

Original article

Associations of frequent sleep insufficiency with health-related quality of life and health behaviors

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Abstract

Background and purpose: Sleep-related problems, which affect 50–70 million Americans, involve all areas of life, including cognitive performance, emotional well-being, work and leisure-time activities, and general physical and mental well-being. We examined the association of insufficient sleep with health-related quality of life (HRQOL) and health behaviors.

Patients and methods: Data were obtained from the Behavioral Risk Factor Surveillance System, an ongoing, state-based, random-digit telephone survey of the non-institutionalized US population aged ≥ 18 years. In 2002, HRQOL measures were administered in 18 states and the District of Columbia, yielding complete responses to questions regarding sleep and demographic characteristics from 98% of study participants ($n = 79,625$).

Results: An estimated 26% of adults reported frequent (≥ 14 days in the past 30 days) sleep insufficiency. They were significantly more likely than those without frequent sleep insufficiency to report fair/poor general health, frequent physical distress, frequent mental distress, activity limitations, depressive symptoms, anxiety, and pain. In addition, they were significantly more likely to smoke, to be physically inactive, to be obese, and, among men, to drink heavily.

Conclusion: Insufficient sleep is associated with a variety of adverse health behaviors and impairment in all HRQOL domains investigated. Accordingly, assessment of sleep appears to be an important component of general medical care. Moreover, expanded assessment of sleep in the general population may provide a better understanding of prevalence of impaired sleep and its many implications.

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1. Introduction

Sleep-related problems affect 50–70 million persons in the United States [1]. Two adults in five sleep less than 7 hours each weeknight and for three adults in eight, their sleepiness during the day interferes with daily activities at least a few times a month [2]. Insufficient sleep not only affects the ability to function optimally but is also associated with an increased risk of psychiatric disorders [3,4]. Sleep disturbance can also exacerbate chronic conditions, disrupt medical treatment, and add to the social disability associated with a chronic illness [5–7]. Yet, nearly two-thirds of US

adults have never been asked by a physician how well they sleep [8]. Given the impact of insufficient sleep on well-being, we examined the association of insufficient sleep with health-related quality of life (HRQOL) measures and health behaviors in the general US population using the Behavioral Risk Factor Surveillance System (BRFSS).

2. Methods

The BRFSS is an ongoing, state-based, random-digit telephone survey of non-institutionalized persons aged 18 years or older in the United States, Guam, Puerto Rico, and the Virgin Islands. The BRFSS is a state-based surveillance system supported by the Centers for Disease Control

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and Prevention, which collects data on many of the behaviors and conditions increasing the risk of chronic disease among adults (aged ≥ 18 years) [9]. Trained telephone interviewers collect data monthly using an independent probability sample of households among the non-institutionalized US population. Data from all states are pooled to produce national estimates. In 2002, interviewers administered HRQOL questions in 18 states (Alabama, Arizona, California, Hawaii, Indiana, Iowa, Kentucky, Minnesota, Missouri, Nebraska, New Jersey, North Dakota, Ohio, Oklahoma, Rhode Island, Tennessee, Virginia, and Wisconsin) and the District of Columbia. Further information on BRFSS survey methods, including its weighting procedure, are beyond the scope of this paper and are described elsewhere [10].

We examined eight HRQOL questions with demonstrated validity and reliability for population health surveillance [11]. General health was assessed by asking respondents to rate their health on a five-point scale from excellent to poor. The remaining seven questions were about self-assessed health in the past 30 days: “How many days was your physical health, which includes physical illness and injury, not good?” (physical distress), “How many days was your mental health, which includes stress, depression, and problems with emotions, not good?” (mental distress), “How many days did pain make it difficult to do your usual activities?” (pain), “How many days did you feel sad, blue, or depressed?” (depressive symptoms), “How many days did you feel worried, tense, or anxious?” (anxiety), “How many days did poor physical or mental health keep you from doing your usual activities, such as self-care, work, or recreation?” (activity limitations), and “How many days have you felt you did not get enough rest or sleep?” (insufficient sleep). Responses were dichotomized into < 14 and ≥ 14 (frequent) unhealthy days in each domain. Our study was designed to examine the effect of frequent sleep insufficiency (≥ 14 days of insufficient sleep in the past 30 days) on the seven remaining HRQOL measures.

BRFSS respondents were also asked about their smoking status, physical activity level, height and weight, and consumption of alcohol. Respondents were considered to be current smokers if they had smoked at least 100 cigarettes in their lifetime and reported being smokers at the time of the interview. Persons were considered to be physically inactive if they had not participated in any leisure-time physical activity or exercise during the past 30 days other than their regular job. Body mass index (BMI) was calculated as weight in kilograms divided by the square of height in meters. Persons were considered obese if their BMI was ≥ 30 kg/m². Consistent with the guidelines of the US Department of Agriculture and the US Department of Health and Human Services [12], heavy drinkers were defined as men who reported drinking more than two drinks per day, and women who reported drinking more than one drink per day.

The 2002 BRFSS collected data on insufficient sleep from 81,053 adults. Those without complete information for study variables ($n=1428$) were excluded, yielding data obtained from a total of 79,625 (20,383 reported ≥ 14 days of

insufficient sleep in the past 30 days) respondents available for analysis. We conducted bivariate analyses to examine the unadjusted prevalences of sociodemographic characteristics, HRQOL, and adverse health behaviors by sleep status. We also constructed logistic regression models adjusted for sex, age, race/ethnicity, marital status, education and employment status where appropriate to identify potential covariates of frequent sleep insufficiency. For all analyses, only P values < 0.05 were considered statistically significant. SAS (SAS Institute, Cary, NC, 2001) and SUDAAN (Research Triangle Institute, Research Triangle Park, NC, 2001) software was used to take into account the complex sample design and to calculate prevalence estimates, 95% confidence intervals (CI), standard errors (SEs) and adjusted odds ratios (AORs). Analytic characteristics of SUDAAN are described in greater detail elsewhere [13].

Table 1

Prevalence of frequent sleep insufficiency among adults with adjusted odd ratios for selected demographic characteristics: Behavioral Risk Factor Surveillance System, 2002

Characteristic	Percent (95% confidence interval)	Adjusted odds ratio (95% confidence interval) ^a
<i>Age group (years)</i>		
18–24	34.1 (31.9–36.3)	3.3 (2.8–3.8)
25–34	33.2 (31.6–34.7)	3.0 (2.6–3.4)
35–44	29.1 (27.8–30.4)	2.2 (2.0–2.5)
45–54	24.5 (23.2–25.8)	1.6 (1.4–1.9)
≥ 55	15.8 (15.0–16.7)	Referent
<i>Sex</i>		
Men	23.2 (22.3–24.1)	Referent
Women	28.5 (27.7–29.3)	1.4 (1.3–1.5)
<i>Race/ethnicity</i>		
White, non-Hispanic	26.9 (26.3–27.5)	Referent
Black, non-Hispanic	27.2 (24.9–29.4)	0.9 (0.8–1.0)
Hispanic	21.2 (18.8–23.6)	0.6 (0.5–0.7)
Other ^b	24.0 (21.3–26.6)	0.8 (0.7–0.9)
<i>Education</i>		
< High school graduate	25.5 (23.3–27.6)	1.1 (1.0–1.3)
High school graduate	26.8 (25.8–27.9)	1.1 (1.0–1.2)
> High school graduate	25.5 (24.8–26.3)	Referent
<i>Marital status</i>		
Married	24.2 (23.5–25.0)	Referent
Previously married ^c	26.2 (25.0–27.3)	1.2 (1.1–1.3)
Never married ^d	30.0 (28.4–31.5)	0.9 (0.8–1.0)
<i>Employment status</i>		
Employed	26.9 (26.1–27.7)	1.4 (1.2–1.6)
Unemployed	26.3 (23.5–29.1)	1.3 (1.0–1.6)
Unable to work	48.9 (45.2–52.7)	4.4 (3.6–5.3)
Retired	13.3 (12.2–14.4)	Referent
Student/homemaker	29.0 (27.1–30.8)	1.3 (1.1–1.5)

Previously married includes those divorced, widowed or separated; never married includes those never married or member of unmarried couple.

^a Adjusted for all other variables in the table.

^b Asian, non-Hispanic; Native Hawaiian/Pacific Islander, non-Hispanic; American Indian/Alaska Native, non-Hispanic; other race, non-Hispanic; multirace, non-Hispanic.

^c Previously married includes those divorced, widowed or separated.

^d Never married includes those never married or member of unmarried couple.

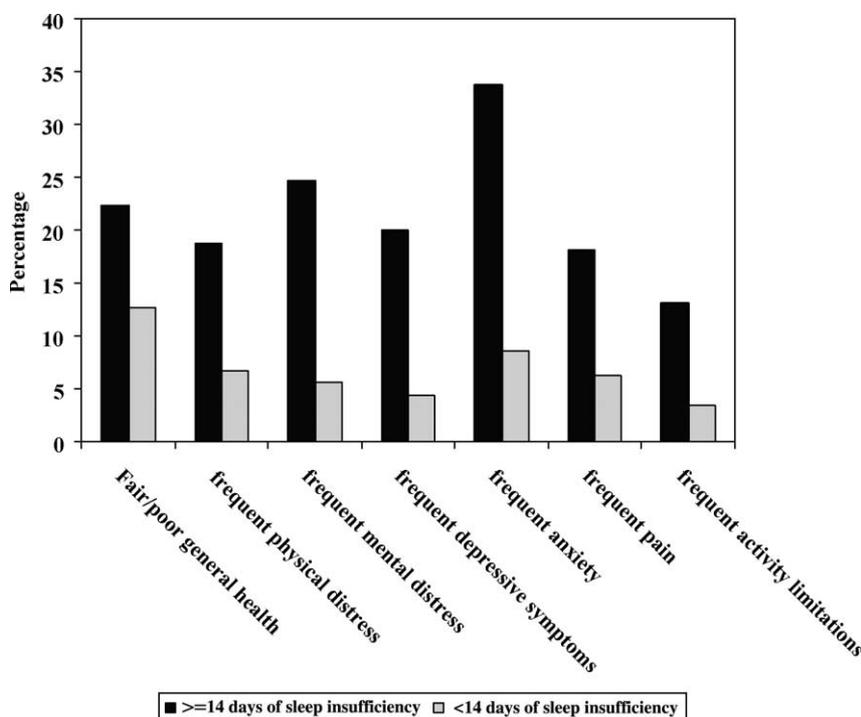


Fig. 1. Unadjusted prevalence rates for health-related quality of life indicators among adults aged 18 years or older with 14 or more days of insufficient sleep in the past 30 days (black bars) or with less than 14 days of insufficient sleep in the past 30 days (light grey bars).

3. Results

An estimated 25.9% (95% CI; 25.3%–26.5%) of adults reported frequent sleep insufficiency. The odds of frequent sleep insufficiency were significantly greater for women than men; adults aged less than 55 years than those 55 years or older, persons previously married (vs those who are currently married); and persons who were employed, unable to work, or a homemaker or student (vs those who were retired) (Table 1). In addition, persons with frequent sleep insufficiency were significantly less likely to be Hispanic or of other race or ethnicity (Asian, non-Hispanic; Native Hawaiian/Pacific Islander, non-Hispanic; American Indian/Alaska Native, non-Hispanic; other race, non-Hispanic; multirace) than to be white, non-Hispanic.

Persons with frequent sleep insufficiency were significantly more likely than those without frequent sleep insufficiency to report fair/poor general health [(22.3%, SE=0.6) vs (12.7%, SE=0.3)], frequent physical distress [(18.8%, SE=0.9) vs (6.7%, SE=0.3)], frequent mental distress [(24.7%, SE=1.0) vs (5.7%, SE=0.3)], frequent activity limitations [13.2%, SE=0.8) vs (3.4%, SE=0.2)], frequent depressive symptoms [(20.0%, SE=0.6) vs (4.4%, SE=0.2)], frequent anxiety [(33.7%, SE=0.7) vs (8.6%, SE=0.2)], and frequent pain [(18.1%, SE=0.5) vs (6.2%, SE=0.2)] (Fig. 1).

People with frequent sleep insufficiency were also significantly more likely than respondents who did not report frequent sleep insufficiency to engage in adverse behavior-related risk factors, including smoking, physical

inactivity, obesity, and, among men, heavy drinking (Table 2).

4. Discussion

Our results corroborate previous research indicating that insufficient sleep is a major public health problem [1–7],

Table 2
Prevalence of adverse health behaviors with adjusted odds ratios, by sleep status: Behavioral Risk Factor Surveillance System, 2002

Characteristic	Percent (95% confidence interval)	Adjusted odds ratio (95% confidence interval)
<i>Smoking^a</i>		
Frequent sleep insufficiency	30.8 (29.5–32.0)	1.7 (1.5–1.8)
No frequent sleep insufficiency	19.3 (18.7–20.0)	Referent
<i>Alcohol consumption</i>		
<i>Heavy drinking (males)^b</i>		
Frequent sleep insufficiency	9.9 (8.5–11.3)	1.6 (1.3–1.9)
No frequent sleep insufficiency	5.8 (5.3–6.4)	Referent
<i>Heavy drinking (females)^b</i>		
Frequent sleep insufficiency	5.1 (4.4–5.8)	1.0 (0.8–1.2)
No frequent sleep insufficiency	4.5 (4.1–4.9)	Referent
<i>Physical inactivity^a</i>		
Frequent sleep insufficiency	27.9 (26.6–29.1)	1.4 (1.3–1.6)
No frequent sleep insufficiency	22.6 (21.9–23.3)	Referent
<i>Body mass index ≥ 30 kg/m^{2a}</i>		
Frequent sleep insufficiency	23.9 (22.8–25.0)	1.4 (1.3–1.5)
No frequent sleep insufficiency	19.9 (19.3–20.5)	Referent

^a Adjusted for sex, age, race/ethnicity, marital status, and education.

^b Adjusted for age, race/ethnicity, marital status, and education.

as we found over one-fourth of US adults reported frequent sleep insufficiency. Insufficient sleep is associated with impairments in numerous areas of life including physical and mental health, as well as performance of work and leisure activities [5]. Our results extend these findings to a non-clinical population and provide additional evidence that people with frequent sleep insufficiency are more likely to be impaired in a variety of both physical and mental health domains.

These data, in tandem with those of previous researchers investigating clinical insomnia, suggest that the adverse health effects associated with insufficient sleep may be widely underestimated. In an assessment of clinical populations, Katz and McHorney [6] found insomnia to be independently associated with impaired HRQOL to almost the same extent as conditions such as congestive heart failure and clinical depression. Moreover, research indicates that HRQOL worsens with more severe insomnia [6,7].

Previous research suggests that sleep disturbance is more prevalent among older adults than among their younger peers [14] and may be associated with age-related changes in sleep architecture [15]. In contrast, the results of this investigation indicated insufficient sleep to be less frequently reported among older adults. This seeming contradiction is consistent with the finding of Vitiello et al. [16] that older adults appear to adapt their perception of what comprises ‘acceptable’ sleep, resulting in fewer subjective complaints concerning impaired sleep.

Notably, previous research indicates that individuals who engage in unhealthy behaviors are often more likely to report sleep complaints [17]. Specifically, cigarette smokers are significantly more likely than non-smokers to report problems falling asleep, staying asleep, and with daytime sleepiness [17]. Although data are less conclusive, exercise has been shown to increase the quality and quantity of sleep, and reduce daytime sleepiness [18]. Obesity is related to sleep disturbance and daytime sleepiness in addition to increasing the risk of sleep-disordered breathing, especially sleep apnea [19]. Finally, alcohol use increases daytime sleepiness and sleep-disordered breathing [20,21]. Similarly, our results indicate that frequent sleep insufficiency was significantly associated with smoking, physical inactivity, obesity, and heavy drinking in a large community-based sample. Thus, modifications of these risk behaviors may be vital to the effective control of sleep-related problems in the general population.

Our study has several limitations. Because BRFSS is a telephone survey, it potentially excludes people of low socioeconomic status, a population for which prior research suggests insufficient sleep may be an important mediator of health [22–24]. Second, because our analysis was based on 18 states and the District of Columbia, our results may not be representative of the entire country. Third, people with severely impaired physical or mental health might not have been able to complete the survey, which might alter our estimates, as would the inability of institutionalized or

hospitalized persons to participate. Fourth, the data we analyzed were based on self-reports and were not validated by physical or psychiatric examination. Moreover, our data did not permit ascertainment of the cause of insufficient sleep, whether it be voluntary and attributable to scheduling demands, or due to other factors such as medical comorbidities. In the absence of clinical diagnosis, insufficient sleep cannot be construed as equivalent to insomnia. Finally, given our data were cross-sectional, we can conclude that insufficient sleep is associated with impairments in all HRQOL domains investigated and with adverse health behaviors, but cannot infer causality. These limitations notwithstanding, epidemiologic studies with non-clinical samples may produce more valid estimates of insufficient sleep and its implications, because many people with sleep disorders do not seek medical care for these problems [25].

Sleep-related problems affect nearly as many US adults as do more widely recognized health conditions, such as arthritis and cardiovascular disease [26,27]. Our research suggests that sleep-related problems are associated with impairments in all domains of HRQOL and, likewise, with adverse health behaviors. In addition, previous investigations indicate that sleep-related problems adversely affect functioning, exacerbate psychiatric symptomatology, and may worsen the course of chronic conditions [3–7]. Assessment of sleep thus appears to be an important component of general medical care. Moreover, expanded assessment of sleep in the general population may provide a better understanding of both the prevalence of impaired sleep and the extensiveness of its implications.

References

- [1] US Department of Health and Human Services. National Institutes of Health. National Heart, Lung, and Blood Institute. National Center on Sleep Disorders Research. 2003 National Sleep Disorders Research Plan. Available at: http://www.nhlbi.nih.gov/health/prof/sleep/res_plan/sleep-rplan.pdf accessed June 14, 2004.
- [2] National Sleep Foundation. 2002 ‘Sleep in America’ Poll. Available at: <http://www.sleepfoundation.org/2002poll.cfm> accessed June 14, 2004.
- [3] Vandeputte M, de Weerd A. Sleep disorders and depressive feelings: a global survey with the Beck depression scale. *Sleep Med* 2003;4:343–5.
- [4] Ford DE, Kamerow DB. Epidemiologic study of sleep disturbances and psychiatric disorders: an opportunity for prevention? *J Am Med Assoc* 1989;262:1479–84.
- [5] Manocchia M, Keller S, Ware JE. Sleep problems, health-related quality of life, work functioning and health care utilization among the chronically ill. *Qual Life Res* 2001;10:331–45.
- [6] Katz DA, McHorney CA. The relationship between insomnia and health-related quality of life in patients with chronic illness. *J Fam Pract* 2002;51:229–35.
- [7] Léger D, Scheuermaier K, Philip P, et al. SF-36: evaluation of quality of life in severe and mild insomniacs compared with good sleepers. *Psychosom Med* 2001;63:49–55.
- [8] National Sleep Foundation. 2000 ‘Sleep in America’ Poll. Available at: <http://www.sleepfoundation.org/publications/2000poll.cfm> accessed June 14, 2004.

- [9] Centers for Disease Control and Prevention. Behavioral Risk Factor Surveillance System User's Guide. Atlanta: US Department of Health and Human Services. Centers for Disease Control and Prevention; 1998. Available at: http://www.cdc.gov/brfss/technical_infodata/usersguide.htm accessed June 14, 2004.
- [10] Mokdad AH, Stroup DF, Giles WH, Behavioral Risk Factor Surveillance Team. Public health surveillance for behavioral risk factors in a changing environment. Recommendations from the Behavioral Risk Factor Surveillance Team. *MMWR Morb Mortal Wkly Rep.* 2003;52(RR-9):1–12.
- [11] Moriarty DG, Zack MM, Kobau R. The Centers for Disease Control and Prevention's Healthy Days Measures—population tracking of perceived physical and mental health over time. *Health Qual Life Outcomes* 2003;1:37.
- [12] Center for Nutrition Policy and Promotion. The dietary guidelines for Americans, 2000. Home and garden bulletin no. 232, 5th ed. US Department of Agriculture and the US Department of Health and Human Services; 2000. Available at: <http://www.usda.gov/cnpp/DietGd.pdf> accessed June 14, 2004.
- [13] Research Triangle Institute. In: SUDAAN User's Manual Release, vols. I and II. Research Triangle Park, NC: Research Triangle Institute; 2001.
- [14] Kryger M, Monjan A, Bliwise D, Ancoli-Israel S. Sleep, health, and aging. Bridging the gap between science and clinical practice. *Geriatrics* 2004;59:29–30.
- [15] Redline S, Kirchner L, Quan SF, et al. The effects of age, sex, ethnicity, and sleep disordered breathing on sleep architecture. *Arch Intern Med* 2004;164:406–18.
- [16] Vitiello MV, Larsen LH, Moe KE. Age-related sleep change: gender and estrogen effects on the subjective-objective sleep quality relationships of healthy, noncomplaining older men and women. *J Psychosom Res* 2004;56:503–10.
- [17] Phillips BA, Danner FJ. Cigarette smoking and sleep disturbance. *Arch Intern Med* 1995;155:734–7.
- [18] Driver HS, Taylor SR. Exercise and sleep. *Sleep Med Rev* 2000;4:387–402.
- [19] Dixon JB, Schachter LM, O'Brien PE. Sleep disturbance and obesity: changes following surgically induced weight loss. *Arch Intern Med* 2001;161:102–6.
- [20] Roehrs T, Roth T. Sleep, sleepiness, sleep disorders and alcohol use and abuse. *Sleep Med Rev* 2001;5:287–97.
- [21] Castaneda R, Sussman N, Levy R, et al. A review of the effects of moderate alcohol intake on psychiatric and sleep disorders. In: Galanter, editor. *Recent developments in alcohol. The consequences of alcoholism*, vol. 14. New York: Plenum Press; 1998.
- [22] Moore PJ, Adler NE, Williams DR, Jackson JS. Socioeconomic status and health: the role of sleep. *Psychosom Med* 2002;64:337–44.
- [23] Sickel AE, Moore PJ, Adler NE, et al. The differential effects of sleep quality and quantity on the relationship between SES and health. *Ann N Y Acad Sci* 1999;896:431–4.
- [24] Van Cauter E, Spiegel K. Sleep as a mediator of the relationship between socioeconomic status and health: a hypothesis. *Ann N Y Acad Sci* 1999;896:254–61.
- [25] Ford DE, Cooper-Patrick L. Sleep disturbances and mood disorders: an epidemiologic perspective. *Depress Anxiety* 2001;14:3–6.
- [26] Centers for Disease Control and Prevention. Prevalence of self-reported arthritis or chronic joint symptoms among adults—United States, 2001. *MMWR Morb Mortal Wkly Rep* 2002;51(42):948–50.
- [27] Centers for Disease Control and Prevention. Preventing heart disease and stroke. Available at: http://www.cdc.gov/nccdphp/bb_heartdisease/index.htm accessed June 14, 2004.