Published in final edited form as:

Soc Sci Med. 2007 May ; 64(10): 1997–2007.

“Job Stress and Poor Sleep Quality: Data from an American Sample of Full-Time Workers”

Hannah Knudsen,

University of Georgia Athens, GA UNITED STATES [Proxy]

Lori J Ducharme, PhD, and

University of Georgia Athens, lorid@uga.edu

Paul M Roman, PhD

University of Georgia Athens, proman@uga.edu

Abstract

Given the associations between poor quality sleep and health, it is important to consider whether job stressors are related to sleep-related outcomes. Studies from Europe and Japan suggest that these stressors negatively impact sleep, but there are few studies of job stressors and sleep quality that draw upon large representative samples of workers in the USA. Using data collected via telephone interviews from a nationally representative random sample of 1,715 American full-time employees, this research considers three dependent variables of past-month poor sleep quality: number of days the respondent had difficulty initiating sleep, number of days of difficulty maintaining sleep, and number of days of non-restorative sleep. Negative binomial regression was used to estimate a count data model of the associations between the frequency of these three types of poor sleep quality and the job stressors of work overload, role conflict, autonomy, and repetitive tasks, while controlling for socio-demographic characteristics. The average American worker reported 5.3 days of difficulty falling asleep, 6.6 days of trouble staying asleep, and 5.0 days of trouble waking up for work in the past month. Across the three types of poor sleep quality, work overload was positively associated with the frequency of poor sleep quality. Role conflict was positively associated with difficulty initiating sleep and non-restorative sleep. Repetitive tasks were associated with more days of difficulty initiating sleep and maintaining sleep. Job autonomy was negatively associated with non-restorative sleep. Given that sleep quality is associated with other health outcomes, future research should continue to explore the associations between job-related stressors, sleep quality, and workers' health status.

Keywords

USA; job stress; sleep; full-time workers; employment

Introduction

Poor sleep quality, including interrupted sleep or non-restorative sleep, is associated with a variety of negative consequences, including health-related problems (NHLBIWG, 1999), diminished quality of life (Ancoli-Israel & Roth, 1999), and economic costs (Lamberg,

Corresponding Author: Dr. Hannah Knudsen University of Georgia Athens, GA UNITED STATES [Proxy] hknudsen@uga.edu

Publisher's Disclaimer: This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final citable form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

2004). Despite a growing recognition of the consequences of sleep problems, particularly for the working population, research on the associations between psychosocial work stressors and sleep quality has been limited (Linton, 2004). Using data from a nationally representative sample of American full-time workers, this research models the associations between work stressors and the frequency of three indicators of poor sleep quality: difficulty falling asleep, difficulty staying asleep, and non-restorative sleep.

Sleep problems have been linked to a variety of physical and mental health-related outcomes (Nakata et al., 2000; NHLBIWG, 1999; Edell-Gustafsson, Kritz, & Bogren, 2002). A recent meta-analysis demonstrated relationships between sleep problems and the risk of myocardial infarction as well as coronary heart disease, concluding that the magnitude of these associations rival those of more conventional risk factors (Schwartz, Anderson, Cole, Cornoni-Huntley, Hayes, & Blazer, 1999). Poor sleep quality may also affect the functioning of the metabolic and endocrine systems, increasing the likelihood of diabetes and hypertension (Spiegel, Leproult, & Van Cauter, 1999). Individuals reporting sleep problems also indicate lower overall health quality (Kuppermann et al., 1995; Edell-Gustafsson et al., 2002) and greater physical health problems such as muscle pain, headaches, and gastrointestinal problems (Kuppermann et al., 1995). In addition, sleep disorders are a risk factor for the onset of mental health problems, such as depression (Gillin, 1998; Breslau, Roth, Rosenthal, & Andreski, 1996; Chang, Ford, Mead, Cooper-Patrick, & Klag, 1997).

Sleep problems experienced by workers have additional public health consequences. There are correlations between poor quality sleep and accidents, including motor vehicles accidents (Akerstedt, 1995; Dement & Mitler, 1993; Ribet & Derrienic, 1999; Roth & Ancoli-Israel, 1999) and incidents in the workplace (Harma, Tenkanen, Sjoblom, Alikoski, & Heinsalmi, 1998; Ribet & Derrienic, 1999; Metlaine, Leger, & Choudat, 2005). The cost of these sleep-related accidents may exceed \$50 billion annually (Leger, 1994). Employers bear additional costs due to sleep-related productivity losses, which may reach another \$50 billion per year (Lamberg, 2004). In particular, sleep disorders are associated with lower job performance, greater absenteeism, and increased use of sick leave (Linton & Bryngelsson, 2000; Doi, Minowa, & Tango, 2003; Leigh, 1991). Finally, there are additional costs due to increased health care utilization (Linton & Bryngelsson, 2000), such as doctor visits and hospitalization (Kalia, 2002). It is estimated that sleep-related disorders result in \$15 billion in health care costs each year (Lamberg, 2004).

Despite these significant negative consequences, there is limited research on the associations between psychosocial job stressors and sleep problems among workers (Doi et al., 2003; Schwartz et al., 1999), particularly relative to the much larger body of research examining associations between job stressors and other measures of health (Belkic, Landsbergis, Schnall, & Baker, 2004; Nasermoaddeli, Sekine, Hamanishi, & Kagamimori, 2002). Within the literature on work and sleep, a key focus has been on how non-standard work hours, particularly shiftwork, affect the quality of sleep. These studies have consistently shown that these types of work schedules have negative effects on sleep patterns (Akerstedt, 2003; Fischer et al., 1997; Rajaratnam & Arendt, 2001), although some workers are able to tolerate these disruptions better than others (Axelsson et al., 2004).

Although less investigated than the effects of shiftwork, there is a growing literature on the associations between stressful workplace experiences and sleep problems (Linton, 2004; Nakata et al., 2004; Kalimo, Tenkanen, Harma, Poppius, & Heinsalmi, 2000; Akerstedt, Knudtsson, Westerholm, Theorell, Alfredsson, & Kecklund, 2002b; Marquie, Foret, & Queinnec, 1999; Jacquinnet-Salord, Lang, Fouriaud, Nicoulet, & Bingham, 1993). These studies often draw on Karasek's (1979) theoretical framework regarding the linkages between health and psychosocial job stressors, such as job demands and job control (Pelfrene, Vlerick, Kittle,

Mak, Kornitzer, & De Backer, 2002).. Job demands include work overload as well as conflicting roles and tasks, while job control focuses on the degree of decision-making authority workers have over how they perform their jobs. The argument is that high demands and low control are risk factors for a variety of negative health-related outcomes.

Recent research has suggested that this theoretical framework can be applied to sleep problems. Indeed, Pelfrene et al. (2002) found support for direct effects of these variables on sleep problems in a sample of Belgian workers. Similar results were reported by Kalimo et al. (2000), who studied men participating in the Helsinki Heart Study. Nakata et al. (2004) reported a positive association between role conflict and trouble falling asleep in a sample of Japanese workers, while data from a Swedish sample demonstrated a positive association between high work demands, disturbed sleep, and non-restorative sleep (Akerstedt, Fredlund, Gillberg, & Jansson, 2002a;Akerstedt et al., 2002b). However, in the latter study, decision-making authority was not associated with the sleep measures once socio-demographic and other work factors were controlled (Akerstedt et al., 2002b). Other research has found associations between general measures of psycho-social work stressors and likelihood of sleep problems (Linton, 2004;Frese & Harwich, 1984;Jacquinet-Salord et al., 1993;Kuppermann et al., 1995) as well as sleep quality (Nasermoaddeli et al., 2002).

Little research on job stress and sleep has been conducted in the American context. Numerous studies have been conducted in Japan (Doi, 2005; Doi et al., 1999; Nakata et al., 2004;Nakata et al., 2000;Ota et al., 2005;Sekine et al., 2006;Utsugi et al., 2005), Finland (Urponen, Vuori, Hasan, & Partinen, 1988), Sweden (Linton, 2004), Germany (Frese & Harwich, 1984), Belgium (Pelfrene et al., 2002), and France (Ribet & Derrienic, 1999). There may be international differences in the significance and magnitude of associations due to variations in cultural contexts. For example, decisional authority (also called job autonomy) was associated with sleep-related problems in a sample of Belgian workers (Pelfrene et al., 2002), but no such association was found among a sample of Swedish workers (Akerstedt et al., 2002). Thus, there is a continued need for research on the associations between work stressors and poor sleep quality in a variety of national contexts, and a particular need to examine these topics in the U.S.

To summarize, this research examines the frequency of sleep-related problems in a nationally representative sample of American employees who work on a full-time basis. Specifically, we model the frequency of three types of poor sleep quality—trouble falling asleep, trouble staying asleep, and non-restorative sleep—as a function of four types of job stressors while controlling for socio-demographic characteristics.

Subjects and Methods

Subjects

Data for these analyses are drawn from the 2002-2003 National Employee Survey (NES), conducted by the University of Georgia. Computer-assisted telephone interviews were conducted with a national probability sample of 1,965 full-time employees, selected via a single-stage random digit dialing procedure. Eligible NES respondents were defined as household members age 18 or older, who were working for pay at least 32 hours per week in a single job. Self-employed persons and part-time employees were not eligible to be interviewed. In households with more than one eligible respondent, the last-birthday method was used to randomly select the survey participant. In all, 60.3% of individuals who were eligible for the study agreed to participate.

To assess response bias, we compared the NES data to contemporaneous data from the US Bureau of Labor Statistics (2005). The distribution of full-time workers across major

occupational categories in the NES and in the BLS data was quite similar (available by request from the authors). In terms of sociodemographic variables, the BLS indicated that 80.7% of full-time workers were white; 82.5% of NES respondents were white. BLS data indicated that 57.8% of full-time workers were currently married, compared to 55.5% of the NES sample. The most noticeable difference was for gender. The BLS data suggest that 43.5% of the full-time workforce is comprised of women, while 52.8% of NES respondents were women. This discrepancy likely reflects the greater willingness of women to participate in telephone surveys (Dillman, 1978; Groves and Lyberg, 1988).

Measurement methods

Three dependent variables related to the frequency of sleep problems in the past month were measured: *difficulty initiating sleep*, *difficulty maintaining sleep*, and *non-restorative sleep*. The wording of these items and the independent variables appear in the Appendix. Each of these symptoms is frequently cited in the literature on sleep disorders (e.g. Ancoli-Israel & Roth, 1999; Schwartz et al., 1999). These symptoms are also included in the Diagnostic and Statistical Manual's (DSM-IV) definition of insomnia (American Psychiatric Association, 1999; Billiard & Bentley, 2004) as well as the definition articulated by the National Heart, Lung, and Blood Institute Working Group (1999). Using the past month as the frame of reference has advantages over more lengthy timeframes in terms of the accuracy of respondents' recall (Buysse, Reynolds, Monk, Berman, & Kupfer, 1989; Jenkins, Stanton, Niemcryk, & Rose, 1988). The measurement of symptoms in days has the additional advantage of minimizing respondent differences in interpreting subjective categories such as "often" and "sometimes" (Partinen & Gislason, 1995). However, these three measures are not treated as an additive index for two reasons. First, there is substantive value in considering if work stressors are associated with each symptom in the same fashion, as some have argued that each is a unique dimension of poor quality sleep (Liljenberg, Almqvist, Hetta, Roos, & Agren, 1988). Finally, other research has indicated that these three symptoms do not all load on a single factor (Akerstedt et al., 2002b; Kalimo et al., 2000).

Four psycho-social work stressors are evaluated as antecedents of the three sleep-related problems: *work overload*, *role conflict*, *repetitive tasks*, and *job autonomy*. These measures were adapted from Karasek (1979), and use a four-point Likert response format with greater scores representing greater amounts of a given construct. Work overload, role conflict, and repetitive tasks were measured using single items. Job autonomy was indicated by a four-item mean scale, which had a Cronbach's alpha of .77 in this dataset.

In addition to work stressors, the models include a measure of depressive symptoms, adapted from Mirowsky and Ross's (1990) modified version of the Center for Epidemiological Studies-Depression (CES-D) scale (Radloff, 1977). The existing literature suggests that there are associations between mood disorders, particularly depression, and sleep-related problems (Ohayon, 1997; Linton & Bryngelsson, 2000). However, it may be difficult to disentangle this relationship because sleep problems are often included as indicators of depression (Kalimo et al., 2000). For example, in Mirowsky and Ross's shortened version of the CES-D, there are items about trouble falling or staying asleep as well as items about fatigue. Measures of fatigue may be indicative of the consequences of poor sleep (NHLBIWG, 1999; Zorick & Walsh, 2000); thus, some have called for differentiating emotion-centered symptoms from the activity/physical symptoms in the CES-D (Aneshensel, Frerichs, Clark, & Yokopenic, 1982; Mirowsky & Ross, 2003).

While there is a clear need to include a measure of depressive symptoms when modeling sleep-related problems, it is important that the measure exclude items about sleep or fatigue if the dependent variable is a sleep-related measure. Our adaptation of the CES-D relies on three items that more directly measure symptoms of depressive affect (Mirowsky & Ross, 2003).

Specifically, the three items used in this analysis measure the number of days in the past week that the respondent “felt sad,” “felt lonely,” and “felt you just couldn't shake the blues.” The resulting measure of depressive symptomatology is an additive index of these three measures (Cronbach's $\alpha = .78$), ranging from 0 to 21.

The analyses control for a variety of socio-demographic variables. These control variables include: *gender* (1 = female), *marital status* (a set of three dummy variables including single, divorced/separated/widowed, and married as the reference category), *age* in years, *race/ethnicity* (a set of four dummy variables with white as the reference category, African American, Hispanic/Latino, and multi-racial/other), *educational attainment* (a set of four dummy variables including high school degree or less as the reference category, some college, undergraduate degree, greater than undergraduate degree), and *earnings* in thousands of dollars. Respondents' earnings were initially measured in ten income categories, beginning with less than \$10,000 and ending with an open-ended category of greater than \$90,000. The nine closed categories were recoded to the midpoint, while the value of the open-ended upper category was estimated using the technique developed by Parker and Fenwick (1983). An additional work-related control variable was *tenure*, measured in years that the respondent has worked for his/her current employer.

Statistical analysis

Models of the three dependent variables were estimated using negative binomial regression (NBR) because they are a type of count data. Although ordinary least squares (OLS) regression has frequently been used to estimate models of work stress and health, it has a number of limitations when the dependent variable is measured as a count (Beck & Tolnay, 1995; Long, 1997). First, OLS regression assumes that the dependent variable is continuous; count data are not continuous because they are measured in whole numbers. In addition, count data are bounded by zero such that negative values are impossible; this again violates an assumption of OLS regression. Finally, count data tend to have a skewed distribution, which has the effects of biasing estimates of standard errors and increasing the probability of incorrect inferences. We considered using Poisson regression as an alternative to OLS regression, but preliminary analyses indicated that overdispersion was a problem in the data; in the case of overdispersion, Poisson regression is not appropriate (Long & Freese, 2003; Barron, 1992).

Negative binomial regression (NBR) has the advantage of including an error term that accounts for overdispersion, resulting in estimates that are superior to those calculated in either OLS or Poisson regression. In addition, it provides standardized estimates that reflect the expected change in count of the dependent variable for a one-unit increase in the independent variable; these estimates are analogous to exponentiated coefficients (odds ratios) in the logistic regression framework. For these reasons, we used negative binomial regression to estimate models of the number of days that respondents experienced each sleep-related symptom. All data were analyzed using Stata 8.2 (Stata Corporation, College Station, TX, USA).

The analyses are restricted to respondents who provided complete data on all indicators ($n = 1,715$). Comparisons were made between complete cases and those excluded due to missing data for all measures, using chi-square tests or t-tests depending on the level of measurement of the variable. There were no significant differences between these two groups on the dependent variables. Among the independent and control variables, the only difference that approached significance was for repetitive tasks (complete cases mean = 3.29 [SD = .90], incomplete cases mean = 3.17 [SD = .99], $t = -1.952$, $df = 1955$, $p = .051$).

Results

Descriptive statistics for all variables are presented in Table 1. On average, respondents reported about 5.34 days of difficulty initiating sleep ($SD = 8.37$), 6.59 days of difficulty maintaining sleep ($SD = 9.85$), and 5.00 days of non-restorative sleep ($SD = 9.29$). There were considerable percentages of respondents who reported none of these sleep-related problems in the past month. About 41.8% reported no past-month problems falling asleep, 43.3% reported no difficulty staying asleep, and 59.1% reported no problems awakening for work.

Table 2 presents the three negative binomial regression models of sleep-related problems. Overall, the results were mixed with regard to associations between work stressors and the three sleep-related dependent variables. Work overload was significantly associated with all three measures of poor quality sleep, such that greater work overload was associated with more frequent incidence of these sleep-related problems. For example, a one-unit increase in work overload was associated with a 14.2% increase in the expected frequency of difficulty initiating sleep over the past thirty days. The magnitude of the percentage change in expected count for difficulty maintaining sleep and non-restorative sleep were 11.9% and 14.4%, respectively.

Role conflict was associated with two of the three sleep measures. A one-unit increase in role conflict was associated with a 9.3% increase in the expected past-month frequency of trouble falling asleep and 29.1% increase in the frequency of non-restorative sleep. There was a trend for role conflict being positively associated with difficulty maintaining sleep ($p = .086$), but this association did not achieve statistical significance.

Repetitive work was positively associated with two of the three sleep-related variables. For difficulty initiating sleep, a one-unit increase in the measure of repetitive work was associated with a 10.3% increase in the expected frequency. In addition, this increase in repetitive work was associated with a 12.4% increase in the expected frequency of difficulty maintaining sleep. Repetitive work was not significantly associated with the frequency of non-restorative sleep.

Job autonomy was the least predictive of the work-related stressors. The only significant association was between autonomy and non-restorative sleep. This negative association indicates that workers reporting greater decision-making authority on the job reported less frequent episodes of non-restorative sleep. A one-unit increase in job autonomy was associated with a 19.6% decrease in the expected frequency of non-restorative sleep.

As expected, there were positive associations between self-reported depressive symptoms and the frequencies of the three types of sleep disturbance. For difficulty initiating sleep, a one-unit increase in depressive symptoms was associated with an 8.0% increase in the expected frequency, while a one-standard deviation increase ($SD = 4.27$) was associated with a 39.0% increase in the expected frequency of this type of sleep-related problem. The association between depressive symptoms and difficulty maintaining sleep was similar, with a standard deviation increase being associated with a 31.3% increase in the expected frequency. For non-restorative sleep, the association was slightly smaller. A standard deviation increase in depressive symptoms was associated with a 23.4% increase in the expected frequency of non-restorative sleep.

In general, the socio-demographic variables were not associated with the measures of sleep-related problems. Women reported significantly greater frequency of difficulty maintaining sleep than men; the expected frequency for women was about 31.5% greater than for men. The only significant difference by marital status was for the measure of trouble falling asleep; the average difference between respondents who were divorced, separated, or widowed and their currently married counterparts was about 29.9%. Age was negatively associated difficulty falling asleep and non-restorative sleep. A standard-deviation increase in age ($SD = 11.78$) was

associated with an 18.7% decrease in the expected frequency in difficulty in initiating sleep and a 52.6% decrease in non-restorative sleep. The only racial/ethnic difference was significantly greater difficulty maintaining sleep by multiracial/other respondents relative to white respondents, who reported an average of 53.8% more days of difficulty staying asleep. Finally, tenure was positively associated with the frequency of non-restorative sleep. A standard-deviation increase in tenure ($SD = 8.79$) was associated with a 23.4% increase in the number of days of non-restorative sleep.

Discussion

This research makes several contributions to the growing literature on work stress and poor quality sleep. First, there have been few available data on sleep quality in samples of American workers. Previous research has largely been conducted in other national contexts. The issue of whether these studies generalize to other workers has also been limited by the sampling designs, which often rely on convenience samples or employees representing a small number of organizations. Thus, the present research addresses some of these limitations by drawing on a large, nationally representative sample of the American full-time workforce.

In addition, the use of a negative binomial regression framework, which estimated models of the frequency of poor quality sleep, is innovative. Much of the previous research has used logistic regression to predict the probability of clinical insomnia. This emphasis, while useful, does not consider subclinical levels of poor sleep quality that may still adversely impact workers' quality of life. Additionally, the examination of the three distinct sleep-related measures offered the opportunity to consider whether job stressors were uniformly associated with these different types of poor sleep quality. These data suggest that the associations between work stressors and poor sleep quality are dependent on the type of sleep disturbance that is measured.

The associations between work stressors and the frequency of sleep disturbances were more complex than expected. Only work overload was associated with all three types of poor sleep quality. Role conflict was positively associated with difficulty initiating sleep and non-restorative sleep, but did not achieve statistical significance in the model of difficulty maintaining sleep. Contrary to other research that has demonstrated the negative effects of low job control, the measure of job autonomy was only associated with the frequency of non-restorative sleep. Finally, it was expected that repetitive tasks would represent a stressor that was positively associated with the frequency of poor sleep quality. These data supported that hypothesis with regard to difficulty initiating and maintaining sleep.

The psychosocial stressors included in this analysis drew from recent tests of Karasek's model of health outcomes in which job demands and decision latitude are treated as independent variables. Our measure of job autonomy was consistent with the concept of decision latitude, and we conceptualized role conflict, work overload, and repetitive tasks as indicators of job demands. In terms of previous studies related to work and sleep, there are a limited number of studies that have considered the main effects of these stressors on sleep-related dependent variables (Akerstedt et al., 2002b; Kalimo et al., 2000; Pelfrene et al., 2002).

The findings that indicate role conflict and work overload generally being associated with sleep-related problems is consistent with studies conducted in other national contexts. Using data from Sweden, Akerstedt et al. (2002b) found that high job demands were associated with more frequent sleep problems. Similar results were reported by Pelfrene et al. (2002) in a study of Belgian workers. Recent research in samples of Japanese workers has also suggested that job demands and job strain are associated with sleep related problems (Ota et al., 2005; Sekine et al., 2006; Utsugi et al., 2005).

Compared to other sources of job stress, job autonomy was less useful in predicting poor sleep quality, although this finding was not without precedent. At the bivariate level (results not shown), there was evidence that autonomy was associated with each of the sleep-related measures in the expected direction. However, once the other job stressors and control variables were added to the model, job autonomy was no longer associated with the frequency of difficulty falling asleep or staying asleep. Using data from a Swedish sample, Akerstedt et al. (2002b) reported similar results, in which high decision latitude reduced the likelihood of disturbed sleep at the bivariate level, but was not significant in a multivariate model. Likewise, other studies of Swedish workers have failed to find an association between decision latitude and insomnia in multivariate models (Linton, 2004; Linton & Bryngelsson, 2000). However, others have found decision latitude to be a protective factor in terms of sleep quality (Sekine et al., 2006). These differences in results suggest a need for additional research.

The negative associations between age and the three sleep-related measures warrant discussion. Population-based studies have often demonstrated that sleep quality declines with age. For example, Klink, Quan, Kaltenborn, & Lebowitz (1992) report a positive association between age and the likelihood of sleep problems. However, data from samples of workers have demonstrated greater variability in the nature of this relationship. Doi et al. (2003) found that being younger was a risk factor for poor sleep quality, arguing that younger workers may be more vulnerable to stressors because they are less able to cope. Breslau et al. (1997) noted that young adult workers were at considerable risk of daytime sleepiness, while Levine, Roehrs, Zorick, and Roth (1988) reported that younger adult workers were sleepier during the day than older adults. Akerstedt et al. (2002b) found that while age was positively associated with “disturbed sleep,” it was negatively associated with problems awakening and waking up tired. In contrast, Kupperman et al. (1995) found no association between age and sleep problems in their sample of telecommunication workers.

There are several limitations to this research. Given that the data are cross-sectional, it is not possible to make causal inferences about the associations between the stressors and the frequency of sleep-related problems. There may be a reciprocal relationship between stress and sleep, such that sleep disturbances result in productivity problems at work which, in turn, produce heightened feelings of work-related stress (Linton, 2004). The self-report nature of the data is an additional limitation. While self-report data are the predominant type of data used in studies of psychosocial work stressors and sleep, the integration of self-report and objective measures of sleep disturbances would strengthen the design.

In addition to these methodological limitations, the design of this research would have been strengthened if the National Employee Survey included measures of other physical health problems and lifestyle behaviors. Sleep problems may be, in part, a function of physical health (Kudielka, Von Kanel, Gander, & Fischer, 2004; Gislason & Almqvist, 1987), and our models were unable to control for physical ailments. However, recent work by Martikainen et al. (2003) suggests that job-related and mental health factors were considerably more important in predicting insomnia than several measures of physical health. Strine and Chapman (2005) reported that a number of lifestyle behaviors were associated with frequent sleep insufficiency, although these models were estimated for the general adult population and did not include measures of sleep. The only lifestyle behavior that we were able to consider was a measure of past-month alcohol consumption (results not shown); this measure of drinking behavior was not associated with any of the sleep measures and did not alter the substantive relationships between the job stressors and the dependent variables. The design would also have been strengthened by the inclusion of other mental health-related measures, such as anxiety, although the association between this condition and sleep is less clear than the relationship between sleep and depression. For example, Breslau et al. (1997) reported that while depression

was associated with daytime sleepiness, anxiety was not associated with this sleep-related measure in their sample of young adults.

These models were also unable to control for non-standard work hours, which affect about 14.8% of full-time American workers (US Bureau of Labor Statistics, 2005). Previous studies have indicated that non-standard work hours (e.g. rotating shifts, night shiftwork) are associated with the likelihood of sleep problems. For example, Harma et al. (1998) reported an association between shiftwork and insomnia, although their models did not include measures of other work stressors. Other research has not found such an association in terms of daytime sleepiness (Breslau et al., 1997) or the development of sleep problems (Linton, 2004). In studies that have considered psychosocial job stressors and shiftwork simultaneously, controlling for shiftwork did not reduce the associations between other stressors and sleep to non-significant levels (Frese and Harwich, 1984; Ota et al., 2005; Sekine et al., 2006; Utsugi et al., 2005), suggesting that shiftwork does not mediate the relationships between stressors and poor sleep quality. Although we did not have a direct measure of shiftwork, we conducted an additional analysis using a proxy measure of the percentage of workers in the respondent's occupation that worked non-standard hours, based on information from the US Bureau of Labor Statistics (2005; not shown but available from the authors). The inclusion of this proxy measure of shiftwork did not alter the substantive results. Based on this additional analysis and the findings of other studies, we are confident that our findings regarding work stressors and sleep would not be mediated by a direct measure of non-standard work hours.

Future research should continue to examine the relationships between workplace stressors and sleep-related problems. The use of longitudinal panel data would greatly strengthen the ability to make causal arguments regarding these associations. Furthermore, future research should consider additional domains of workplace stress. The present research focused on aspects of job design, namely task-related stressors such as overload, conflicting role demands, the repetitiveness of the work, and the amount of control over how job tasks are performed. There may be important insights to be gained from research that considers work stressors related to organizational injustice and interpersonal stressors in the workplace. A large body of research has documented associations between stress-related health outcomes and organizational injustice (Cropanzano, Goldman, & Benson III, 2005), abusive supervision (Rispens & Richman, 2005), and a lack of co-worker support (Ducharme & Martin, 2000). Recent work by Nakata et al. (2004), in their study of Japanese workers, suggests that interpersonal conflict and low social support in the workplace are risk factors for insomnia. Consideration of these types of workplace stressors as predictors of poor sleep quality, particularly after controlling for task-related stressors, represents an important avenue for future research.

Acknowledgements

The authors gratefully acknowledge research support from the National Institute on Drug Abuse (R01DA07417).

Appendix: Dependent and Independent Variables

Dependent Variables

In the past month, on how many nights have you had trouble falling asleep?

In the past month, on how many nights have you had trouble staying asleep?

In the past month, on how many days did you have difficulty waking up in the morning to make it to work on time?

Independent Variables

Work Overload (1 = not at all true, 2 = not very true, 3 = somewhat true, 4 = very true)

I am asked to excessive amounts of work.

Role Conflict (1 = very true, 2 = somewhat true, 3 = not very true, 4 = not at all true)

I am free from conflicting demands on my job.

Repetitive Tasks (1 = not at all true, 2 = not very true, 3 = somewhat true, 4 = very true)

My job requires me to do things that are repetitive

Job Autonomy (1 = not at all true, 2 = not very true, 3 = somewhat true, 4 = very true)

I have a lot of say over what happens on my job.

My job allows me freedom to decide how I do my own work.

On my job I make a lot of decisions on my own.

On my job I get to take part in making decisions that affect me.

Depressive Symptoms

How many days in the last week...

...have you felt sad?

...felt lonely?

...felt you just couldn't shake the blues?

REFERENCES

- Akerstedt T. Shift work and disturbed sleep/wakefulness. *Occupational Medicine* 2003;53:89–94. [PubMed: 12637592]
- Akerstedt T. Work hours, sleepiness and accidents: Introduction and summary. *Journal of Sleep Research* 1995;4(Suppl 2):1–3.
- Akerstedt T, Fredlund P, Gillberg M, Jansson B. Work load and work hours in relation to disturbed sleep and fatigue in a large representative sample. *Journal of Psychosomatic Research* 2002a;53:585–588. [PubMed: 12127175]
- Akerstedt T, Knutsson A, Westerholm P, Theorell T, Alfredsson L, Kecklund G. Sleep disturbances, work stress and work hours: A cross-sectional study. *Journal of Psychosomatic Research* 2002b; 53:741–748. [PubMed: 12217447]
- American Psychiatric Association (APA). *Diagnostic Criteria from DSM-IV-TR*. APA; Washington, DC: 2000.
- Ancoli-Israel S, Roth T. Characteristics of insomnia in the United States: Results from the 1991 National Sleep Foundation Survey. *Sleep* 1999;22(Suppl 2):S347–S353. [PubMed: 10394606]
- Aneshensel CS, Frerichs RR, Clark VA, Yokopenic PA. Measuring depression in the community: A comparison of telephone and personal interviews. *The Public Opinion Quarterly* 1982;46:110–121.
- Axelsson J, Akerstedt T, Kecklund G, Lowden A. Tolerance to shift work—how does it relate to sleep and wakefulness? *Internal Archives of Occupational and Environmental Health* 2004;77:121–129.
- Barron D. The analysis of count data: Overdispersion and autocorrelation. *Sociological Methodology* 1992;22:179–220.
- Beck EM, Tolnay SE. Analyzing historical count data: Poisson and negative binomial regression models. *Historical Methods* 1995;28:125–31.
- Belkic KL, Landsbergis PA, Schnall PL, Baker D. Is job strain a major source of cardiovascular disease risk? *Scandinavian Journal of Work, Environment and Health* 2004;30:85–128.

- Billiard M, Bentley A. Is insomnia best categorized as a symptom or a disease? *Sleep Medicine* 2004;3:S35–S40. [PubMed: 15301996]
- Breslau N, Roth T, Rosenthal L, Andreski P. Daytime sleepiness: An epidemiological study of young adults. *American Journal of Public Health* 1997;87:1649–1653. [PubMed: 9357347]
- Buysse DJ, Reynolds CF III, Monk TH, Berman SR, Kupfer DJ. The Pittsburgh Sleep Quality Index: A new instrument for psychiatric practice and research. *Psychiatry Research* 1989;28:193–213. [PubMed: 2748771]
- Chang PP, Ford DE, Mead LA, Cooper-Patrick L, Klag MJ. Insomnia in young men and subsequent depression. *American Journal of Epidemiology* 1997;146:105–114. [PubMed: 9230772]
- Cropanzano, R.; Goldman, BM.; Benson, L, III. Organizational justice. In: Barling, J.; Kelloway, EK.; Frone, MR., editors. *Handbook of work stress*. Sage; Thousand Oaks, CA: 2005. p. 63-87.
- Dement WC, Mitler MM. It's time to wake up to the importance of sleep disorders. *JAMA* 1993;269:1548–1550. [PubMed: 8445820]
- Dillman, D. *Mail and telephone surveys: The total design method*. Wiley; NY: 1978.
- Doi Y. An epidemiologic review of occupational sleep research among Japanese workers. *Industrial Health* 2005;43:3–10. [PubMed: 15732297]
- Doi Y, Minowa M, Tango T. Impact and correlates of poor sleep quality in Japanese white-collar employees. *Sleep* 2003;26:467–471. [PubMed: 12841374]
- Ducharme LJ, Martin JK. Unrewarding work, coworker support, and job satisfaction: A test of the buffering hypothesis. *Work & Occupations* 2000;27:223–243.
- Edell-Gustafsson UM, Krizt EI, Bogren IK. Self-reported sleep quality, strain and health in relation to perceived working conditions in females. *Scandinavian Journal of Caring Sciences* 2002;16:179–187. [PubMed: 12000672]
- Fischer FM, Castro Bruni AC, Berwerth A, Castro Moreno CR, Lima Fernandez R, Riviello C. Do weekly and fast-rotating shiftwork schedules differentially affect duration and quality of sleep? *Internal Archives of Occupational and Environmental Health* 1997;69:354–360.
- Frese M, Harwich C. Shiftwork and the length and quality of sleep. *Journal of Occupational Medicine* 1984;26:561–566. [PubMed: 6481495]
- Gillin JC. Are sleep disturbances risk factors for anxiety, depressive and addictive disorders? *Acta Psychiatrica Scandinavica* 1998;98(Suppl 393):39–43.
- Gislason T, Almqvist M. Somatic diseases and sleep complaints. *Acta Medica Scandinavica* 1987;221:475–481. [PubMed: 3496735]
- Groves, RM.; Lyberg, LE. An overview of nonresponse issues in telephone surveys. In: Groves, RM.; Biemer, PP.; Lyberg, LE.; Massey, JT.; Nichols, WL., II; Waksberg, J., editors. *Telephone Survey Methodology*. Wiley; New York: 1988. p. 191-212.
- Harma M, Tenkanen L, Sjoblom T, Alikoski T, Heinsalmi P. Combined effects of shift work and life-style on the prevalence of insomnia, sleep deprivation and daytime sleepiness. *Scandinavian Journal of Work, Environment, and Health* 1998;24:300–307.
- Jacquinet-Salord MC, Lang T, Fouriaud C, Nicoulet I, Bingham A. Sleeping tablet consumption, self reported quality of sleep, and working conditions. *Journal of Epidemiology and Community Health* 1993;47:64–68. [PubMed: 8094733]
- Jenkins CD, Stanton BA, Niemcryn SJ, Rose RM. A scale for the estimation of sleep problems in clinical research. *Journal of Clinical Epidemiology* 1988;41:313–321. [PubMed: 3351539]
- Kalia M. Assessing the economic impact of stress—the modern day hidden epidemic. *Metabolism: Clinical & Experimental* 2002;51(6 Supplement 1):49–53. [PubMed: 12040542]
- Kalimo R, Tenkanen L, Harma M, Poppius E, Heinsalmi P. Job stress and sleep disorders: Findings from the Helsinki Heart Study. *Stress Medicine* 2000;16:65–75.
- Karasek RA. Job demands, job decision latitude, and mental strain: Implications for job design. *Administrative Science Quarterly* 1979;24:285–308.
- Klink ME, Quan SF, Kaltenborn WT, Lebowitz MD. Risk factors associated with complaints of insomnia in a general adult population. *Archives of Internal Medicine* 1992;152:1634–1637. [PubMed: 1497397]

- Kudielka B, Von Kanel R, Gander ML, Fischer JE. Effort-reward imbalance, overcommitment, and sleep in a working population. *Work & Stress* 2004;18:167–178.
- Kuppermann M, Lubeck DP, Mazonson PD, Patrick DL, Stewart AL, Buesching DP, Fifer SK. Sleep problems and their correlates in a working population. *Journal of General Internal Medicine* 1995;10:25–32. [PubMed: 7699483]
- Lamberg L. Promoting adequate sleep finds a place on the public health agenda. *JAMA* 2004;291:2415–2417. [PubMed: 15161875]
- Leger D. The cost of sleep-related accidents: A report for the National Commission on Sleep Disorders Research. *Sleep* 1994;17:84–93. [PubMed: 7677805]
- Leigh JP. Employee and job attributes as predictors of absenteeism in a national sample of workers. *Social Science & Medicine* 1991;33:127–137. [PubMed: 1887276]
- Levine B, Roehrs T, Zorick F, Roth T. Daytime sleepiness in young adults. *Sleep* 1988;11:39–46. [PubMed: 3363268]
- Liljenberg B, Almqvist M, Hetta J, Roos BE, Agren H. The prevalence of insomnia: The importance of operationally defined criteria. *Annals of Clinical Research* 1988;20:393–398. [PubMed: 3218910]
- Linton SJ. Does work stress predict insomnia? A prospective study. *British Journal of Health Psychology* 2004;9:127–136. [PubMed: 15125800]
- Linton SJ, Bryngelsson IL. Insomnia and its relationship to work and health in a working-age population. *Journal of Occupational Rehabilitation* 2000;10:169–183.
- Long, JS. Regression models for categorical and limited dependent variables. Sage Publications; Thousand Oaks, CA: 1997.
- Long, JS.; Freese, J. Regression models for categorical dependent variables using Stata: Revised edition. Stata Corporation; College Station, TX: 2003.
- Marquie JC, Foret J, Queinnec Y. Effects of age, working hours, and job content on sleep: A pilot study. *Experimental Aging Research* 1999;25:421–427. [PubMed: 10553526]
- Martikainen K, Partinen M, Hasan J, Laippala P, Urponen H, Vuori I. The impact of somatic health problems on insomnia in middle age. *Sleep Medicine* 2003;4:201–206. [PubMed: 14592322]
- Metlaine A, Leger D, Choudat D. Socioeconomic impact of insomnia in working populations. *Industrial Health* 2005;43:11–19. [PubMed: 15732298]
- Mirowsky, J.; Ross, CE. Social causes of psychological distress. 2nd ed.. Aldine de Gruyter; Hawthorne, NY: 2003.
- Mirowsky J, Ross CE. Control or defense? Depression and the sense of control over good and bad outcomes. *Journal of Health and Social Behavior* 1990;31:71–86. [PubMed: 2313078]
- Nakata A, Haratani T, Takahashi M, Kawakami N, Arito H, Kobayashi F, Araki S. Job stress, social support, and prevalence of insomnia in a population of Japanese daytime workers. *Social Science & Medicine* 2004;59:1719–1730. [PubMed: 15279928]
- Nakata A, Haratani T, Kawakami N, Miki A, Kurabayashi L, Shimizu H. Sleep problems in white-collar male workers in an electric equipment manufacturing company in Japan. *Industrial Health* 2000;38:62–68. [PubMed: 10680312]
- Nasermoaddeli A, Sekine M, Hamanishi S, Kagamimori S. Job strain and sleep quality in Japanese civil servants with special reference to sense of coherence. *Journal of Occupational Health* 2002;44:337–342.
- National Heart, Lung, and Blood Institute Working Group on Insomnia. Insomnia: Assessment and management in primary care. *American Family Physician* 1999;59:3029–3038. [PubMed: 10392587]
- Ohayon MM. Prevalence of DSM-IV diagnostic criteria of insomnia: Distinguishing insomnia related to mental disorders from sleep disorders. *Journal of Psychiatric Research* 1997;31:333–346. [PubMed: 9306291]
- Ota A, Masue T, Yasuda N, Tsutsumi A, Mino Y, Ohara H. Association between psychosocial job characteristics and insomnia: An investigation using two relevant job stress models—the demand-control-support (DCS) model and the effort-reward imbalance (ERI) model. *Sleep Medicine* 2005;6:353–358. [PubMed: 15978518]
- Parker RN, Fenwick R. The Pareto curve and its utility for open-ended income distributions in survey research. *Social Forces* 1983;61:872–885.

- Partinen M, Eskelinen L, Tuomi K. Complaints of insomnia in different occupations. *Scandinavian Journal of Work, Environment, and Health* 1984;10:467–469.
- Partinen M, Gislason T. Basic Nordic Sleep Questionnaire (BNSQ): A quantitated measure of subjective sleep complaints. *Journal of Sleep Research* 1995;4(Suppl 1):150–155. [PubMed: 10607192]
- Pelfrene E, Vlerick P, Kittle F, Mak RP, Kornitzer M, De Backer G. Psychosocial work environment and psychological well-being: Assessment of the buffering effects in the job demand-control (-support) model in BELSTRESS. *Stress and Health* 2002;18:43–56.
- Radloff L. The CES-D scale: A self-report depression scale for research in the general population. *Applied Psychological Measurement* 1977;1:385–401.
- Rajaratnam SMW, Arendt J. Health in a 24-h society. *Lancet* 2001;358:999–1005. [PubMed: 11583769]
- Ribet C, Derriennic F. Age, working conditions, and sleep disorders: A longitudinal analysis of the French cohort E.S.T.E.V. *Sleep* 1999;22:491–504. [PubMed: 10389225]
- Rospenda, KM.; Richman, JA. Harassment and discrimination. In: Barling, J.; Kelloway, EK.; Frone, MR., editors. *Handbook of work stress*. Sage; Thousand Oaks, CA: 2005. p. 149-188.
- Roth T, Ancoli-Israel S. Daytime consequences and correlates of insomnia in the United States: Results of the 1991 National Sleep Foundation Survey. *Sleep* 1999;22(Suppl 2):S354–S358. [PubMed: 10394607]
- Schwartz S, Anderson WM, Cole SR, Cornoni-Huntley J, Hayes JC, Blazer D. Insomnia and heart disease: A review of epidemiologic studies. *Journal of Psychosomatic Research* 1999;47:313–333. [PubMed: 10616226]
- Sekine M, Chandola T, Martikainen P, Marmot M, Kagamimori S. Work and family characteristics as determinants of socioeconomic and sex inequalities in sleep: The Japanese Civil Servants Study. *Sleep* 2006;29:206–216. [PubMed: 16494089]
- Spiegel K, Leproult R, Van Cauter E. Impact of sleep debt on metabolic and endocrine function. *The Lancet* 1999;354:1435–1439.
- Strine TW, Chapman DP. Associations of frequent sleep insufficiency with health-related quality of life and health behaviors. *Sleep Medicine* 2005;6:23–27. [PubMed: 15680291]
- Urponen H, Vuori I, Hasan J, Partinen M. Self-evaluations of factors promoting and disturbing sleep: An epidemiological survey in Finland. *Social Science & Medicine* 1988;26:443–450. [PubMed: 3363395]
- US Bureau of Labor Statistics Table 5. Shift usually worked: Full-time wage and salary workers by occupation and industry, May 2004. 2005 Retrieved November 27, 2006, from <http://www.bls.gov/news.release/flex.t05.htm>.
- Utsugi M, Saijo Y, Yoshioka E, Horikawa N, Sato T, Gong Y, Kishi R. Relationships between occupational stress to insomnia and short sleep in Japanese workers. *Sleep* 2005;28:728–735. [PubMed: 16477960]
- Zorick, FJ.; Walsh, JK. Evaluation and management of insomnia: An overview. In: Kryger, MH.; Roth, T.; Dement, WC., editors. *Principles and practice of sleep medicine*. 3rd edition. W. B. Saunders Company; Philadelphia: 2000. p. 615-623.

Table 1

Past-month frequency of poor sleep quality, work stressors, and socio-demographic characteristics of a US sample of full-time workers (n = 1715)

Variable	Mean (SD) or %
<i>Frequency of sleep problems</i>	
<i>Past-month difficulty initiating sleep</i>	5.34 (8.37)
<i>Past-month difficulty maintaining sleep</i>	6.59 (9.85)
<i>Past-month non-restorative sleep</i>	5.00 (9.29)
<i>Work stressors</i>	
<i>Work overload</i>	2.70 (1.03)
<i>Role conflict</i>	2.30 (1.07)
<i>Repetitive work</i>	3.29 (0.90)
<i>Job autonomy</i>	3.23 (0.68)
<i>Depressive Symptoms</i>	2.75 (4.27)
<i>Gender</i>	
Female	52.77%
Male	47.23%
<i>Marital status</i>	
Married	55.45%
Divorced/separated/widowed	16.79%
Single	27.76%
<i>Age in years</i>	40.13 (11.78)
<i>Race/ethnicity</i>	
White	82.51%
African American	8.40%
Hispanic/Latino	3.97%
Multiracial/other	5.13%
<i>Educational attainment</i>	
High school degree or less	27.29%
Some college	28.57%
Undergraduate degree	24.43%
Greater than undergraduate degree	19.71%
<i>Annual earnings in thousands of dollars</i>	44.40 (22.80)
<i>Tenure with present employer in years</i>	8.35 (8.79)

Table 2
Negative binomial regression models of frequency of poor sleep quality (n = 1715)

Variable	Difficulty Initiating Sleep	Difficulty Maintaining Sleep	Non-Restorative Sleep
	b (S.E.)	b (S.E.)	b (S.E.)
<i>Work overload</i>	.133 (.041)**	.112 (.045)*	.134 (.058)*
<i>Role conflict</i>	.089 (.040)*	.075 (.044)	.255 (.057)***
<i>Repetitive work</i>	.098 (.050)*	.117 (.055)*	.098 (.067)
<i>Job autonomy</i>	-.035 (.068)	-.110 (.068)	-.218 (.094)*
<i>Depressive Symptoms</i>	.077 (.011)***	.064 (.011)***	.049 (.015)**
<i>Female</i>	.140 (.090)	.274 (.098)**	.242 (.126)
<i>Marital status</i>			
Married	Reference	Reference	Reference
Divorced/separated/widowed	.262 (.123)*	.084 (.131)	.222 (.172)
Single	.030 (.109)	-.029 (.116)	-.029 (.150)
<i>Age</i>	-.017 (.005)***	.000 (.005)	-.063 (.007)***
<i>Race/ethnicity</i>			
White	Reference	Reference	Reference
African American	-.158 (.157)	-.158 (.169)	-.210 (.214)
Hispanic/Latino	.085 (.219)	-.111 (.239)	-.249 (.302)
Multiracial/other	.221 (.193)	.431 (.208)*	.272 (.264)
<i>Educational attainment</i>			
High school degree or less	Reference	Reference	Reference
Some college	-.153 (.115)	-.058 (.124)	.176 (.162)
Undergraduate degree	-.102 (.126)	-.056 (.132)	.220 (.172)
> Undergraduate degree	-.223 (.141)	-.156 (.151)	.273 (.191)
<i>Annual earnings in thousands</i>	-.000 (.002)	.003 (.002)	-.002 (.003)
<i>Tenure</i>	.001 (.006)	.007 (.006)	.021 (.008)*
Alpha	2.814 (.122)	3.342 (.141)	5.337 (.259)
Constant	1.736 (.342)***	1.384 (.342)***	3.276 (.487)***

*
p<.05,

**
p<.01,

p<.001 (two-tailed tests)