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The Pain-Depression Dyad and the Association with Sleep Dysfunction in Chronic Rhinosinusitis

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Abstract

Background—Depression, pain, and sleep disturbance is a symptom cluster often found in patients suffering from chronic illness, exerting a large impact on quality-of-life (QOL). A wealth of literature exists demonstrating a significant association between depression, pain, and sleep dysfunction in other chronic diseases. This relationship has not been described in patients with chronic rhinosinusitis (CRS).

Methods—Sixty-eight adult patients with CRS were prospectively enrolled. Patients at risk for depression were identified using the Patient Health Questionnaire-2 (PHQ-2) using a cutoff of 1 or greater. Pain experience was measured using the Brief Pain Inventory Short Form (BPI-SF) and the Short Form McGill Pain Questionnaire (SF-MPQ). Sleep quality was assessed using the Pittsburgh Sleep Quality Index (PSQI).

Results—Forty-seven patients were at risk for depression. Significant positive correlations were found between total PSQI scores and all pain measures ($R=0.38-0.61$, $p < 0.05$) and between total PSQI scores and PHQ-2 scores ($R=0.46$, $p < 0.05$). For patients at risk for depression, significant, positive correlations were found between pain measures, the total PSQI score, and the three PSQI subdomains (sleep latency, sleep quality, and daytime dysfunction; $R=0.31-0.61$, $p < 0.05$). The relationship between pain and sleep dysfunction scores was not seen in the absence of depression.

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Conclusions—Depression, pain, and sleep dysfunction are inter-related in patients with CRS. In the absence of depression significant correlations between pain and sleep are not observed, suggesting that depression plays a key role in this interaction. Further research investigating the complex relationship between depression, pain, and sleep dysfunction in CRS is needed.

Keywords

Outcome assessment; chronic disease; depression; sleep; pain; sinusitis

INTRODUCTION

The combination of pain, sleep dysfunction, and depression is a symptom cluster often found in patients suffering from chronic illness, exerting a substantial impact on quality-of-life (QOL) in this population. Recent studies have demonstrated significant correlations between pain, sleep dysfunction, and depression in a variety of chronic illnesses including diabetic peripheral neuropathy¹, chronic pain syndromes²⁻⁴, cancer^{5,6} and rheumatoid arthritis^{7,8} among others.⁹

While the relationship between pain, sleep dysfunction, and depression has been studied in patients suffering from other chronic illnesses, no studies to date have attempted to describe the complex interplay between these symptoms in patients with chronic rhinosinusitis (CRS). Individual assessments of these symptoms in patients with CRS have, however, shown an increased burden of disease compared to controls.¹⁰ For example, using validated instruments to assess pain, DeConde et al. showed that patients with CRS have more facial pain compared to controls, and pain correlated with CRS disease-specific QOL measures.¹¹ In a recent study by Alt et al., 75% of patients with CRS reported poor sleep scores using the Pittsburgh Sleep Quality Index (PSQI)¹² while Schlosser et al. recently demonstrated higher rates of depression in patients with CRS compared to controls based on Beck Depression Inventory scores.¹³

Our group recently showed that facial pain scores using validated pain questionnaires correlated significantly with the sleep dysfunction domain scores of the 22-item SinoNasal Outcome Test (SNOT-22) in patients who have depressive symptoms, but did not correlate significantly in patients without depressive symptoms, suggesting a potential link between pain, depression and sleep dysfunction in patients with CRS.¹⁴ For this investigation we hypothesized that facial pain, sleep dysfunction, and depressive symptoms were associated in patients with CRS. Our objective was to further investigate evidence for these complex associations using validated instruments for assessing pain, depressive symptoms and sleep quality.

MATERIALS & METHODS

Subjects and Data Collection

Study participants were enrolled from the University of Utah Sinus and Skull base clinic. Patients meeting inclusion criteria were adult patients with the diagnosis of CRS according to the 2015 American Academy of Otolaryngology Adult Sinusitis Guideline.¹⁵

Study participants completed necessary enrollment procedures and provided informed consent. Study-related questionnaires completed by participants include the PSQI, the Patient Health Questionnaire-2 (PHQ-2), the Brief Pain Inventory Short Form (BPI-SF), and the Short-Form McGill Pain Questionnaire (SF-MPQ).

Demographic information and medical/social history were obtained from each study participant, including: age, gender, asthma, acetylsalicylic acid (ASA) sensitivity, allergy, current tobacco use, alcohol consumption, prior sinus surgery and previous diagnosis of obstructive sleep apnea (OSA). Approval from the University of Utah Institutional Review Board (IRB #61810) was obtained.

Exclusion criteria

Patients with an autoimmune and/or inflammatory disease such as rheumatoid arthritis or systemic lupus erythematosus (SLE) or with underlying severe or debilitating illnesses such as multiple sclerosis, cancer, cystic fibrosis (CF), or heart failure were excluded given the high likelihood of comorbid depressive symptoms, pain, and sleep dysfunction in this population. Patients with chronic pain conditions including fibromyalgia and chronic migraines, as well as those with a history of obstructive sleep apnea (OSA), were excluded from the analysis. In addition, all study participants who failed to complete all study-related questionnaires during the initial enrollment meeting were excluded.

Research Instruments

Pittsburgh Sleep Quality Index—The PSQI is a validated instrument to evaluate sleep quality.¹⁶ It asks participants to answer questions pertaining to sleep quality during the past month. There is a total score (range: 0-21) and 7 subdomain scores (range: 0-3 for each) including those for: sleep quality, latency, duration, efficiency, disturbance, sleep medication use, and daytime dysfunction. Higher PSQI scores indicate poorer sleep quality. A PSQI total score < 5 is considered the threshold for “good” sleep quality while a total score > 5 represents “poor” sleep quality.

Patient Health Questionnaire-2—The PHQ-2 is comprised of the first two questions of the Patient Health Questionnaire-9 (PHQ-9). It has been validated as a screening tool to identify patients who are at-risk for depression.¹⁷ Participants report how frequently they have experienced 1) little interest or pleasure in doing things and 2) feeling down, depressed, or hopeless in the past two weeks on a scale from 0 (not at all) to 3 (nearly every day). Patients were divided into two groups based on PHQ-2 score. Patients with a PHQ-2 score of ≥ 1 were designated as being at risk for any depressive disorder (n=47), and those with a PHQ-2 score of 0 were designated as not at risk for any depressive disorder (n=23). The commonly accepted cutoff for the PHQ-2 is ≥ 3 , however it has been suggested that if the instrument is being used as a screening tool for depressive disorder, a cutoff of ≥ 3 may result in an unacceptably high false negative rate¹⁸. We therefore opted to use a score of ≥ 1 to define patients at risk for depression.

Brief Pain Inventory Short Form—The BPI-SF measures pain intensity and the extent to which pain interferes with daily activities. It has been validated for use in chronic pain

and has recently been used to examine facial pain in patients with CRS.¹¹ For the present study, the questionnaire was modified to specifically assess facial pain. Participants rate their current pain level on a 0-10 scale with larger numbers representing more severe pain. Participants also rate their pain at its “worst,” “least,” and “average” on a 0-10 scale. The final pain severity score is the mean of the four values (range 0-10). Pain interference is assessed by asking participants to rate the level of interference their pain causes in 7 different categories including: general activity, walking ability, work, mood, enjoyment of life, relations with other people, and sleep. These are also rated on a 0-10 scale with higher scores representing more interference. The pain interference score is calculated as the mean of the interference items (range: 0-10).

Short Forum McGill Pain Questionnaire—The SF-MPQ consists of 15 items relating to pain quality.¹⁹ As with the BPI-SF, this questionnaire was also modified to address facial pain specifically. Patients rate their pain experience with regard to each item on a scale of 0 (none) to 3 (severe). The first 11 items represent the sensory dimension of pain, while the remaining 4 represent the affective dimension. Totals in each dimension are calculated (ranges: sensory 0-33, affective 0-12, total 0-45). In addition, participants rate their current pain (Present Pain Inventory, PPI) on a 0-5 scale with higher scores representing more severe pain. The final total score of the SF-MPQ is calculated as the sum of the PPI and the total score of the sensory and affective dimensions (range 0-50). Finally, the SF-MPQ includes a visual analogue scale (VAS) to indicate overall pain intensity. For the current study, the VAS was modified to a Likert scale from 0-10 and participants were asked to refer only to sinus pain.

Data Management, Sampling Size Estimations, and Statistical Analysis

Study data were collected using standardized research instruments. All participants were assigned a unique study identifier to ensure confidentiality. Data were manually entered into an electronic database (Microsoft Access; Microsoft Corp., Redmond, WA) by a trained research coordinator. SPSS (IBM Corp., Armonk, NY, Version 22.0) statistical software was used for data analysis. An estimated sample size was calculated for bivariate correlation coefficients (R) between pain and depression. Calculations assumed 80% power (1- β error probability) and a 0.050 alpha (α) level. Results of the power analysis suggest that the current sample size has the power to detect a significant correlation coefficient of $R = 0.324$.

Descriptive statistics were calculated to summarize patient characteristics, such as age, gender, and other health conditions. Bivariate Spearman (R_s) correlations were used to identify associations between pain, depression, and sleep scores among patients with CRS.

RESULTS

A total of 68 patients qualified for the study based on inclusion and exclusion criteria and were prospectively enrolled between August, 2013–October, 2015. Study group demographic characteristics are summarized in **Table 1**. Demographic and clinical characteristics for patients at risk versus not at risk for depression are compared in **Table 2**. Patients at risk for depression had significantly higher prevalence of prior surgery compared to those not at risk

for depression. Otherwise, there were no statistically significant differences observed between the two groups across patient characteristics.

Bivariate correlation analysis was performed for PSQI scores and pain severity measures. Significant positive correlations were found between overall PSQI scores and all pain measures (**Table 3**). PSQI subdomain analysis also revealed positive correlations between facial pain measures and PSQI subdomain scores (**Table 3**). The R-values reported here are in the range of what is conventionally considered to be ‘mild’ to ‘moderate’ in magnitude²⁰. The strongest correlations were seen between SF-MPQ scores and the sleep latency, daytime dysfunction, sleep quality, and medication use subdomains.

Association between depression and sleep measures are described in **Tables 4-5**. Significant positive associations were identified between PHQ-2 and PSQI total scores. When the PSQI was divided into subdomains, significant positive correlations were seen between PHQ-2 scores and all PSQI subdomain scores except sleep efficiency. Again, these correlations were in the mild to moderate range. Additionally, patients at risk for depression had significantly higher mean PSQI total scores than those not at risk for depression. When the patients were stratified into “good” vs “poor” sleep quality subgroups, patients with “poor” sleep quality who were at risk for depression had significantly higher PSQI scores than those not at risk for depression. This relationship was not seen in patients with “good” sleep quality.

Finally, we sought to delineate the relationship between pain, sleep and depression scores in CRS (**Table 6**). There were significant positive correlations between facial pain measures and all PSQI subdomains in patients at risk for depression. The correlations were again mild to moderate in strength, with the strongest correlations seen in the sleep latency, daytime dysfunction, sleep quality, and medication use subdomain scores. For patients not at risk for depression, associations between PHQ-2 scores and PSQI scores were substantially less frequent and were seen only in the sleep disturbance and medication use subdomains.

DISCUSSION

Individuals with chronic illnesses often experience a number of comorbid ailments that disturb overall QOL. Pain, depression, and sleep dysfunction are among these, and this symptom constellation is often seen in patients with CRS. The relationship between these three symptom constructs has been investigated in other chronic illnesses, but has not been well delineated in CRS. In the present study, we demonstrated correlations between reported pain, sleep and depression scores in patients with CRS. We found significant correlations between sleep quality scores and pain measures. We also demonstrated significant correlations between sleep quality scores and PHQ-2 scores. Patients at risk for depression had significantly higher scores on the PSQI than those not at risk for depression. Additionally, we demonstrated that pain measures and PSQI scores were correlated to a large degree in patients at risk for depression, but this association was markedly diminished in those not at risk for depression. Taken together, these findings suggest some magnitude of association between facial pain, depressive symptoms, and sleep dysfunction in CRS.

The associations between facial pain, sleep dysfunction and depression in patients with CRS that were found in the present study raise some interesting questions about whether there is a plausible pathobiologic mechanism that could explain these associations. Although this has not been studied in CRS, several possibilities have been posited in other fields. For example, it is known that pain, sleep, and mood share common neurobiological pathways, and it has been suggested that alterations in these pathways could be responsible for the association. For example, disturbance in the mesolimbic dopamine signaling system has been extended as a putative mechanism.²¹ Mesolimbic dopaminergic neurons originate in the ventral tegmental area and project to a number of locations in the brain known to be related to sleep and wakefulness.²² In vivo models have suggested that increased dopamine levels in these areas is related to the arousal-promoting effects of exogenous stimulants and the resultant sleep disturbance/insomnia.²³⁻²⁵ In addition, phasic release of dopamine in the mesolimbic system produces analgesia in response to a pain stimulus. Studies have shown that increased tonic dopamine levels in the mesolimbic system results in decreased sensitivity to phasic dopamine release leading to increased pain response to an acute pain stimulus.²⁶ This decreased phasic dopamine release is also believed to be related to the development of depression and anhedonia.^{27,28} This body of evidence suggests that persistent elevation of tonic dopamine levels in the mesolimbic system is at least a plausible explanation for the correlation and interaction between sleep dysfunction, pain and depression in patients suffering from chronic illness.

Other neurobiological signaling pathways are also known to play a role in depression, sleep regulation, and pain modulation, and may be implicated in this triad. Serotonin, for example, has long been recognized as a key regulatory neurotransmitter in the sleep/wake cycle.²⁹ Serotonin is also believed to play a crucial role in the pathobiology of depression³⁰, and has been implicated in pain modulation.³¹ Some authors have therefore suggested serotonergic signaling dysfunction as the underlying mechanism linking pain, sleep dysfunction, and depression in patients with chronic illness.³² Other neurotransmitters including norepinephrine have also been suggested to contribute.

Perhaps more intriguing is the idea that inflammation may contribute to this symptom constellation through what has been referred to as the “immune brain pathway.” There are a number of studies describing the role of pro-inflammatory cytokines in sleep regulation, specifically IL-1 and TNF.³³ The effects of inflammatory cytokines on pain and depression have also been described. A recent systematic review by Howren et al. found positive associations between depression and IL-1, CRP, and IL-6.³⁴ TNF and IL-1 have also been shown to modulate pain perception.^{35,36} Doong et al. demonstrated that variations in pro- and anti-inflammatory genes are associated with pain, fatigue, sleep disturbance, and depression in patients with breast cancer.⁵ These inflammatory cytokines are known to be up regulated in CRS.³³ These findings support the notion that sinonasal inflammation may play a role in the complex interaction between pain, sleep dysfunction, and depression in CRS.

In the current study, we demonstrated correlations between facial pain measures and PSQI scores in patients at risk for depression based on PHQ-2 screening scores. For patients not at risk for depression, these associations were markedly decreased. This supports the findings of our prior study in which we demonstrated significant positive correlations between all

pain measures and the sleep dysfunction domain of the SNOT-22 in patients at risk for depression, but not in patients not at risk for depression.¹⁴ The loss of association between pain and sleep dysfunction in the absence of depression suggests that depression may play a key role in the interplay between these symptoms.

We have shown that patients with CRS who are at risk for depression experience significantly more facial pain and sleep dysfunction than those not at risk for depression.¹⁴ It is not currently known whether patients have more facial pain and sleep dysfunction because they are depressed or if they experience more depressive symptoms because of facial pain or sleep dysfunction. The relationship between these symptoms is likely highly complex and studies aimed at determining which, if any, of these symptoms is the driving force behind this interaction are warranted.

Research efforts focused on better understanding this complex relationship in CRS may help inform treatment strategies and improve outcomes. Recent research has shown that depression predicts worse QOL outcomes after endoscopic sinus surgery.^{37,38} In light of the results of the current study, the question arises of whether managing comorbid depressive symptoms would improve outcomes in CRS. The effect of antidepressant therapy in patients with CRS has not been investigated to date. Additional investigations are needed to determine if there is a benefit to managing depression in CRS.

Interestingly, we found that patients in our cohort who were at risk for depression had significantly higher prevalence of prior sinus surgery compared to those not at risk for depression. A recent study by Orb et al³⁹ showed that after an initial period of medical management, patients with CRS electing endoscopic sinus surgery over continued medical management had significantly higher scores on the emotional subdomains of the RSDI compared with those who opted for continued medical management, suggesting that, in some patients, emotional forces may be influencing the decision to pursue surgery. This could explain the higher incidence of prior sinus surgery in those at risk for depression in our cohort. Alternatively, it may be that prior sinus surgery had an effect on the emotional state of patients thereby increasing depressive symptoms. Further research is needed to better clarify this relationship.

We used the PHQ-2 to detect depressive symptoms in our patient population. Historically, a score of 3 or greater has been used to define patients who are at risk for depression due to an instrument sensitivity of 83% and a specificity of 92% for major depression¹⁷. More recently, it has been suggested that a cutoff of 3 has an unacceptably high false negative rate for a screening instrument.¹⁸ Using a cutoff score of 1 or greater, the PHQ-2 has a sensitivity and specificity of 97.6% and 59.2%, respectively, for detection of major depressive disorder, and a sensitivity and specificity of 90.6% and 65.4%, respectively, for detection of any depressive disorder. We elected to use a score threshold of 1 or greater, instead of the traditional cutoff of 3 in order to decrease the risk of misclassifying at-risk patients.

It is important to point out that although statistically significant and the R-values observed are in the range of what is generally accepted as mild to moderate in strength. Additionally,

there is currently no defined minimum clinically important difference (MCID) for the PSQI. Therefore, it is unknown whether the difference in PSQI scores between patients at-risk and not at-risk for depression (**Table 5**) is clinically significant. Further defining the clinical relevance of these findings is an area of potential future study.

Strengths of the current study include a prospective design and utilization of validated instruments to assess pain, depression, and sleep dysfunction. One limitation is that patients were enrolled exclusively through a tertiary sinus clinic located in an academic center. Patients enrolled in this setting may not be comparable to those seen in the community setting, and the results may therefore not be externally generalizable. Additionally, we did not attempt to control for, or exclude patients based on, current medication use. There are a number of medications including anti-depressants and anxiolytics which act on the central nervous system and could have affected the relationships seen between pain, sleep dysfunction, and depressive symptom scores.

CONCLUSION

Depression, pain, and sleep dysfunction are interrelated in patients with CRS. The relationship between pain and sleep dysfunction is lost in the absence of depression, suggesting that depression may play a key role in this interaction. Further research investigating the complex relationship between depression, facial pain, and sleep dysfunction in CRS is needed.

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Table 1

Baseline characteristics of study group (N=68)

Demographics/History	CRS	
	Mean [SD]	N [%]
Age (years)	49.12 [16.87]	
Males		36 [53]
Females		32 [47]
Asthma		35 [52]
ASA sensitivity		9 [13]
Allergy		35 [52]
Current tobacco use		4 [6]
Alcohol consumption		19 [28]
Prior sinus surgery		41 [60]
Pain Scores		
BPI-SF pain severity	3.39 [2.05]	
BPI-SF pain interference	3.40 [2.68]	
Total SF-MPQ	12.59 [10.29]	
Sensory dimension	9.70 [7.85]	
Affective dimension	3.00 [2.85]	
PPI	2.14 [1.31]	
Depression		
PHQ-2 score	1.81 [1.91]	
PHQ-2 Score 1		47 [69]
Sleep		
PSQI score (total)	9.85 [4.74]	
Disease Severity Measures:		
Lund-Mackay CT Score	12.71 [7.03]	
Lund-Kennedy Endoscopy Score	5.57 [3.41]	

SD = standard deviation; BPI-SF = Brief Pain Inventory Short Form; SF-MPQ = Short-Form McGill Pain Questionnaire; PPI = Present Pain Inventory; PHQ-2 = Patient Health Questionnaire-2; PSQI = Pittsburgh Sleep Quality Index.

Table 2

Comparison of baseline characteristics between patients with CRS at risk and not at risk for depression based on PHQ-2 scores.

Demographics/History	PHQ-2 = 1		PHQ-2 = 0		p-value
	Mean [SD]	N [%]	Mean [SD]	N [%]	
Age (years)	47.34 [16.20]		53.10 [18.04]		0.196
Males		23 [48.9%]		13 [61.9%]	0.322
Asthma		21 [44.7%]		14 [66.7%]	0.094
ASA sensitivity		5 [10.6%]		4 [19.0%]	0.344
Allergy		23 [48.9%]		12 [57.1%]	0.333
Current tobacco use		4 [8.5%]		0 [0.0%]	0.168
Alcohol consumption		10 [21.3%]		9 [42.9%]	0.067
Prior sinus surgery		32 [68.1%]		9 [42.9%]	0.049*
SNOT-22 score	59.14 [18.67]		54.21 [19.58]		0.349
Lund-Mackay CT Score	11.91 [7.50]		14.50 [5.59]		0.173
Lund-Kennedy Endoscopy Score	5.36 [3.64]		6.05 [2.86]		0.465

SD = standard deviation; PHQ-2 = Patient Health Questionnaire-2

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Table 3
Bivariate Spearman correlation coefficients between PSQI scores and pain severity measures for patients with CRS.

	PSQI Scores									
	Sleep Duration R_s	Sleep Disturbance R_s	Sleep Latency R_s	Daytime Dysfunction R_s	Sleep Efficiency R_s	Sleep Quality R_s	Medication Use R_s	Total R_s		
BPI-SF Pain severity	0.191	0.131	0.229	0.394	0.198	0.313	0.380	0.388		
BPI-SF Pain interference	0.397	0.409	0.444	0.483	0.172	0.459	0.412	0.587		
Total SF-MPQ	0.348	0.407	0.505	0.449	0.328	0.575	0.429	0.613		
Sensory dimension	0.321	0.392	0.432	0.420	0.232	0.549	0.441	0.558		
Affective dimension	0.302	0.373	0.493	0.421	0.313	0.514	0.377	0.585		
PPI Score	0.299	0.154	0.427	0.378	0.235	0.392	0.397	0.455		
VAS Score	0.229	0.204	0.347	0.370	0.163	0.279	0.416	0.451		

R_s =correlation coefficient; BPI-SF = Brief Pain Inventory Short Form; SF-MPQ = Short-Form McGill Pain Questionnaire; PPI = Present Pain Inventory; VAS = Visual Analogue Scale; PSQI = Pittsburgh Sleep Quality Index.

* $p < 0.05$

** $p < 0.01$

Table 4 Bivariate Spearman correlation coefficient between PSQI score and PHQ-2 score for patients with CRS.

	PSQI Scores							Total R_s
	Sleep Duration R_s	Sleep Disturbance R_s	Sleep Latency R_s	Daytime Dysfunction R_s	Sleep Efficiency R_s	Sleep Quality R_s	Medication Use R_s	
PHQ-2 Score	0.314**	0.327**	0.298*	0.374**	0.220	0.335**	0.341**	0.457**

R_s =correlation coefficient; PSQI = Pittsburgh Sleep Quality Index; PHQ-2 = Patient Health Questionnaire-2

* $p < 0.05$

** $p < 0.01$

Table 5

Comparison of PSQI scores between patients with CRS at risk and not at risk for depression based on PHQ-2 scores.

	PHQ -2 1 or greater	PHQ-2 less than 1	p-value
	Mean [SD]	Mean [SD]	
PSQI Score	10.80 [4.76]	7.19 [3.54]	0.008*
Good Sleep Quality (PSQI ≤ 5)	4.33 [0.82]	3.67 [1.51]	0.369
Poor Sleep Quality (PSQI > 5)	11.79 [4.32]	9.30 [2.54]	0.027*

SD – standard deviation; PSQI = Pittsburgh Sleep Quality Index; PHQ-2 = Patient Health Questionnaire–2.

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Table 6

Bivariate Spearman correlation coefficient between pain severity measures and PSQI scores in patients with CRS at risk and not at risk for depression based on PHQ-2 scores.

Pain Severity Measures: PHQ-2 1	PSQI Scores										Total R _s
	Sleep Duration R _s	Sleep Disturbance R _s	Sleep Latency R _s	Daytime Dysfunction R _s	Sleep Efficiency R _s	Sleep Quality R _s	Medication Use R _s				
BPI-SF Pain severity	0.071	0.025	0.308*	0.393**	0.152	0.315*	0.280	0.305*			
BPI-SF Pain interference	0.319*	0.285	0.497**	0.491**	0.159	0.424**	0.447**	0.530**			
Total SF-MPQ	0.272	0.320*	0.528**	0.414**	0.365*	0.610**	0.376*	0.573**			
Sensory dimension	0.245	0.310*	0.500**	0.368*	0.262	0.590**	0.385**	0.536**			
Affective dimension	0.266	0.297	0.486**	0.345*	0.417**	0.537**	0.332*	0.543**			
PPI Score	0.230	0.050	0.446**	0.399**	0.143	0.398**	0.265	0.371*			
VAS Score	0.114	0.154	0.410**	0.316*	0.068	0.284	0.339*	0.331*			

Pain Severity Measures: PHQ-2 = 0	PSQI Scores										Total R _s
	Sleep Duration R _s	Sleep Disturbance R _s	Sleep Latency R _s	Daytime Dysfunction R _s	Sleep Efficiency R _s	Sleep Quality R _s	Medication Use R _s				
BPI-SF Pain severity	0.248	0.144	-0.051	0.120	0.064	0.122	0.583*	0.218			
BPI-SF Pain interference	0.366	0.514*	0.175	0.113	0.012	0.418	0.317	0.417			
Total SF-MPQ	0.258	0.396	0.263	0.117	0.113	0.278	0.460	0.318			
Sensory dimension	0.161	0.231	0.111	0.203	0.057	0.213	0.513*	0.253			
Affective dimension	0.192	0.408	0.314	0.244	-0.112	0.275	0.372	0.275			
PPI Score	0.330	0.223	0.203	0.044	0.245	0.242	0.585*	0.385			
VAS Score	0.173	0.000	0.049	0.180	0.190	0.024	0.520*	0.370			

R_s=correlation coefficient; BPI-SF = Brief Pain Inventory Short Form; SF-MPQ = Short-Form McGill Pain Questionnaire; PPI = Present Pain Inventory; VAS = Visual Analogue Scale; PSQI = Pittsburgh Sleep Quality Index; PHQ-2 = Patient Health Questionnaire-2.

* p-value<0.05

** p-value<0.01