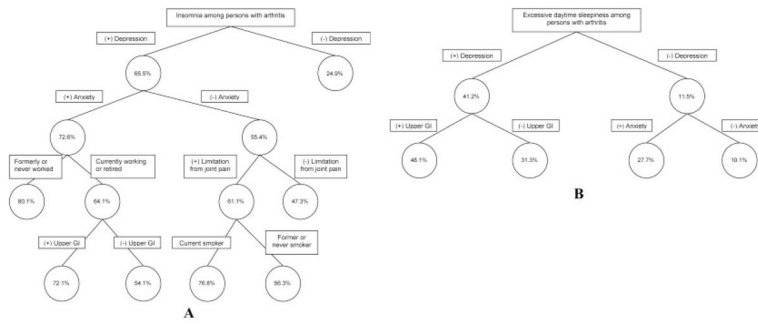
Figure 2.
Identification of predictors of **A**, insomnia and **B**, excessive daytime sleepiness among persons with arthritis using classification tree analysis. Minimum number of persons in terminal nodes = 5. GI = gastrointestinal.

Table 1

Characteristics of adult participants in the 2007 National Health Interview Survey[*]

	Total	Arthritis present[†]	Arthritis absent
Insomnia, past 12 months			
Present	17.6	32.1	13.9
Absent	82.4	67.9	86.1
Excessive daytime sleepiness, past 12 months			
Present	9.8	17.5	7.9
Absent	90.2	82.5	92.1
Average hours of sleep in a 24-hour period			
<6	7.1	10.7	6.3
6	92.9	89.3	93.7
Age, years			
18–29	22.3	3.3	27.0
30–39	18.0	6.9	20.8
40–49	19.7	15.4	20.8
50–59	16.9	22.1	15.5
60–69	11.8	23.7	8.9
70–79	7.0	17.3	4.4
80	4.3	11.1	2.6
Sex			
Men	48.8	42.0	50.5
Women	51.2	58.0	49.5
Race/ethnicity			
White, non-Hispanic	69.1	79.1	66.7
Black, non-Hispanic	11.8	10.5	12.1
Hispanic	13.5	7.4	15.0
Asian, non-Hispanic	4.7	1.9	5.3
Other, non-Hispanic	0.9	1.1	0.9
Education			
No high school degree	15.7	19.7	14.7
High school degree	28.9	31.5	28.3
Attended college	28.4	26.7	28.8
College degree or higher	27.0	22.1	28.2
Employment status			
Currently working	62.3	41.2	67.6
Retired	14.9	34.0	10.1
Formerly worked	12.9	19.7	11.2
Never worked	9.9	5.1	11.1
Marital status			
Married or living with a partner	62.4	64.6	61.8
Widowed	6.3	15.1	4.1

	Total	Arthritis present[†]	Arthritis absent
Divorced or separated	10.7	13.6	10.0
Never married	20.6	6.7	24.1
Body mass index			
Underweight	1.9	1.2	2.0
Normal weight	36.9	27.0	39.3
Overweight	35.3	34.9	35.5
Obese	25.9	36.9	23.2
Smoking status			
Current smoker	19.6	18.6	19.9
Former smoker	21.5	34.2	18.4
Never smoker	58.9	47.2	61.7
Alcohol status			
Current drinker	61.6	54.1	63.5
Former drinker	14.6	24.0	12.3
Never drinker	23.8	21.9	24.2
Hypertension			
Present	27.0	53.7	20.3
Absent	73.0	46.3	79.7
Cardiac disease[‡]			
Present	10.6	23.0	7.5
Absent	89.4	77.0	92.5
Stroke			
Present	2.4	6.9	1.3
Absent	97.6	93.1	98.7
COPD[§]			
Present	4.4	11.1	2.8
Absent	95.6	88.9	97.2
Asthma			
Present	10.8	16.0	9.5
Absent	89.2	84.0	90.5
Upper GI tract disease[¶]			
Present	24.3	42.6	19.7
Absent	75.7	57.4	80.3
Urinary/prostate problems			
Present	11.2	24.4	7.9
Absent	88.8	75.6	92.1
Diabetes mellitus			
Present	7.6	15.8	5.6
Absent	92.4	84.2	94.4
Cancer			
Present	7.3	14.9	5.4

	Total	Arthritis present[†]	Arthritis absent
Absent	92.7	85.1	94.6
Depression, past 12 months			
Present	10.4	19.0	8.2
Absent	89.6	81.0	91.8
Anxiety, past 12 months			
Present	10.5	18.3	8.5
Absent	89.5	81.7	91.5
Symptoms of joint pain, aching, stiffness in past 30 days			
Present	26.9	69.8	16.3
Absent	73.1	30.2	83.7
Limited currently due to arthritis or joint symptoms			
Present	11.5	42.8	3.7
Absent	88.5	57.2	96.3

[*] Values are the percentage and may not sum to 100 due to rounding. COPD = chronic obstructive pulmonary disease; GI = gastrointestinal.

[†] Comparison of all variables between participants with arthritis and those without arthritis had a P value of <0.0001.

[‡] Coronary heart disease, myocardial infarction, or heart condition/disease.

[§] Emphysema or chronic bronchitis.

[¶] Ulcer or acid reflux/heartburn.

Table 2

Association between arthritis and the presence of insomnia during the past 12 months among adults participating in the 2007 National Health Interview Survey using logistic regression models[*]

	Model 1, OR (95% CI)[†]	Model 2, OR (95% CI)[‡]	Model 3, OR (95% CI)[§]	Model 4, OR (95% CI)[¶]
Arthritis				
Absent	1.00	1.00	1.00	1.00
Present	2.92 (2.68–3.17)	2.27 (2.06–2.50)	1.53 (1.36–1.71)	1.06 (0.93–1.21)
Age, years				
18–29		1.00	1.00	1.00
30–39		1.35 (1.13–1.61)	1.35 (1.11–1.63)	1.29 (1.07–1.56)
40–49		1.45 (1.21–1.74)	1.40 (1.15–1.71)	1.30 (1.07–1.58)
50–59		1.48 (1.24–1.78)	1.36 (1.11–1.66)	1.22 (1.00–1.49)
60–69		1.11 (0.90–1.36)	1.01 (0.80–1.28)	0.92 (0.73–1.17)
70–79		1.23 (0.94–1.59)	1.06 (0.79–1.43)	0.97 (0.72–1.30)
80		1.37 (1.02–1.85)	1.14 (0.79–1.62)	1.02 (0.71–1.48)
Sex				
Men		1.00	1.00	1.00
Women		1.40 (1.27–1.54)	1.26 (1.13–1.41)	1.26 (1.12–1.41)
Race/ethnicity				
White, non-Hispanic		1.00	1.00	1.00
Black, non-Hispanic		0.75 (0.65–0.86)	0.82 (0.71–0.96)	0.82 (0.71–0.96)
Hispanic		0.92 (0.80–1.06)	0.98 (0.83–1.14)	1.00 (0.86–1.17)
Asian, non-Hispanic		0.73 (0.58–0.92)	0.83 (0.63–1.10)	0.84 (0.64–1.11)
Other, non-Hispanic		1.17 (0.78–1.76)	1.13 (0.75–1.70)	1.08 (0.70–1.66)
Marital status				
Married or living with a partner		1.00	1.00	1.00
Widowed		1.13 (0.96–1.34)	1.07 (0.89–1.29)	1.05 (0.87–1.28)
Divorced or separated		1.60 (1.43–1.79)	1.35 (1.18–1.54)	1.33 (1.16–1.52)
Never married		1.36 (1.19–1.55)	1.33 (1.15–1.55)	1.32 (1.13–1.53)
Education				
College degree or higher		1.00	1.00	1.00
Attended college		1.50 (1.33–1.70)	1.39 (1.23–1.57)	1.35 (1.19–1.53)
High school degree		1.24 (1.10–1.40)	1.13 (0.99–1.29)	1.13 (0.99–1.28)
No high school degree		1.32 (1.12–1.54)	1.12 (0.93–1.34)	1.09 (0.91–1.31)
Employment status				
Currently working		1.00	1.00	1.00
Retired		1.53 (1.30–1.82)	1.38 (1.14–1.67)	1.38 (1.14–1.68)
Formerly worked		2.56 (2.26–2.89)	1.52 (1.31–1.77)	1.45 (1.25–1.69)
Never worked		1.30 (1.11–1.51)	1.12 (0.95–1.33)	1.13 (0.95–1.33)
Smoking status				
Never smoker		1.00	1.00	1.00
Former smoker		1.28 (1.14–1.43)	1.09 (0.96–1.24)	1.09 (0.96–1.25)

	Model 1, OR (95% CI)[†]	Model 2, OR (95% CI)[‡]	Model 3, OR (95% CI)[§]	Model 4, OR (95% CI)[¶]
Current smoker		1.60 (1.42–1.79)	1.24 (1.08–1.42)	1.22 (1.06–1.39)
Alcohol status				
Never drinker		1.00	1.00	1.00
Former drinker		1.37 (1.19–1.58)	1.21 (1.03–1.42)	1.18 (1.01–1.39)
Current drinker		1.40 (1.23–1.58)	1.39 (1.22–1.59)	1.37 (1.20–1.57)
Body mass index				
Normal weight			1.00	1.00
Underweight			0.83 (0.56–1.23)	0.82 (0.55–1.21)
Overweight			0.96 (0.85–1.09)	0.95 (0.84–1.08)
Obese			1.04 (0.92–1.18)	1.00 (0.88–1.13)
Hypertension				
Absent			1.00	1.00
Present			1.26 (1.12–1.41)	1.24 (1.11–1.39)
Cardiac disease				
Absent			1.00	1.00
Present			1.37 (1.18–1.59)	1.34 (1.15–1.56)
Stroke				
Absent			1.00	1.00
Present			1.06 (0.81–1.40)	1.00 (0.76–1.31)
COPD				
Absent			1.00	1.00
Present			1.28 (1.05–1.57)	1.26 (1.04–1.54)
Asthma				
Absent			1.00	1.00
Present			1.39 (1.20–1.61)	1.37 (1.19–1.59)
Upper GI tract disease				
Absent			1.00	1.00
Present			1.97 (1.75–2.22)	1.85 (1.64–2.09)
Urinary/prostate problems				
Absent			1.00	1.00
Present			1.45 (1.27–1.66)	1.37 (1.20–1.56)
Diabetes mellitus				
Absent			1.00	1.00
Present			1.16 (0.97–1.38)	1.13 (0.94–1.35)
Cancer				
Absent			1.00	1.00
Present			1.40 (1.20–1.64)	1.41 (1.20–1.66)
Depression, past 12 months				
Absent			1.00	1.00
Present			3.07 (2.67–3.53)	2.94 (2.55–3.39)
Anxiety, past 12 months				

	Model 1, OR (95% CI)[†]	Model 2, OR (95% CI)[‡]	Model 3, OR (95% CI)[§]	Model 4, OR (95% CI)[¶]
Absent			1.00	1.00
Present			3.09 (2.67–3.58)	2.90 (2.51–3.36)
Joint pain, past 30 days				
Absent				1.00
Present				1.80 (1.59–2.04)
Limitations due to joint pain				
Absent				1.00
Present				1.45 (1.22–1.72)

[*] OR = odds ratio; 95% CI = 95% confidence interval; COPD = chronic obstructive pulmonary disease; GI = gastrointestinal.

[†] Arthritis status as the sole independent variable.

[‡] Model 1, adjusted for sociodemographic variables and health behaviors.

[§] Model 2, adjusted for comorbid conditions.

[¶] Model 3, adjusted for joint pain and limitations due to joint pain.

Table 3

Association between arthritis and presence of excessive daytime sleepiness during the past 12 months among adults participating in the 2007 National Health Interview Survey using logistic regression models[*]

	Model 1, OR (95% CI)[†]	Model 2, OR (95% CI)[‡]	Model 3, OR (95% CI)[§]	Model 4, OR (95% CI)[¶]
Arthritis				
Absent	1.00	1.00	1.00	1.00
Present	2.48 (2.23–2.76)	2.18 (1.90–2.50)	1.37 (1.16–1.61)	0.96 (0.80–1.16)
Age, years				
18–29		1.00	1.00	1.00
30–39		0.94 (0.78–1.14)	0.89 (0.73–1.09)	0.85 (0.70–1.03)
40–49		0.79 (0.64–0.97)	0.68 (0.54–0.85)	0.62 (0.50–0.78)
50–59		0.69 (0.56–0.86)	0.55 (0.43–0.71)	0.49 (0.38–0.63)
60–69		0.53 (0.42–0.69)	0.44 (0.33–0.59)	0.40 (0.29–0.53)
70–79		0.64 (0.47–0.89)	0.53 (0.37–0.76)	0.49 (0.33–0.71)
80		0.96 (0.67–1.36)	0.80 (0.52–1.23)	0.73 (0.47–1.13)
Sex				
Men		1.00	1.00	1.00
Women		1.23 (1.09–1.39)	1.06 (0.92–1.21)	1.05 (0.91–1.21)
Race/ethnicity				
White, non-Hispanic		1.00	1.00	1.00
Black, non-Hispanic		0.76 (0.64–0.91)	0.81 (0.67–0.98)	0.81 (0.67–0.98)
Hispanic		0.85 (0.72–1.00)	0.86 (0.72–1.03)	0.88 (0.73–1.05)
Asian, non-Hispanic		0.86 (0.64–1.14)	0.98 (0.71–1.34)	0.99 (0.71–1.37)
Other, non-Hispanic		1.11 (0.56–2.19)	0.94 (0.49–1.79)	0.89 (0.45–1.75)
Marital status				
Married or living with a partner		1.00	1.00	1.00
Widowed		0.86 (0.70–1.07)	0.79 (0.63–1.00)	0.78 (0.61–0.98)
Divorced or separated		1.28 (1.09–1.50)	1.05 (0.88–1.25)	1.01 (0.85–1.21)
Never married		1.10 (0.94–1.29)	1.06 (0.89–1.26)	1.04 (0.88–1.24)
Education				
College degree or higher		1.00	1.00	1.00
Attended college		1.61 (1.37–1.90)	1.42 (1.20–1.68)	1.37 (1.15–1.63)
High school degree		1.51 (1.27–1.79)	1.29 (1.08–1.54)	1.29 (1.08–1.54)
No high school degree		1.76 (1.44–2.14)	1.45 (1.17–1.81)	1.43 (1.15–1.78)
Employment status				
Currently working		1.00	1.00	1.00
Retired		1.51 (1.20–1.89)	1.26 (0.96–1.64)	1.24 (0.95–1.62)
Formerly worked		2.83 (2.47–3.23)	1.54 (1.31–1.81)	1.47 (1.25–1.74)
Never worked		1.45 (1.20–1.76)	1.16 (0.93–1.44)	1.16 (0.94–1.44)
Smoking status				
Never smoker		1.00	1.00	1.00
Former smoker		1.41 (1.21–1.63)	1.19 (1.01–1.40)	1.19 (1.01–1.41)

	Model 1, OR (95% CI)[†]	Model 2, OR (95% CI)[‡]	Model 3, OR (95% CI)[§]	Model 4, OR (95% CI)[¶]
Current smoker		1.47 (1.28–1.69)	1.11 (0.94–1.30)	1.09 (0.93–1.28)
Alcohol status				
Never drinker		1.00	1.00	1.00
Former drinker		1.54 (1.29–1.83)	1.34 (1.10–1.63)	1.31 (1.07–1.60)
Current drinker		1.21 (1.05–1.40)	1.17 (1.00–1.36)	1.14 (0.98–1.34)
Body mass index				
Normal weight			1.00	1.00
Underweight			1.26 (0.81–1.95)	1.25 (0.81–1.93)
Overweight			1.03 (0.88–1.20)	1.01 (0.86–1.18)
Obese			1.34 (1.10–1.63)	1.29 (1.09–1.52)
Hypertension				
Absent			1.00	1.00
Present			1.18 (1.02–1.37)	1.16 (1.00–1.35)
Cardiac disease				
Absent			1.00	1.00
Present			1.27 (1.08–1.49)	1.24 (1.05–1.46)
Stroke				
Absent			1.00	1.00
Present			1.41 (1.00–1.98)	1.34 (0.95–1.90)
COPD				
Absent			1.00	1.00
Present			1.26 (1.01–1.59)	1.25 (0.99–1.57)
Asthma				
Absent			1.00	1.00
Present			1.22 (1.03–1.44)	1.20 (1.01–1.42)
Upper GI tract disease				
Absent			1.00	1.00
Present			1.78 (1.55–2.05)	1.68 (1.46–1.94)
Urinary/prostate problems				
Absent			1.00	1.00
Present			1.69 (1.44–1.98)	1.59 (1.36–1.87)
Diabetes mellitus				
Absent			1.00	1.00
Present			1.53 (1.26–1.85)	1.49 (1.22–1.82)
Cancer				
Absent			1.00	1.00
Present			0.98 (0.80–1.21)	0.99 (0.81–1.22)
Depression, past 12 months				
Absent			1.00	1.00
Present			3.31 (2.74–3.98)	3.17 (2.63–3.82)
Anxiety, past 12 months				

	Model 1, OR (95% CI)[†]	Model 2, OR (95% CI)[‡]	Model 3, OR (95% CI)[§]	Model 4, OR (95% CI)[¶]
Absent			1.00	1.00
Present			2.44 (2.04–2.92)	2.29 (1.91–2.75)
Joint pain, past 30 days				
Absent				1.00
Present				1.78 (1.53–2.07)
Limitations due to joint pain				
Absent				1.00
Present				1.39 (1.16–1.66)

[*] OR = odds ratio; 95% CI = 95% confidence interval; COPD = chronic obstructive pulmonary disease; GI = gastrointestinal.

[†] Arthritis status as the sole independent variable.

[‡] Model 1, adjusted for sociodemographic variables and health behaviors.

[§] Model 2, adjusted for comorbid conditions.

[¶] Model 3, adjusted for joint pain and limitations due to joint pain.

Table 4

Association between arthritis and <6 hours of sleep in a 24-hour period among adults participating in the 2007 National Health Interview Survey using logistic regression models[*]

	Model 1, OR (95% CI)[†]	Model 2, OR (95% CI)[‡]	Model 3, OR (95% CI)[§]	Model 4, OR (95% CI)[¶]
Arthritis				
Absent	1.00	1.00	1.00	1.00
Present	1.79 (1.58–2.03)	1.84 (1.60–2.12)	1.38 (1.18–1.62)	1.09 (0.91–1.29)
Age, years				
18–29		1.00	1.00	1.00
30–39		1.20 (0.95–1.51)	1.10 (0.87–1.40)	1.08 (0.85–1.37)
40–49		1.39 (1.11–1.74)	1.26 (1.01–1.57)	1.21 (0.97–1.51)
50–59		1.06 (0.79–1.43)	0.88 (0.66–1.18)	0.83 (0.62–1.11)
60–69		0.87 (0.64–1.18)	0.74 (0.54–1.03)	0.71 (0.51–0.98)
70–79		0.74 (0.50–1.08)	0.63 (0.42–0.95)	0.60 (0.40–0.90)
80		0.81 (0.53–1.24)	0.76 (0.50–1.15)	0.71 (0.46–1.08)
Sex				
Men		1.00	1.00	1.00
Women		0.92 (0.80–1.06)	0.86 (0.74–1.01)	0.87 (0.74–1.02)
Race/ethnicity				
White, non-Hispanic		1.00	1.00	1.00
Black, non-Hispanic		1.54 (1.30–1.82)	1.61 (1.35–1.93)	1.62 (1.35–1.93)
Hispanic		1.05 (0.86–1.28)	1.06 (0.86–1.30)	1.06 (0.87–1.31)
Asian, non-Hispanic		1.17 (0.87–1.57)	1.23 (0.90–1.69)	1.25 (0.91–1.71)
Other, non-Hispanic		1.02 (0.52–2.00)	0.91 (0.47–1.77)	0.90 (0.47–1.71)
Marital status				
Married or living with a partner		1.00	1.00	1.00
Widowed		1.34 (1.06–1.71)	1.26 (0.99–1.61)	1.26 (0.98–1.61)
Divorced or separated		1.64 (1.40–1.93)	1.50 (1.26–1.79)	1.48 (1.24–1.77)
Never married		1.04 (0.86–1.27)	1.00 (0.81–1.23)	0.99 (0.81–1.22)
Education				
College degree or higher		1.00	1.00	1.00
Attended college		1.66 (1.25–2.20)	1.52 (1.14–2.02)	1.49 (1.12–1.98)
High school degree		1.55 (1.16–2.06)	1.41 (1.05–1.88)	1.41 (1.06–1.88)
No high school degree		1.63 (1.20–2.21)	1.41 (1.04–1.92)	1.40 (1.02–1.90)
Employment status				
Currently working		1.00	1.00	1.00
Retired		0.99 (0.77–1.28)	0.86 (0.66–1.12)	0.84 (0.64–1.10)
Formerly worked		1.51 (1.27–1.80)	1.06 (0.87–1.29)	1.00 (0.81–1.22)
Never worked		0.97 (0.77–1.22)	0.91 (0.72–1.15)	0.90 (0.71–1.13)
Smoking status				
Never smoker		1.00	1.00	1.00
Former smoker		0.94 (0.80–1.10)	0.85 (0.72–1.01)	0.85 (0.72–1.01)

	Model 1, OR (95% CI)[†]	Model 2, OR (95% CI)[‡]	Model 3, OR (95% CI)[§]	Model 4, OR (95% CI)[¶]
Current smoker		1.52 (1.29–1.78)	1.35 (1.14–1.59)	1.33 (1.13–1.58)
Alcohol status				
Never drinker		1.00	1.00	1.00
Former drinker		1.37 (1.12–1.68)	1.23 (0.99–1.53)	1.22 (0.98–1.52)
Current drinker		1.32 (1.12–1.56)	1.30 (1.09–1.56)	1.30 (1.09–1.56)
Body mass index				
Normal weight			1.00	1.00
Underweight			1.07 (0.64–1.77)	1.05 (0.63–1.75)
Overweight			1.24 (1.05–1.46)	1.23 (1.04–1.45)
Obese			1.34 (1.13–1.59)	1.31 (1.10–1.55)
Hypertension				
Absent			1.00	1.00
Present			1.29 (1.10–1.51)	1.28 (1.09–1.49)
Cardiac disease				
Absent			1.00	1.00
Present			1.04 (0.84–1.28)	1.01 (0.82–1.25)
Stroke				
Absent			1.00	1.00
Present			1.22 (0.90–1.66)	1.17 (0.86–1.60)
COPD				
Absent			1.00	1.00
Present			1.09 (0.85–1.39)	1.07 (0.84–1.37)
Asthma				
Absent			1.00	1.00
Present			1.21 (1.01–1.46)	1.20 (0.99–1.44)
Upper GI tract disease				
Absent			1.00	1.00
Present			1.25 (1.07–1.47)	1.21 (1.03–1.42)
Urinary/prostate problems				
Absent			1.00	1.00
Present			1.19 (0.98–1.44)	1.14 (0.94–1.38)
Diabetes mellitus				
Absent			1.00	1.00
Present			1.33 (1.02–1.72)	1.30 (0.99–1.69)
Cancer				
Absent			1.00	1.00
Present			1.28 (0.98–1.67)	1.29 (0.98–1.69)
Depression, past 12 months				
Absent			1.00	1.00
Present			1.92 (1.59–2.32)	1.83 (1.51–2.22)
Anxiety, past 12 months				

	Model 1, OR (95% CI)[†]	Model 2, OR (95% CI)[‡]	Model 3, OR (95% CI)[§]	Model 4, OR (95% CI)[¶]
Absent			1.00	1.00
Present			1.57 (1.30–1.91)	1.50 (1.24–1.82)
Joint pain, past 30 days				
Absent				1.00
Present				1.28 (1.08–1.51)
Limitations due to joint pain				
Absent				1.00
Present				1.52 (1.20–1.91)

[*] OR = odds ratio; 95% CI = 95% confidence interval; COPD = chronic obstructive pulmonary disease; GI = gastrointestinal.

[†] Arthritis status as the sole independent variable.

[‡] Model 1, adjusted for sociodemographic variables and health behaviors.

[§] Model 2, adjusted for comorbid conditions.

[¶] Model 3, adjusted for joint pain and limitations due to joint pain.