RESEARCH ARTICLE

Sleep Disturbance and Upper-Extremity Disability

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Abstract

Background: Although upper-extremity disability correlates with psychosocial aspects of illness the association with sleep disturbance in upper extremity disability is less certain.
To evaluate whether sleep disturbance is associated with upper-extremity disability among patients with upper extremity illness, accounting for sociodemographic, condition-related, and psychosocial factors.

Methods: A cohort of 111 new or follow-up patients presenting to an urban academic hospital-based hand surgeon completed a sociodemographic survey and measures of sleep disturbance (PROMIS Sleep Disturbance), disability (PROMIS Upper-Extremity Physical Function), ineffective coping strategies (PROMIS Pain Interference), and depression (PROMIS Depression). Bivariate and multivariable linear regression modeling were performed.

Results: Sleep disturbance correlated with disability (r=-0.38; *P*<0.001) in bivariate analysis. Symptoms of depression (r=-0.44; *P*<0.001) and ineffective coping strategies (PROMIS Pain Interference: r=-0.71; *P*<0.001) also correlated with upper-extremity specific disability in bivariate analysis. Pain Interference was the only factor associated with disability in multivariable analysis.

Conclusions: Sleep disturbance is not as strongly or directly associated with symptom intensity and magnitude of disability as ineffective coping strategies. Interventions to reduce pain interference (e.g. cognitive behavioral therapy) hold great potential to decrease musculoskeletal symptom intensity and magnitude of disability, and perhaps even sleep disturbance.

Keywords: Disability, Pain interference, Sleep disturbance, Upper extremity

Introduction

Arm specific disability is measured with a variety of instruments such as the Patient-Reported Outcomes Measurement Information System (PROMIS) Upper Extremity questionnaire and the Disability of the Arm, Shoulder, and Hand (DASH) questionnaire. Psychosocial factors, such as mood, mindset, coping strategies, and kinesophobia, are strongly correlated with disability as measured with PROMIS Upper Extremity and DASH. Objective physical impairment has less influence (1-6).

Sleep disturbance is common among patients with upper extremity illness. Sometimes the sleep disturbance is associated with pathophysiology (e.g. carpal tunnel syndrome), while often it is also a function of psychosocial distress and ineffective coping (e.g. orthopaedic trauma) (7-11).

In this study, we evaluated whether sleep disturbance is associated with upper-extremity disability among patients with upper extremity illness. The primary null hypothesis was that there is no association between sleep disturbance and upper-extremity disability, accounting for sociodemographic, condition-related, and psychosocial factors (ineffective coping strategies and symptoms of depression). The secondary null hypotheses were that there is no association between ineffective coping strategies and symptoms of depression with upper-extremity disability.

Materials and Methods

Study Design

After approval of our institutional review board, 115 new or follow-up patients presenting to an urban academic

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Table 1. Characteristics of the study population (n=111)

Parameter	*P*-Value
Age* (y)	52 ± 17 (18-91)
Sex†	
Female	56 (51)
Male	55 (49)
Race/ethnicity†	
White	92 (83)
Non-white	19 (17)
Duration of education* (y)	15±3.2 (0-21)
Working status†	
Working	69 (62)
Unemployed	8 (7.2)
Disabled	11 (10)
Retired	23 (21)
Marital status†	
Single	30 (27)
Married	61 (55)
Separated or divorced	12 (11)
Widowed	8 (7.2)
Diagnosis†	
Sprain, dislocation, or mallet finger	9 (8.1)
Hand fracture	13 (12)
Wrist fracture	12 (11)
Amputation, crush, or laceration	6 (5.4)
Carpal tunnel or cubital tunnel syndrome	16 (14)
Osteoarthrosis	5 (4.5)
Trigger finger	13 (12)
Non specific arm pain	6 (5.4)
Elbow fracture	6 (5.4)
De Quervain tendinopathy	5 (4.5)
Dupuytren	4 (3.6)
All other diagnoses	16 (14)
Other pain conditions†	
Yes	48 (43)
No	63 (57)
Body mass index*	27±6.2 (17-48)
Obesity (BMI ≥ 30)†	
Yes	29 (26)
No	82 (74)
Visit type†	
First	50 (45)
Follow-up	61 (55)
PROMIS Questionnaires*	
Sleep Disturbance	51±9.5 (32-79)
Upper Extremity Function	42±11 (18-56)
Pain Interference	55±8.1 (39-84)
Depression	47±10 (34-74)

*The values are given as the mean and the standard deviation, with the range in parentheses
†The values are given as the number of patients, with the percentage in parentheses

Table 2. Bivariate Statistical Analysis

	PROMIS Upper Extremity Function	
Pearson correlation	r value	*P*
Age	-0.13	0.17
Education	0.27	0.004
BMI	-0.2	0.038
PROMIS Sleep Disturbance	-0.38	<0.001
PROMIS Pain Interference	-0.71	<0.001
PROMIS Depression	-0.44	<0.001
t-test	t value	*P*
Sex	-2.3	0.023
Race/ethnicity	0.49	0.63
Other pain conditions	2.9	0.004
Visit type	1,2	0,24
One-way ANOVA	F value	*P*
Working status	4.6	0.005
Marital status	1.9	0.14
Diagnoses	1.2	0.30

hospital-based hand surgeon were invited to participate in this cross-sectional study between December 2014 and January 2015. Patients were considered eligible for this study if they were aged 18 or older and spoke English fluently. Pregnant patients were excluded. Four patients (3.4%) declined participation, leaving 111 patients in the study. We obtained informed consent from each subject prior to enrollment.

All consenting patients were asked to complete a sociodemographic survey and 4 PROMIS-based computerized adaptive testing questionnaires: PROMIS Sleep Disturbance, Upper-Extremity Physical Function, Pain Interference, and Depression (12-15). Sociodemographic variables included age, sex, race/ethnicity, education, working status, marital status, and body mass index (BMI). All questionnaires were completed using a laptop computer, and the answers were collected in an Excel (Windows Excel, Microsoft, Redmond, WA) spreadsheet.

Patient Characteristics [Table 1]

Our study sample consisted of 56 (50%) women and 55 (50%) men with a mean (±SD) age of 55 (±17) years. Most patients were white (83%), and either single (27%) or married (55%). Twenty-nine patients (26%) were obese (BMI≥30). The most common diagnosis was compression neuropathy (14%), followed by hand (12%) and wrist (11%) fractures.

Outcome Measures

Unlike instruments with a fixed set of items, the PROMIS questionnaires utilize computerized adaptive testing technology based on item response theory to filter items that are redundant or do not apply to the respondent, thereby enabling the administration of individually tailored questionnaires with fewer items while still maintaining good psychometrics (16). The number of items administered ranges from 4 to 12.

The PROMIS Sleep Disturbance questionnaire evaluates qualitative aspects of sleep and wake function (e.g. perceptions of sleep quality, sleep depth, and restoration associated with sleep) (12); a higher score indicates greater sleep disturbance (12, 17).

The PROMIS Upper-Extremity Physical Function questionnaire assesses the degree of disability with physical activities that entail use of the arm and hand (e.g. writing, tying shoelaces, using buttons, and lifting heavy objects (13); lower scores indicate higher levels of upper-extremity specific disability.

The PROMIS Pain Interference questionnaire determines the extent to which pain impedes patients' physical, mental, and social activities (14); a higher score represents greater pain interference.

The PROMIS Depression questionnaire evaluates depressive symptoms by measuring negative mood (sadness, guilt), views of self (worthlessness, self-criticism), and diminished positive affect and engagement (loss of interest) (3, 15); a higher score indicates greater symptoms of depression.

Statistical Analysis

An a priori power analysis indicated that a sample size of 111 patients would provide 90% statistical power (α=0.05) to detect a moderate effect size (f^2=0.18) in a linear regression model with 7 predictors.

Continuous data were reported as the mean, standard deviation, and range. Categorical variables were presented with frequencies and percentages.

In bivariate analysis, the correlations of continuous

Table 3. Multivariable Statistical Analysis

	PROMIS Upper Extremity Function					
Predictors	Beta	Standard error	95% CI	Partial R^2	*P*	Adjusted R^2
Sex	2.1	1.5	-0.93 to 5.2	0.0088	0.17	
BMI	0.086	0.13	-0.18 to 0.35	0.0019	0.52	
Other pain conditions	1.4	1.7	-2.1 to 4.8	0.0028	0.44	
Education	0.20	0.25	-0.30 to 0.71	0.0030	0.43	
Working status						0.49
Unemployed	1.9	3.0	-4.0 to 7.8	0.0019	0.53	
Disabled	-2,2	2.7	-7.7 to 3.2	0.0030	0.42	
Retired	-0,63	2.0	-4.6 to 3.4	0.00044	0.76	
PROMIS Sleep Disturbance	-0,10	0.090	-0.28 to 0.075	0.0061	0.25	
PROMIS Pain Interference	-0,79	0.12	-1.0 to -0.56	0.21	<0.001	
PROMIS Depression	-0,11	0.093	-0.30 to 0.075	0.0064	0.24	

variables with PROMIS Upper-Extremity Physical Function were analyzed using Pearson correlations. Associations with dichotomous and categorical variables were determined with the independent samples t-test and one-way analysis of variance, respectively.

All variables with *P*<0.10 in bivariate analysis were entered into a multiple linear regression model with the PROMIS Upper-Extremity Function score as the response variable. All covariates that met the criteria for entry were inserted into the model simultaneously, without further selection. The model calculated the adjusted R-squared value, a measure of the percentage of the overall variability in the PROMIS Upper-Extremity Function score that could be explained by all the variables included in the model. The model also calculates betas for each individual predictor, showing whether a particular variable has a significant effect on the dependent variable in the presence of all other predictors.

Results

Sleep disturbance correlated with disability (r=-0.38; *P*<0.001) in bivariate analysis [Table 2], but not after adjusting for confounding with other variables using multivariable regression [Table 3].

Symptoms of depression (r=-0.44; *P*<0.001) and ineffective coping strategies (PROMIS Pain Interference: r=-0.71; *P*<0.001) correlated with upper-extremity specific disability in bivariate analysis. Pain Interference was the sole predictor of disability in multivariable analysis (adjusted R-squared for the model=0.49), explaining 21% of the variability (partial R-squared=0.21) in the PROMIS Upper-Extremity Function score.

Discussion

Although upper-extremity disability has been shown to correlate highly with various psychosocial aspects of illness (e.g., self-efficacy, depression, kinesiophobia, and pain catastrophizing) (1-6,18), the role of sleep disturbance in upper extremity disability is less certain. This study sought to evaluate whether sleep disturbance is associated with upper-extremity disability, accounting for sociodemographic, condition-related, and psychosocial factors.

This study should be considered in light of its shortcomings. First, sleep disturbance is multifactorial and there may be more factors affecting sleep quality ––and thus confounding its association with disability–– beyond the variables we considered (e.g. depression, BMI, work status, age). For instance, we did not account for use of sleep compromising drugs, sleeping alone or with a partner, working rotating shifts, use of caffeine, and the use of multiple electronic devices during the evening (19-23). Second, all patients were seen by a single hand surgeon at a large urban academic center, which may limit generalizability to other physicians and settings. Third, it would have been ideal to only enroll patients presenting with the same condition (or a group of similar conditions), instead of including patients with any hand disorder. Although we did not find any differences in sleep disturbance among the various diagnoses categories, this finding could have been a function of the small number of patients in each category. Additional research on disability in patients with specific hand conditions could provide additional information. Finally, all of the patients included in our study lived in the United States; hence, we were unable to evaluate culture-related discrepancies in disability and sleep disturbance.

The observation that greater sleep disturbance was not associated with increased upper extremity disability in multivariable analysis suggests that the sleep disturbance may be a function of ineffective coping strategies. Whether sleep disturbance causes less effective coping or less effective coping contributes to poor sleep cannot be addressed with observational data, but it is likely that the relationship is bidirectional. A previous study evaluating sleep disturbance one year after orthopaedic trauma found that disability was not associated with sleep disturbance accounting for other factors (10). In contrast, Wilcox et al. found that greater disability was associated with greater sleep disturbance in patients with knee pain (11).

Our findings are consistent with prior research that found ineffective coping strategies to be more strongly associated with symptom intensity and magnitude of disability than psychological distress. For instance, PROMIS Pain Interference explained 51% of the variation in QuickDASH scores in a cohort of 213 patients with upper extremity illness (3). Similarly, Overbeek and colleagues recently reported that upper extremity disability is most strongly influenced by the degree to which pain interferes with achieving goals (24). The correlation of symptoms of depression with magnitude of disability is also consistent with previous studies with the correlation consistently in the 0.40 to 0.50 range (1, 3, 18). In some studies symptoms of depression are independently associated with upper extremity disability and ineffective coping strategies dominate and symptoms of depression are not associated.

In conclusion, our data suggest that sleep disturbance is not as strongly or directly associated with symptom intensity and magnitude of disability compared to ineffective coping strategies. Interventions to reduce pain interference (e.g. cognitive behavioral therapy) hold great potential to decrease musculoskeletal symptom intensity and magnitude of disability, and, indirectly, perhaps even sleep disturbance. There is encouraging evidence for a beneficial effect on symptoms and disability from a preliminary randomized clinical trial among orthopaedic trauma patients (25). Additional research and more widespread adoption of mind body skills-based interventions as a routine part of orthopaedic care are warranted.

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