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Factors Associated With Sleep Quality Among Operating Engineers

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Abstract

Blue collar workers generally report high job stress and are exposed to loud noises at work and engage in many of the health behavioral factors, all of which have been associated with poor sleep quality. However, sleep quality of blue collar workers has not been studied extensively, and no studies have focused Operating Engineers (heavy equipment operators) among whom daytime fatigue would place them at high risk for accidents. Therefore, the purpose of this study was to determine variables associated with sleep quality among Operating Engineers. This was a cross-sectional survey design with a dependent variable of sleep quality and independent variables of personal and related health behavioral factors. A convenience sample of 498 Operating Engineers was recruited from approximately 16,000 Operating Engineers from entire State of Michigan in 2008. Linear regression was used to determine personal and related health behavior factors associated with sleep quality. Multivariate analyses showed that personal factors related to poor sleep quality were younger age, female sex, higher pain, more medical comorbidities and depressive symptoms and behavioral factors related to poor sleep quality were nicotine dependence. While sleep scores were similar to population norms, approximately 34% (n=143) showed interest in health services for sleep problems. While many personal factors are not changeable, interventions to improve sleep hygiene as well as interventions to treat pain, depression and smoking may improve sleep quality resulting in less absenteeism, fatal work

accidents, use of sick leave, work disability, medical comorbidities, as well as subsequent mortality.

Keywords

Sleep; Pain; Comorbidity; Depression; Nicotine

Introduction

The prevalence of sleep complaints has been estimated to be 16–30% among working populations in the United States[1] and include difficulty in falling asleep, difficulty staying asleep, and poor quality sleep.[2] These sleep problems are associated with daytime fatigue, sleepiness, and impaired daytime function.[3] The socioeconomic losses associated with sleep problems include increases in absenteeism, fatal work accidents, the use of sick leave, work disability, medical comorbidities, as well as subsequent mortality.[1]

Sleep quality has been associated with demographic, psychological, as well as health behavioral factors. Older age is related to changes in sleep architecture and patterns, such as reduced electroencephalogram slow-wave activity and a reduced slow-wave response to sleep deprivation.[4] However, younger workers have been found to be at greater risk for poor sleep quality because of their high work stress, yet low ability to cope with the stress. [5] Those who are female,[1, 2] not married,[6] and less educated[6] have been shown to be at greater risk of poor sleep quality[1, 2, 6]. Racial differences in sleep quality have not been well studied, yet more sleep disturbances have been reported in African Americans compared to Caucasians.[7] In addition, bidirectional inverse relationships between sleep quality and pain,[8] medical comorbidities,[9] and depression[2, 5] have been studied. Among health behaviors, smoking,[4, 9] problem drinking,[4, 9] physical inactivity,[9] and obesity[9–11] have been associated with poor sleep quality. Moreover, blue collar workers generally report high job stress (partially due to lack of control over their tasks or schedule, and repeated and monotonous work)[12] and particularly Operating Engineers (heavy equipment operators) has been shown to be at greater risk of being exposed to loud noises at work[13] and engage in many of the health behavioral factors,[14] all of which have been associated with poor sleep quality. However, most previous studies were population-based surveys,[9, 11] and none of them did not focus blue collar workers, particularly Operating Engineers. Therefore, the purpose of this study was to investigate correlates of sleep quality among Operating Engineers. Using the Health Promotion Model as a theoretical framework[15], personal, health conditional and health behavioral factors were hypothesized to influence sleep quality.

Methods

Design

This was a cross-sectional survey among Operating Engineers. The dependent variable was sleep quality. Potential correlates included personal factors, including biological and sociocultural factors (age, sex, marital status, educational level, pain, and self-reported

number of medical comorbidities), a psychological factor (depressive symptoms), and behavioral factors (smoking, alcohol problems, physical activity, and obesity). Institutional Review Board (IRB) approval was received from the University of Michigan.

Study Population/Setting/Place

A convenience sample was recruited from approximately 16,000 Operating Engineers in the entire State of Michigan coming to either an apprentice certification or Hazardous Materials (Hazmat) refresher course during the Winter of 2008. Operating Engineers were asked to participate until a quota of 500 was reached. Ninety percent of the Operating Engineers who were asked to participate agreed and returned a survey. While constructing a multivariate model, missing values were deleted by listwise method, resulting in a final sample size of 348.

Procedure

The instructor for the Hazmat course explained the study to the attendees, passed out the survey packets (which included a study information sheet, health survey, and return envelope), and collected the completed surveys in sealed envelopes. Each participant received a \$10 gasoline gift card for completing the survey. The sealed envelopes were then returned to the study team.

Measures

Sleep quality was measured by the Medical Outcomes Study sleep quality scale-revised (MOS-R), a six-item questionnaire, designed to measure the quality and quantity of sleep. [16] Possible scores range from zero to 100 with higher scores indicating better sleep quality. Demographic factors included age, sex, race, marital status, educational level, and job experience. Pain was measured using the bodily pain scale from the Medical Outcomes Survey Short Form-36[17]; lower scores indicate worse pain. Self-reported medical comorbidities were collected by survey (cancer, lung disease, heart disease, high blood pressure, stroke, psychiatric problems, diabetes, and arthritis)[18] and then were totaled to calculate the number of medical comorbidities. Depressive symptoms were measured by the Center for Epidemiologic Studies Depression Scale (CES-D)[19].

Smoking status was first divided into smokers (some smoking within the previous 1 month) and non-smokers (no smoking within the previous 1 month) by self-report. Then, smokers were further divided on the basis of Fagerstrom scores of six or higher into those with (smokers with nicotine dependence) and without (smokers with non-nicotine dependence) nicotine dependence.[20] Alcohol problems were measured by the Alcohol Use Disorder Identification Test (AUDIT) with a cut-off point of eight or higher indicating alcohol problems.[21] Physical activity was measured as the score of the Physical Activity Questionnaire.[22] BMI (weight in kilograms divided by the square of height in meters) was calculated based on self-reported height and weight.

Data Analysis

Descriptive statistics (means and frequencies) were computed for all variables. To determine the association of independent variables with sleep quality, bivariate analyses were

conducted using Pearson correlations, t-tests, and one-way ANOVA tests. Since job experience was highly correlated with age ($r = .64$, $p = .000$), only age was included in the final multivariate model. Multicollinearity was assessed using tolerance values and the variance inflation factor (VIF); multicollinearity is a concern when either the tolerance values equal 0.1 or less or the VIF values exceed 10.[23] The tolerance values ranged from .79 to .95, and VIF values ranged from 1.05 to 1.29 in this study. Results from bivariate and multicollinearity analyses and clinical judgment were used to select variables for the final, multivariate linear regression model. Final sample size was 348 since subjects with missing data were properly excluded in a listwise deletion manner. Values of $p < .05$ were considered to be significant. Analyses were performed with the SPSS for Windows, version 17.0.

Results

Descriptions of the Sample

The sample has been described in Table 1. Numbers of the sample for each variable varied due to missing values. The mean age of the sample was 43.0 (± 9.4), and the majority of the participants were males (92.3%) and White (92.4%). Sixty-eight percent of the participants were married, and 60.8% had a high school education or less. The most common comorbidities were hypertension (25.7%) and arthritis (18.7%). Almost half (46.8%) screened positive for depressive symptoms, and 32.8% scored positive for alcohol problems. Among the participants, 28.5% were smokers and 54.2% were non-smokers. Among the smokers, 40.1% ($n = 57$) were nicotine dependent. The majority were overweight (40%) or obese (45%), and physical activity (Mean = 42.7) was about average when compared to population norms of 40.8.[22] While sleep quality (Mean = 70.3) did not differ from the population norms of 72,[24] 34% ($n = 143$) showed interest in health service for better sleep quality.

Bivariate Analyses

Table 2 shows the bivariate associations between the independent variables and sleep quality. Sex, marital status, pain, self-reported number of medical comorbidities, depressive symptoms, alcohol problems, and smoking were significantly associated with sleep quality. While being married ($p = .014$) was associated with better sleep quality, being a female ($p = .006$), reported pain ($p = .000$), increased number of medical comorbidities ($p = .000$), depressive symptoms ($p = .000$), and problem drinking ($p = .002$) were associated with poor sleep quality. The association of smoking and sleep quality was significant ($p = .002$), and a bonferroni post hoc analysis revealed that sleep quality in smokers with nicotine dependence was significantly lower than that in either non-smokers ($p = .001$) or smokers with no nicotine dependence ($p = .012$). Age, race, educational level, physical activity, and obesity did not vary by sleep quality.

Multivariate Analyses

Multivariate analysis revealed that age, sex, pain, self-reported number of medical comorbidities, depressive symptoms, and nicotine dependence were significantly associated with sleep quality among Operating Engineers (Table 3). While older age ($\beta = .134$; $p = .005$) was significantly related to better sleep quality, being a female ($\beta = -.100$; $p = .041$),

reported pain ($\beta = .239$; $p = .000$), increased number of medical comorbidities ($\beta = -.151$; $p = .003$), and depressive symptoms ($\beta = -.310$; $p = .000$) were associated with poor sleep quality. As expected, sleep quality in smokers with nicotine dependence was significantly lower than that of non-smokers ($\beta = -.129$; $p = .008$). This model explained 33% of variance in sleep quality. Marital status and alcohol problems were significant in bivariate analysis, but no longer significant in multivariate analysis. Race, educational level, physical activity, and obesity were not significant in the multivariate analysis.

Discussion

Consistent with other findings from working populations,[5] older age had a positive relationship with sleep quality, while younger Operating Engineers experienced poorer sleep quality related to more job stress, yet fewer resources to deal with the stress. Similar to previous studies,[1, 2] females are more likely to report poor sleep quality related to reproductive hormone changes.[6] As expected, pain, medical comorbidities, and depressive symptoms were related to poor sleep quality related to a vicious cycle where pain, underlying medical comorbidities, and depressive symptoms disrupt sleep quality, which in turn, augments pain intensity, underlying medical comorbidities and depressive symptoms. [8]

The National Center for Sleep Disorders Research reviewed the associations between sleep practice and other health risky behaviors and concluded that smoking, alcohol problems, physical inactivity, and obesity were clustered among either individuals who slept less than six hours or those who sleep nine hours or more.[25] Furthermore, risky health behaviors have a dose-response relationship to poor sleep quality with a higher number of risky health behaviors associated with poorer sleep quality.[9] Contrary to expectations, the associations of sleep quality with alcohol problems, physical activity, and obesity were not statistically significant in this study perhaps because the population was relatively young and had not fully experienced the detrimental consequences associated with these negative health behaviors. Among the health behavior factors, only nicotine dependence was significantly associated with poorer sleep quality.

Given the clustering of poor sleep quality, depression and nicotine dependence, health care providers need to consider the interrelatedness in treating these disorders. For example, widely used non-nicotine pharmacotherapies—bupropion (an antidepressant) and varenicline (a partial nicotine receptor agonist)—have been proven to be effective in helping smokers quit smoking. However, these drug therapies also caused sleep problems,[26] which may lead patients to stop using these drugs. Therefore, for smokers with sleep problems, nicotine replacement therapies (patch, gum, inhalator, spray, sublingual tablet, and lozenge), which cause fewer sleep disturbances,[27] should be considered as the first smoking cessation treatment rather than non-nicotine pharmacotherapies. Given the reciprocal relationship of sleep quality to pain and medical comorbidities, interventions to improve sleep quality may conversely improve pain and other underlying diseases and vice versa. Since one-third of the sample was interested in services to improve sleep, worksite sleep interventions may improve their sleep quality by addressing personal (e.g., managing underlying diseases, depression) and behavioral factors (e.g., interventions to modify smoking or problem

drinking). Pharmaceutical and worksite behavioral therapies have been shown to be effective in improving sleep.

Those with sleep problems spent two to five times more money on prescriptions for sleep treatments as well as for depression and anxiety.[28] However, their long-term use often leads to side effects, such as cognitive and psychosocial impairment, anterograde amnesia, rebound insomnia, development of drug tolerance and dependence, as well as a high risk of mortality by overuse.[29] Therefore, health care providers may consider behavioral interventions first in treating sleep problems.

Considering that younger workers report higher job stress, stress management skills such as cognitive behavioral or relaxation therapies, both of which have been shown to be effective among working populations,[30] may be a good intervention for improving their sleep quality. Klatt et al. determined the efficacy of a six-week worksite intervention consisting of meditation and yoga using a randomized controlled trial design with forty-eight university faculty and staff and those in the intervention group reduced perceived stress and improved sleep quality.[31]

Given the impact of health behaviors on sleep quality,[9] modifying health behaviors may promote sleep quality, such as treating tobacco use and problem drinking and enhancing physical activity. Atlantis et al. conducted a randomized controlled trial of a worksite intervention with 73 casino workers using exercise and sleep hygiene education for 24 weeks, and the intervention group improved sleep quality as well as health-related quality of life.[32] Similarly, Adachi et al. developed a self-help program including regular exercise for a month with 47 workers and reported that the self-help material increased total sleep time, reduced sleep onset latency, and improved sleep efficiency.[33] Even though sleep hygiene interventions alone have been shown to be less effective, sleep hygiene interventions combined with other cognitive behavioral therapies and customized sleep hygiene interventions produced favorable outcomes.[34] Core factors of sleep hygiene programs include regular bedtime/waketime; avoiding use of caffeine and nicotine; and appropriate temperature, comfortable bed, and noise.

About 40% were overweight and 45% were obese, which may put Operating Engineers at risk for Obstructive Sleep Apnea (OSA), yet unfortunately OSA was not assessed in this study. While more complicated, treatment of OSA may also be used to treat sleeplessness. [35] Education to increase awareness of the symptoms of OSA, often related to obesity, may help identify high risk workers and create motivation for polysomnographic assessment. Diagnosis of OSA may allow treatment with Continuous Positive Airway Pressure (CPAP) for a minimum of four hours within a 24-hour period, or surgery as recommended. When properly identified, sleep disturbances are often amenable to treatment which may increase work productivity, improve quality of life, and reduce morbidity and mortality.

There are several limitations in this study. First, since this was a cross-sectional design, the findings from this study cannot determine causal relationships as might a prospective study. Second, the results were also based on the data from a convenience sample of Operating Engineers in Michigan, thus the results may not be generalizable to Operating Engineers in

other geographic areas. Third, there were no differences in sleep quality according to race and educational level most likely due to few variations of these variables in this sample as most were White with similar educational levels. Fourth, all of the survey data was based on self-report without clinical verification, which may bias the results. Fifth, job stress is speculated to relate the relationship between younger age and poor sleep quality, job stress was not examined in this study. As a result, this study was not able to determine which aspects of the Operating Engineers work were associated with poor sleep quality (e.g., shift work). Sixth, the non-significant association between obesity and sleep quality may be because some obese Operating Engineers were already receiving treatment for OSA, which we did not examine. Seventh, other factors that potentially affect sleep quality, such as stress, anxiety, medication, drug use, and sleep hygiene, were not measures.

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Table 1

Characteristics of the Sample

	Mean (SD)	Range
Age (n= 476)	42.95 (9.38)	18–70
Physical activity (n= 472)	42.65 (5.34)	29.1–61.54
Sleep quality (n= 487)	70.32 (17.36)	0–100
	Frequency	Percent
Sex (n= 482)		
Male	445	92.3
Female	37	7.7
Race (n= 472)		
White	436	92.4
Non-white	36	7.6
Marital status (n= 485)		
Married	329	67.8
Non-married	156	32.2
Education (n= 485)		
High school or lower	295	60.8
College or higher	190	39.2
Significant depressive symptoms (n= 470)		
Yes	220	46.8
No	250	53.2
Medical comorbidities (n= 482)		
None	239	49.6
One or more	243	50.4
Smoking (n= 487)		
Smokers	142	28.5
Non-smokers	270	54.2
Alcohol problems (n= 476)		
Yes	156	32.8
No	320	67.2
BMI (n=478)		
Obese (BMI ≥ 30)	213	44.6
Overweight (BMI 25–29.9)	192	40.2
Normal (BMI 18.5–24.9)	71	14.8
Underweight (BMI < 18.5)	2	0.4

Table 2

Correlations of Independent Variables With Sleep Quality

	Pearson Correlation Coefficients	P-values
Age (n=470)	.090	.052
Sex (Female) (n=476)	-.126	.006 **
Race (White) (n=469)	.049	.294
Marital status (Married) (n=479)	.112	.014 *
Education (High school or less) (n=479)	-.046	.315
Pain (n=486)	.376	.000 ***
Number of Medical Comorbidities (n=476)	-.242	.000 ***
Depressive symptoms (n=466)	-.444	.000 ***
Alcohol Problems (n=469)	-.142	.002 **
Smoking (n=395)	6.43 ^a	.002 **
Physical Activity (n=471)	.002	.972
Obesity (n=474)	-.010	.826

Numbers of the sample varied due to missing values.

^a indicates analysis of variance.*
p .05;**
p .01;***
p .001

Table 3

Multivariate Analysis of Independent Variables Related to Sleep Quality (n=348)

	Beta	P-value
Age	.134	.005 **
Sex (Female)	-.100	.041 *
Race (White)	-.055	.235
Marital status (Married)	.067	.159
Education (High school or less)	-.065	.156
Pain	.239	.000 ***
Number of Medical Comorbidities	-.151	.003 **
Depressive symptoms	-.310	.000 ***
Alcohol Problems	-.063	.185
Smoking		
Non-Smokers	0	
Smokers with Non-Nicotine Dependence	.036	.451
Smokers with Nicotine Dependence	-.129	.008 **
Physical Activity	-.055	.243
Obesity	.024	.614
R ²	.327	

*
p .05;**
p .01;***
p .001