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Perceived Control and Sleep in Hospitalized Older Adults: A Sound Hypothesis?

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Abstract

Background/Objectives—To examine the associations between perceived control over sleep, noise levels, sleep duration and noise complaints in a cohort of hospitalized adults.

Design—Prospective cohort study.

Setting—General medicine ward in an academic medical center.

Participants—118 hospitalized patients age 50 years and over (mean age 65 years, 57% female, 67% African American).

Measurements—Sleep duration was measured via wrist actigraphy and noise levels in patient rooms were measured via sound monitors. Validated questionnaires used to assess sleep characteristics at baseline and sleep quality for each night. Perceived control over sleep was measured at baseline using the Sleep Self-Efficacy (SSE) scale (range 9–45).

Results—Mean SSE score was 32.1 (SD = 9.4) and median score was 34 (IQR = 24–41). Average sleep duration for patients in the hospital was 333 minutes (5.5 hours). Forty-two percent of patients complained of noise disrupting their sleep. Linear regression clustered by subject showed that above median SSE was associated with longer sleep duration (+55 minutes 95%CI[14, 97], p=0.010). This association remained significant after controlling for objective noise levels and patient demographics (+50 minutes 95%CI [11, 90], p=0.014). In logistic regression controlling for noise level and patient demographics, those patients with high SSE were 51% less likely to complain of noise disruptions (OR=0.49 95%CI[0.25, 0.96], p=0.039).

Conclusion—Higher perceived control over sleep is associated with longer sleep duration, better sleep quality, and fewer reports of noise disruptions. In addition to noise control, interventions to boost perceived control may improve in-hospital sleep.

Keywords

Hospitalized Patients; Sleep Quality; Perceived Control

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INTRODUCTION

Lack of sleep is a common problem in hospitalized patients and is associated with poorer health outcomes, especially in older patients.(1–3) Prior studies highlight a multitude of factors that can result in sleep loss in the hospital(3–6) with one of the most common causes of sleep disruption in the hospital being noise.(7,8,9)

In addition to external factors, such as hospital noise, there may be inherent characteristics that predispose certain patients to greater sleep loss when hospitalized. One such measure is the construct of perceived control, or the psychological measure of how much individuals expect themselves to be capable of bringing about desired outcomes (10). Among older patients, low perceived control is associated with increased rates of physician visits, hospitalizations, and death.(11–12) In contrast, patients who feel more in control their environment may experience positive health benefits.(13)

Yet, when patients are placed in a hospital setting, they experience a significant reduction in control over their environment along with an increase in dependency on medical staff and therapies.(14,15) For example, hospitalized patients are restricted in their personal decisions, such as what clothes they can wear and what they can eat, and are not in charge of their own schedules, including their sleep time.

While prior studies suggest that perceived control over sleep is related to actual sleep among community dwelling adults,(16,17) no study has examined this relationship in hospitalized adults. Therefore, the aim of our study is to examine the possible association between perceived control, noise levels and sleep in hospitalized middle-aged and older patients.

METHODS

Study Design

We conducted a prospective cohort study of subjects recruited from a large ongoing study of admitted patients at the University of Chicago inpatient general medicine service.(18) Because we were interested in middle-aged and older adults who are most sensitive to sleep disruptions, patients who were age 50 years and over, ambulatory and living in the community were eligible for the study.(19) Exclusion criteria were cognitive impairment (telephone version of the Mini-Mental State Exam < 17 out of 22), preexisting sleeping disorders identified via patient charts such as obstructive sleep apnea and narcolepsy, transfer from the ICU and admission to the hospital more than 72 hours prior to enrollment.(20) These inclusion and exclusion criteria were selected in order to identify a patient population with minimal sleep disturbances at baseline. Patients under isolation were excluded because they are not visited as frequently by the health care team.(21,22) Most general medicine rooms were double occupancy, but efforts were made to make patient rooms single when possible or required (i.e. isolation for infection control). The study was approved by the University of Chicago Institutional Review Board.

Subjective Data Collection

Baseline levels of perceived control over sleep, or the amount of control patients believe they have over their sleep, were assessed using two different scales. The first tool was the 8-item Sleep Locus of Control (SLOC) scale,(17) which ranges from 8 to 48 and higher values correspond to a greater internal locus of control over sleep. An internal sleep locus of control indicates beliefs that patients feel that they are primarily responsible for their own sleep, as opposed to an external locus of control which indicates beliefs that good sleep is due to luck or chance. For example, patients were asked how strongly they agree or disagree

with statements, such as, “If I take care of myself, I can avoid insomnia” and “People who never get insomnia are just plain lucky.” (Appendix 2) The second tool was the 9-item Sleep Self-Efficacy (SSE) scale, (23) which ranges from 9 to 45, with higher values corresponding to greater confidence patients have in their ability to sleep. One of the items asks, “How confident are you that you can lie in bed feeling physically relaxed?” (Appendix 1) Both instruments have been validated in an outpatient setting. (23) These surveys were given immediately upon enrollment in the study to measure baseline perceived control.

Baseline sleep habits were also collected upon enrollment using the Epworth Sleepiness Scale, (24,25) a standard validated survey that assesses excess daytime sleepiness in various common situations. For each day in the hospital, patients were asked to report in-hospital sleep quality using the Karolinska Sleep Log. (26) The Karolinska Sleep Quality Index (KSQI) is calculated from four items on the Karolinska Sleep Log (sleep quality, sleep restlessness, slept throughout the night, ease of falling asleep). The questions are on a 5-point scale and the four items are averaged for a final score out of 5, with a higher number indicating better subjective sleep quality. The item “How much was your sleep disturbed by noise?” on the Karolinska Sleep Log was used to assess the degree to which noise was a disruptor of sleep. This question was also on a 5-point scale, with higher scores indicating greater disruptiveness of noise. Patients were also asked how disruptive noise from roommates was on a nightly basis using this same scale.

Objective Data Collection

Wrist activity monitors (Actiwatch 2: Respironics, Inc., Murrysville, Pennsylvania) (27–30) were used to measure patient sleep. Actiware 5 software (Respironics, Inc., Murrysville, Pennsylvania) (31) was used to estimate quantitative measures of sleep time and efficiency. Sleep time is defined as the total duration of time spent sleeping at night and sleep efficiency is defined as the fraction of time, reported as a percentage, spent sleeping by actigraphy out of the total time patients reported they were sleeping.

Sound levels in patient rooms were recorded using Larson Davis 720 Sound Level Monitors (Larson Davis, Inc., Provo, Utah). These monitors store functional average sound pressure levels in A-weighted decibels called the Leq over one-hour intervals. The Leq is the average sound level over the given time interval. Minimum (Lmin) and maximum (Lmax) sound levels are also stored. The LD SLM Utility Program (Larson Davis, Inc., Provo, Utah) was used to extract the sound level measurements recorded by the monitors.

Demographic information (age, gender, race, ethnicity, highest level of education, length of stay in the hospital and comorbidities) was obtained from hospital charts via an ongoing study of admitted patients at the University of Chicago Medical Center inpatient general medicine service. (18) Chart audits were performed to determine whether patients received pharmacologic sleep aids in the hospital.

Data Analysis

Descriptive statistics were used to summarize mean sleep duration and sleep efficiency in the hospital as well as Sleep Locus of Control and Sleep Self-Efficacy. Because the SSE scores were not normally distributed, the scores were dichotomized at the median to create a variable denoting high and low SSE. Additionally, because the distribution of responses to the noise disruption question was skewed to the right, reports of noise disruptions were grouped into “not disruptive” (score = 1) and “disruptive” (score > 1).

Two-sample t-tests with equal variances were used to assess the relationship between perceived control measures (high / low SLOC, SSE) and objective sleep measures (sleep time, sleep efficiency). Multivariate linear regression was used to test the association

between high SSE (independent variable) and sleep time (dependent variable), clustering for multiple nights of data within subject. Multivariate logistic regression, also adjusting for subject, was used to test the association between high SSE and noise disruptiveness and the association between high SSE and Karolinska scores. Leq, Lmax and Lmin were all tested using stepwise forward regression. Because our prior work(9) demonstrated that noise levels separated into tertiles were significantly associated with sleep time, our analysis also used noise levels separated into tertiles. Stepwise forward regression was used to add basic patient demographics (gender, race, age) to the models. Statistical significance was defined as $p < 0.05$ and all statistical analysis was done using Stata 11.0 (Stata Corp., College Station, TX).

RESULTS

From April 2010 to May 2012, 1,134 patients were screened by study personnel for this study via an ongoing study of hospitalized patients on the inpatient general medicine ward. Of the 361 (31.8%) eligible patients, 206 (57.1%) consented to participate. Of the subjects enrolled in the study, 118 were able to complete at least one night of actigraphy, sound monitoring and subjective assessment for a total of 185 patient nights. (Figure 1)

The majority of patients were female (57%), African American (67%) and non-Hispanic (97%). The mean age was 65 (SD=11.6) years and the median length of stay was 4 days (Interquartile Range (IQR) = 3–6). The majority of patients also had hypertension (67%), with COPD (31%) and congestive heart failure (31%) being the next most common comorbidities. About two-thirds of subjects (64%) were characterized as “average” or “above average” sleepers with Epworth Sleepiness Scale scores 9.(20) (Table 1). Only 5% of patients received pharmacological sleep aids.

Mean baseline Sleep Locus of Control (SLOC) score was 30.4 (SD = 6.7), with a median of 31 (IQR = 27–35). Mean baseline Sleep Self-Efficacy (SSE) score was 32.1 (SD = 9.4), with a median of 34 (IQR = 24–41). Fifty-four patients were categorized as having “high sleep self-efficacy” (high SSE), which we defined as scoring above the median of 34.

Average in-hospital sleep was 5.5 hours (333 minutes, SD=128) which was significantly shorter than self-reported sleep duration of 6.5 hours prior to admission (387 minutes, SD=125, $p=0.0001$). Mean sleep efficiency was 73% (SD=19) with 55% of actigraphy nights below the normal range of 80% efficiency for adults.(19) Median Karolinska Sleep Quality Index (KSQI) was 3.5 (IQR 2.25–4.75), with 41% of the patients with a KSQI 3, putting them in the “insomniac” range.(32) The median score on the noise disruptiveness question was 1 (IQR 1–4), with 42% of reports coded as “disruptive” defined as a score greater than 1 on the 5-point scale. The median score on the roommate disruptiveness question was 1 (IQR1-1) with 77% of responses coded as “not disruptive” defined as a score of 1 on the 5-point scale.

A two-sample t-test with equal variances showed that those patients reporting high SSE were more likely to sleep longer in the hospital than those reporting low SSE (364 minutes 95%CI[340, 388] vs. 309 minutes 95%CI[283, 336], $p=0.003$) (Figure 2) Patients with high SSE were also more likely to have a normal sleep efficiency (above 80%) compared to those with low SSE (54% 95%CI[43, 65] vs. 38% 95% CI[28,47], $p=0.028$). Lastly, there was a trend towards patients reporting higher SSE to also report less noise disruption compared to those patients with low SSE (42% 95%CI[31, 53] vs. 56% 95%CI[46, 65] $p=0.063$) (Figure 3)

Linear regression clustered by subject showed that high SSE was associated with longer sleep duration (55 minutes 95%CI[14, 97], $p=0.010$). Furthermore, high SSE was

significantly associated with longer sleep duration after controlling for both objective noise level and patient demographics in the model using stepwise forward regression (50 minutes 95%CI[11, 90], $p=0.014$). (Table 2)

Logistic regression clustered by subject demonstrated that patients with high SSE had 2 times higher odds of having a KSQI score above 3 (95%CI[1.12, 3.71], $p=0.020$). This association was still significant after controlling for noise and patient demographics (OR=2.01, 95%CI[1.06, 3.79], $p=0.032$). After controlling for noise levels and patient demographics, there was a statistically significant association between high SSE and lower odds of noise complaints (OR=0.49, 95%CI[0.25, 0.96], $p=0.039$). (Table 2) While demographic characteristics were not associated with high SSE, those patients with high SSE had lower odds of being in the loudest tertile rooms (OR=0.34 95%CI[0.15, 0.74], $p=0.007$).

In multivariate linear regression analyses, there were no significant relationships between Sleep Locus of Control (SLOC) scores and KSQI, reported noise disruptiveness and markers of sleep (sleep duration or sleep efficiency).

DISCUSSION

This study is the first to examine the relationship between perceived control, noise levels and objective measurements of sleep in a hospital setting. One measure of perceived control, namely sleep self-efficacy (SSE) was associated with objective sleep duration, subjective and objective sleep quality, noise levels in patient rooms and perhaps also patient complaints of noise. These associations remained significant after controlling for objective noise levels and patient demographics, suggesting that sleep self-efficacy is independently related to sleep.

In contrast to SSE, sleep locus of control (SLOC) was not found to be significantly associated with either subjective or objective measures of sleep quality. The lack of association may be due to the fact that the SLOC questionnaire does not translate as well to the inpatient setting as the SSE questionnaire. The SLOC questionnaire focuses on general beliefs about sleep while the SSE questionnaire focuses on personal beliefs about one's own ability sleep in the immediate future, which may make it more relevant in the inpatient setting. (Appendix 1,2)

Given our findings, it is important to identify why patients with high SSE have better sleep and fewer noise complaints. One possibility is that sleep self-efficacy is an inherent trait unique to each person that is also predictive of a patient's sleep patterns. However, is it also possible that those patients with high SSE feel more empowered to take control of their environment, allowing them to advocate for better sleep? This hypothesis is further strengthened by the finding that those patients with high SSE on study entry were less likely to be in the noisiest rooms. This raises the possibility that at least one of the mechanisms by which high SSE may be protective against sleep loss is through patients taking an active role in noise reduction, such as closing the door or advocating for their sleep with staff. However, we did not directly observe or ask patients whether doors of patient rooms were open or closed or whether the patients took other measures to advocate for their own sleep. Thus, further work is necessary to understand the mechanisms by which SSE may influence sleep.

One potential avenue for future research is to explore possible interventions for boosting SSE in the hospital. While most interventions have focused on environmental noise and staff-based education, empowering patients through boosting SSE may be a helpful adjunct to improving hospital sleep.(33,34) Currently, the Sleep Self-Efficacy scale is not commonly

used in the inpatient setting. Motivational interviewing and patient coaching could be explored as potential tools for boosting SSE. Furthermore, even if SSE is not easily changed, measuring SSE in patients newly admitted to the hospital may be useful in identifying patients most susceptible to sleep disruptions. Efforts to identify patients with low SSE should go hand-in-hand with measures to reduce noise. Addressing both patient-level and environmental factors simultaneously may be the best strategy for improving sleep in an inpatient hospital setting.

In contrast to our prior study, it is worth noting that we did not find any significant relationships between overall noise levels and sleep (9). In this dataset, nighttime noise is still a predictor of sleep loss in the hospital. However, when we restrict our sample to those who answered SSE and had nighttime noise recorded, we lose a significant number of observations. Because of our interest in testing the relationship between SSE and sleep, we chose to control for overall noise (which enabled us to retain more observations). We also did not find any interactions between SSE and noise in our regression models. Further work is warranted with larger sample sizes to better understand the role of SSE in the context of sleep and noise levels. In addition, females also received more sleep than males in our study.

There are several limitations to this study. This study was carried out at a single service at a single institution, limiting the ability to generalize the findings to other hospital settings. This study had a relatively high rate of patients who were unable to complete at least one night of data collection (42%), often due to watch removal for imaging or procedures, which may also affect the representativeness of our sample. Moreover, we can only examine associations and not causal relationships. The Sleep Self-Efficacy scale has never been used in hospitalized patients, making comparisons between scores from hospitalized patients and population controls difficult. In addition, the Sleep Self-Efficacy scale also has not been dichotomized in previous studies into high and low SSE. However, a sensitivity analysis with raw SSE scores did not change the results of our study. It can be difficult to perform actigraphy measurements in the hospital because many patients spend most of their time in bed. Since we chose a relatively health cohort of patients without significant limitations in mobility, actigraphy could still be used to differentiate time spent awake from time spent sleeping. Because we did not perform polysomnography, we cannot explore the role of sleep architecture, which is an important component of sleep quality. While the use of pharmacologic sleep aids is a potential confounding factor, the rate of use was very low in our cohort and unlikely to significantly affect our results. Continued study of this patient population is warranted in order to further develop the findings.

In conclusion, patients with high sleep self-efficacy sleep better in the hospital, tend to be in quieter rooms and may report fewer noise complaints. Our findings suggest that a greater confidence in the ability to sleep may be beneficial in hospitalized adults. In addition to noise control, hospitals should also consider targeting patients with low sleep self-efficacy when designing novel interventions to improve in-hospital sleep.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Figure 1.

Flow of Patients through the Study. Abbreviations: ICU, intensive care unit

Figure 2.

Association between sleep self-efficacy (SSE) and sleep duration. Baseline levels of SSE were measured using the Sleep Self-Efficacy Scale where a higher score indicates a greater degree of confidence in one's ability to sleep. Patients were considered to have high SSE if they scored above the median score of 35 on the Sleep Self-Efficacy Scale and low SSE if they scored below the median. Sleep duration was measured in minutes via wrist- watch actigraphy. A 2-sample t test with equal variances showed that those with high SSE had longer sleep duration than those with low SSE.

Figure 3.

Association between sleep self-efficacy (SSE) and complaints of noise. Baseline levels of SSE were measured using the Sleep Self-Efficacy Scale where a higher score indicates a greater degree of confidence in one's ability to sleep. Patients were considered to have high SSE if they scored above the median score of 35 on the Sleep Self-Efficacy Scale and low SSE if they scored below the median. Patient complaints of noise were measured on a 5-point scale, where a higher score indicates greater disruptiveness of noise. Scores >1 were considered to be noise complaints. Patients with high SSE had significantly fewer complaints of noise compared to those with low SSE.

Table 1**Patient Demographics and Baseline Sleep Characteristics**

n = 118	
Patient Characteristics	Value [n (%)]^a
Age (in years), mean (SD)	63 (12)
Length of stay (in days) ^b , median (IQR)	4 (3–6)
Female	67 (57)
African American	79 (67)
Hispanic	3 (3)
High school graduate	92 (78)
Comorbidities	
Hypertension	79 (66)
Chronic obstructive pulmonary disease	37 (31)
Congestive Heart Failure	37 (31)
Diabetes	36 (30)
End stage renal disease	23 (19)
Baseline Sleep Characteristics	
Sleep duration (in minutes) ^c , mean (SD)	333 (128)
Epworth Sleepiness Scale ^d (score 9)	73 (64)

NOTE: Abbreviations: IQR, interquartile range; SD, standard deviation

^a[n (%)] unless otherwise noted

^bNumber of days from patient admission to discharge

^cBased on self-reported sleep from previous month

^dRange from 0 to 24, with 9 being “average” or “above average” and > 9 being “excessively sleepy”

Table 2

Regression Models for Sleep and Noise Complaints

n=118		
Sleep Duration (minutes)		
	Model 1 ^a Beta [95% CI]	Model 2 ^a Beta [95% CI]
High SSE	55 [14, 97] ^d	50 [11, 90] ^d
Lmin tert 3	-----	-14 [-59, 29]
Lmin tert 2	-----	-21 [-65, 23]
Female	-----	49 [10, 89] ^d
African American	-----	-16 [-59, 27]
Age	-----	1 [-0.9, 3]
Karolinska Sleep Quality		
	Model 1 ^b OR [95% CI]	Model 2 ^b OR [95% CI]
High SSE	2.04 [1.12, 3.71] ^d	2.01 [1.06, 3.79] ^d
Lmin tert 3	-----	0.90 [0.37, 2.2]
Lmin tert 2	-----	0.86 [0.38, 1.94]
Female	-----	1.78 [0.90, 3.52]
African American	-----	1.19 [0.60, 2.38]
Age	-----	1.02 [0.99, 1.05]
Noise Complaints		
	Model 1 ^c OR [95% CI]	Model 2 ^c OR [95% CI]
High SSE	0.57 [0.30, 1.12]	0.49 [0.25, 0.96] ^d
Lmin tert 3	-----	0.85 [0.39, 1.84]
Lmin tert 2	-----	0.91 [0.43, 1.93]
Female	-----	1.40 [0.71, 2.78]
African American	-----	0.35 [0.17, 0.70]
Age	-----	1.00 [0.96, 1.03]
Age ^{2e}	-----	1.00 [1.00, 1.00]

NOTE: Baseline levels of sleep self-efficacy were measured using the Sleep Self-Efficacy Scale, where a higher score indicates a greater degree of confidence in one's ability to sleep. Patients were considered to have high sleep self-efficacy (high SSE) if they scored above the median score of 35 on the Sleep Self-Efficacy Scale, and low sleep self-efficacy (low SSE) if they scored below the median. Sleep duration was measured in minutes via wristwatch actigraphy. KSQI scores greater than 3 were considered to represent "good" qualitative sleep. Lowest recorded sound levels (Lmin) were divided into tertiles, where "Lmin tert 3" is the loudest and "Lmin tert 2" is the second loudest.

^aLinear regression analyses, clustered by subject, were done to assess the relationship between high sleep self-efficacy and sleep duration, both with and without Lmin tertiles and patient demographics as covariates. Coefficients (minutes) and 95% confidence interval (CI) are reported.

^b Logistic regression analyses, clustered by subject, were done to assess the relationship between high SSE and odds of high Karolinska score (>3), both with and without Lmin tertiles and patient demographics. Odds ratios and 95% confidence intervals are reported.

^c Logistic regression analyses, clustered by subject, were done to assess the relationship between high SSE and noise complaints, both with and without Lmin tertiles and patient demographics. Odds ratios and 95% confidence intervals are reported.

^d $p < 0.05$

^e Age² was used in this model fit