

## Prevalence of sleep disturbance in chronic pain

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**Abstract. – OBJECTIVE:** Sleep is a vital function for human beings, which can be affected by several factors. Chronic pain is one of these factors where it is the most frequent cause for seeking medical care in combination with insomnia. The aim of this study is to examine the prevalence and relationship between sleep disturbance and chronic pain.

**PATIENTS AND METHODS:** After approval, a total of 85 Family Medicine Units from over 170 in Tokat were randomly selected using a 50% sampling. A sample of 2635 subjects, over the age of 19 years, who were registered with the selected Family Medicine Units, were assessed due to gender, age group, and the urban/rural population size of Tokat using the stratified sampling method. The sample size distribution was calculated as 1515 urban subjects, 1120 rural subjects; 1345 female subjects, 1290 male subjects; 1123 subjects between 20-39 years of age, 1103 subjects between the ages of 40-64, and 409 subjects over 64 years of age. After sampling, subjects were invited to participate in the study via an invitation letter, and agreeing individuals were taken to the Family Medicine Unit for face-to-face meetings. Written, informed consent was obtained, along with demographic data. The presence of chronic pain was recorded. According to the presence of chronic pain, all subjects were separated into two groups as Group Chronic Pain and Group Non-Chronic Pain. The visual analog scale for pain intensity, and Pittsburgh Sleep Quality Index for sleep quality, were performed with all subjects. A multiple linear regression model was used to assess the predictors of sleep quality. Analyses were conducted using the Statistical Package for Social Sciences program (SPSS Inc., Chicago, IL, USA), version 20.0. The statistical significance for all analyses was set at  $p < 0.05$ .

**RESULTS:** The mean global Pittsburgh Sleep Quality Index score of Group Chronic Pain ( $5.30 \pm 4.29$ ) was significantly higher than in Group Non-Chronic Pain ( $3.22 \pm 3.30$ ;  $p < 0.01$ ). The mean Pittsburgh Sleep Quality Index scores of females ( $5.69 \pm 4.40$ ) were significantly higher

than males ( $4.54 \pm 3.96$ ) in Group Chronic Pain ( $p = 0.000045$ ). A total of 40.7% of patients in Group Chronic Pain, and 21.9% in Group Non-Chronic Pain demonstrated poorer sleep quality according to the Pittsburgh Sleep Quality Index scores, with a cut-off level  $> 5$ . A moderate positive correlation was found between the global Pittsburgh Sleep Quality Index and Visual Analog Scale scores ( $r = 0.310$ ,  $p < 0.01$ ). A multiple linear regression analysis showed that age, gender, income, Visual Analog Scale, and presence of depression were the significant predictors for Pittsburgh Sleep Quality Index score.

**CONCLUSIONS:** The current study revealed that chronic pain and pain intensity are important predictors of sleep quality.

*Key Words:*

Chronic pain, Sleep, Visual analog pain scale.

### Introduction

Pain and sleep are two different physiological requirements of humans, where pain is recognized as the fifth vital sign, and sleep is a biologically essential individual function<sup>1</sup>. Besides uncertainty in regards to the exact nature of these functions, the interaction between pain and sleep can lead to impairment in the biological and behavioral capacity of an individual<sup>1,2</sup>.

Chronic pain and insomnia are major health problems worldwide, and they are the most frequent reasons for seeking medical care<sup>3,4</sup>. Furthermore, several population-based surveys have demonstrated an overall wide variety of chronic pain, ranging from 10 to 50% of the population<sup>5-7</sup>. In addition, the persistent pain ratio among primary care patients was reported to be between 5 and 33%<sup>3</sup>. Moreover, it has been reported that 19% of the European population experiences chronic pain, and 40% of the European

population indicated that chronic pain affects daily activities including sleep<sup>6</sup>. A recent survey conducted by the American Pain Society showed that pain control improves sleep quality by 14%, and pain management positively affects the quality of sleep<sup>8,9</sup>. In addition, the interaction between pain and sleep disturbances have been shown to have an affect on quality of life in a variety of medical conditions<sup>10,11</sup>. Power et al.<sup>12</sup> reported that pain has a substantial effect on sleep disturbances in patients with arthritis and other chronic conditions. Disturbed sleep from chronic pain is inevitably related with restricted social functioning, poor quality of life, and higher levels of disability<sup>13,14</sup>. Several studies have been conducted to elucidate the relationship between pain and sleep disturbance, employing various instruments<sup>15-17</sup>. Nevertheless, a systematic search of the literature revealed that there have been few studies with a large sample size evaluating the quality of sleep in patients with chronic pain of non-oncologic origin. The aim of this study is to demonstrate the prevalence of sleep disturbance using Pittsburgh Sleep Quality Index (PSQI), and to define the predictors those lead an effect on sleep quality.

### Patients and Methods

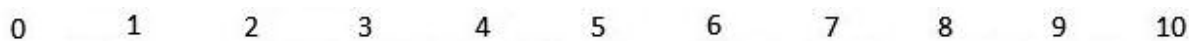
After receiving approval from the Gaziosmanpasa University Medical School Ethics Committee (13-KAEK-232), a sample size of 2635 was calculated using the Epi Info software from the total Tokat city population of 608,299 (59% urban and 41% rural) with a 5% total error, 97% confidence interval, and 2% design effect. Individuals aged over 19 years were randomly identified using the Family Medicine Unit's registration system at the Tokat Provincial Directorate of Health.

A total of 85 Family Medicine Units (FMU) from over 170 in Tokat were randomly selected using a 50% sampling. A sample of 2635 subjects, over the age of 19 years, who were registered with the selected FMUs, were assessed due to gender, age group, and the urban/rural popula-

tion size of Tokat using the stratified sampling method. The sample size distribution was calculated as 1515 urban subjects, 1120 rural subjects; 1345 female subjects, 1290 male subjects; 1123 subjects between 20-39 years of age, 1103 subjects between the ages of 40-64, and 409 subjects over 64 years of age.

Mental disorders and pregnancy were the exclusion criteria. An invitation letter was sent to the randomly selected subjects. Subjects who agreed to participate in the study was invited to the FMU for face-to-face meetings. Written, informed consent was obtained, and demographic data (age, gender, education, marital status, occupational status, income, history of depression) and the presence of non-cancer originated chronic pain (pain lasting more than 6 months) were recorded. The visual analog scale ([VAS], [Appendix 1]) for pain intensity, and PSQI for sleep quality, were utilized with all subjects. Additionally, participants were asked to evaluate their sleep quality as "poor" or "good" (subjective sleep assessment). According to the presence of chronic pain, all subjects were separated into two groups as Group Chronic Pain (CP) and Group Non-Chronic Pain (NCP).

The VAS is a measurement instrument that assesses pain intensity on a 10 cm scale, where "0" indicates no pain and "10" reflects the worst possible pain. The PSQI, which was designed by Buysse et al<sup>18</sup>. in 1989, is a self-rated questionnaire that consists of 19 items to evaluate sleep quality and disturbances over a 1-month period of time, and five questions rated by the bed partner. There are seven component scores including subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleeping medication, and daytime dysfunction. The last five questions are not mixed into the scoring of the PSQI. The 19 items are weighted equally on a 0-3 scale, and the seven component scores are then summed to obtain a global PSQI score, which has a range of 0-21; higher scores show worse sleep quality. The Turkish translation and cross-cultural adaptation of the PSQI was conducted by Agargun et al<sup>19</sup> in 1996.



Appendix 1. Visual Analog Pain Scale.

### Statistical Analysis

Normality and variance for each variable were tested using the One-Sample Kolmogorov-Smirnov test, skewness and kurtosis, histograms, and Q-Q plots. Quantitative data were presented as the means and standard deviation, and qualitative data as the frequency and percentage.

Depending on these results, a non-parametric analysis was undertaken for each variable. Age, global PSQI, and subscale score differences among groups were analyzed using the Mann-Whitney U test. Gender, marital status, educational level, and income level differences between the groups were analyzed using a Chi-square test.

A multiple linear regression model with backward elimination was used to assess the effects of age, gender, income, VAS, marital status, educational level, and presence of depression on the global PSQI score. The backward stepwise method was used to restrict the suppressor effects, which occur when a predictor has a substantial effect, but only when another variable is held constant, and to limit the risk of making a type II error, thereby missing an important predictor. This was done so the variable with the highest *p*-value could be excluded at each step.

We used a receiver operating characteristics (ROC) curve to determine a cut-off value for the PSQI score. The ROC curve is a useful method for evaluating the performance of a diagnostic test in the classification of subjects into two categories, as positive and negative. To display a ROC curve in the subjective sleep assessment da-

ta, “good” were determined as 0 (negativity for test), and “poor” as 1 (positivity for test). The ROC curve displays a graph between sensitivity and 1-specificity. A sample of enough size may be taken with known positive and negative cases. Observed values were noted when the test was administered. For every observed value, sensitivity and 1-specificity of the test were displayed. In a new graph, sensitivity and specificity values were drawn, and the intersection point of the sensitivity and specificity graphs was defined as the cut-off point. Sensitivity shows the proportion of subjects who have poor sleep quality and indicate positivity in subjective sleep assessment scores. Specificity is the proportion of subjects without poor sleep quality and who indicate negativity in their subjective sleep assessment scores. The ROC curve was used to judge how well the test performs based on the area under the curve (AUC). If the AUC is near 1, it has a higher chance of correct classification; however, when it is near 0, it has a higher chance of being incorrectly classified in the opposite group<sup>20</sup>.

Analyses were conducted using the Statistical Package for Social Sciences program (SPSS Inc., Chicago, IL, USA), version 20.0. The statistical significance for all analyses was set at *p* < 0.05.

### Results

Patient characteristics were presented in Table I. The number of female patients was significantly higher in CP (*p* < 0.01). The educational level in CP was found to be lower compared to NCP (*p*

**Table I.** Characteristics of the participants.

	Total sample	CP	NCP	<i>p</i>
Age		47.79±15.10	48.10±15.03	46.86±15.15
0.056 <sup>†</sup>				
Gender				
Male	1113 (55.8%)	348	535	< 0.01 <sup>§*</sup>
Female	883 (44.2%)	666	447	
Marital Status				
Single	241 (12.1%)	109	132	0.065 <sup>§</sup>
Married	1755 (87.9%)	905	850	
Educational Level				
(Primary school or less)	1315 (65.9%)	746	569	< 0.01 <sup>§*</sup>
Income Level (US Dollars per month)				
< 400	763 (38.2%)	419	344	
400 – 799	891 (44.6%)	450	441	
800 – 1200	198 (9.9%)	89	109	
> 1200	144 (7.2%)	56	88	

\**p* < 0.01; <sup>†</sup>Mann-Whitney U test; <sup>§</sup>Chi-square test; CP: Group Chronic Pain; NCP: Group Non-Chronic Pain.

**Table II.** Pittsburgh Sleep Quality Index and component scores.

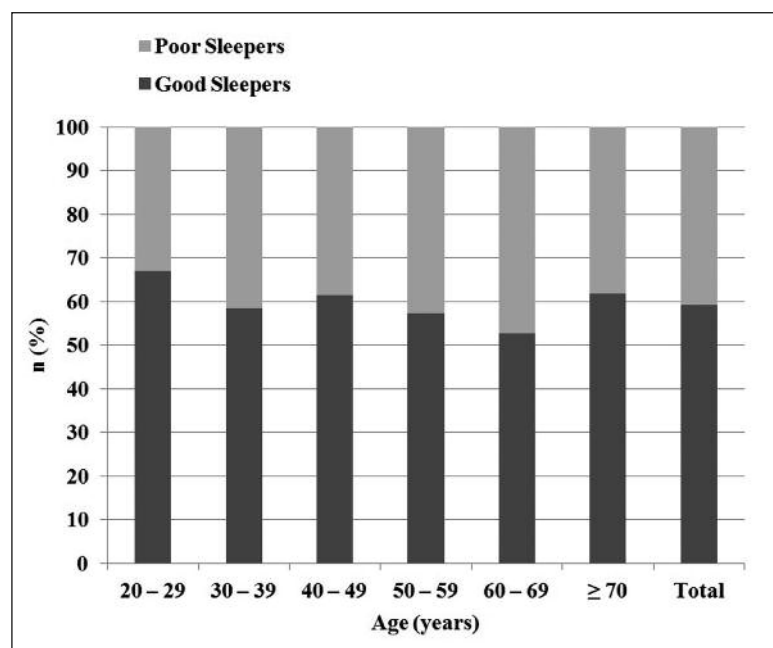
CP	NCP	p	
Subjective Sleep Quality	0.35 ± 0.72	0.19 ± 0.49	0.000001 <sup>†*</sup>
Sleep latency	1.23 ± 1.11	0.86 ± 1.02	< 0.01 <sup>†*</sup>
Sleep duration	0.73 ± 0.88	0.43 ± 0.69	< 0.01 <sup>†*</sup>
Habitual sleep efficiency	0.44 ± 0.85	0.24 ± 0.66	< 0.01 <sup>†*</sup>
Step disturbances	0.91 ± 0.70	0.49 ± 0.55	< 0.01 <sup>†*</sup>
Use of sleeping medication	1.14 ± 0.95	0.72 ± 0.81	< 0.01 <sup>†*</sup>
Daytime dysfunction	0.42 ± 0.75	0.28 ± 0.56	0.001 <sup>†*</sup>
<b>Global PSQI Score</b>	<b>5.30 ± 4.29</b>	<b>3.22 ± 3.30</b>	<b>&lt;0.01<sup>†*</sup></b>

\* $p < 0.01$ ; <sup>†</sup>Mann-Whitney U test; CP: Group Chronic Pain, NCP: Group Non-Chronic Pain; PSQI: Pittsburgh Sleep Quality Index.

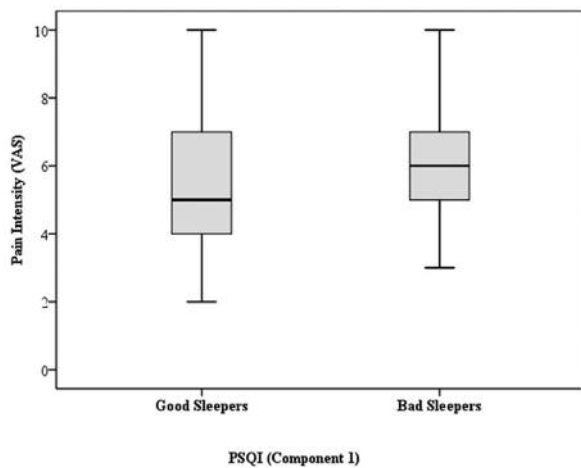
< 0.01). A total of 44.6% of patients had an income level between 400 and 800 US Dollars (\$). The mean global PSQI score and the mean scores of all PSQI components in CP were significantly higher than in NCP (mean total PSQI score of  $5.30 \pm 4.29$  in CP and  $3.22 \pm 3.30$  in NCP;  $p < 0.01$ ; Table II).

The mean PSQI scores of females ( $5.69 \pm 4.40$ ) were significantly higher than those of males ( $4.54 \pm 3.96$ ) in CP ( $p = 0.000045$ ). A total of 413 patients (40.7%) in CP and 215 (21.9%) in NCP had poorer sleep quality, according to the PSQI scores, with a cut-off level > 5. A total of 33% of patients with chronic pain in ages between 20-30 years, and 47.8% of them between 60-70 years, were poorer sleepers (Figure 1). The mean intensity of pain score was  $5.13 \pm 1.76$  in

good sleepers, and  $6.14 \pm 1.87$  in bad sleepers according to the PSQI-Component 1 scores ( $p < 0.01$ ; Figure 2). A multiple linear regression analysis of age, gender, income, VAS, marital status, educational level, and presence of depression as candidate-independent variables using the backward stepwise elimination method revealed that age ( $\beta = 0.022$ ,  $p = 0.009$ ), gender ( $\beta = -0.845$ ,  $p = 0.002$ ), income ( $\beta = 0.420$ ,  $p = 0.007$ ), VAS ( $\beta = 0.698$ ,  $p < 0.01$ ), and presence of depression ( $\beta = 2.073$ ,  $p = 0.000133$ ) were the significant predictors for the PSQI score (Table III). A moderate positive correlation was found between the global PSQI and VAS scores ( $r = 0.310$ ,  $p < 0.01$ ). The mean intensity of pain in good sleepers was significantly lower than in the bad sleepers ( $p < 0.01$ ). The cut-off level was



**Figure 1.** Sleep quality characteristics of the patients with chronic pain.



**Figure 2.** The intensity of pain (VAS) according to the PSQI-Component 1 scores (n = 1014). The mean intensity of pain score was  $5.13 \pm 1.76$  in good sleepers and  $6.14 \pm 1.87$  in bad sleepers ( $p < 0.01$ ).

found to be 5 for predicting the subjective sleep quality with a score  $\geq 2$  (AUC = 0.919). The sensitivity and specificity with the cut-off level of 5 were 83.1% and 82%, respectively.

### Discussion

The present study revealed that patients with chronic pain have poorer sleep quality than pain-free control subjects, and a moderate positive correlation exists between pain intensity and sleep quality. In this sample, 40.7% of patients with chronic pain were poorer sleepers. In addition,

age, gender, income, VAS, and presence of depression were the predictors of sleep quality. Furthermore, consistent with the study of Buysse et al<sup>18</sup>, a cut-off level of 5, was calculated to predict the sleep quality.

Several studies have been conducted to elucidate the relationship between pain, and sleep disturbances or sleep quality<sup>15-17</sup>. Moreover, over the past decade, a number of studies of populations with pain and sleep disturbances have reported on subjects with headaches, fibromyalgia, chronic fatigue syndrome, rheumatoid arthritis, ankylosing spondylitis, osteoarthritis, carpal tunnel syndrome, back pain, and Sjogren's syndrome. While interests of the researchers on this area has been widely increased, a diverse ratio ranging from 50% to 75% is announced for the pain with sleep disturbance<sup>21-23</sup>. The current study was designed as a general population-based research on the prevalence of sleep disturbance and its association with pain. In relation, Covarrubias-Gomez et al<sup>15</sup> revealed that 89% of subjects with chronic pain unrelated to cancer had poorer sleep. A study conducted by Palermo et al<sup>24</sup> showed that 55% of adolescents with chronic pain, compared to 10% of healthy adolescents reported insomnia. The current study indicated a sleep disturbance occurrence rate of 40.7% in chronic pain individuals, as compared to 21.9% in healthy ones; those figures appear to be consistent with the rates in the literature.

Nevertheless, Jansson-Fröjmark et al<sup>17</sup> focused on pain, anxiety, depression and insomnia, and indicated that pain and anxiety symptoms have an increasing effect on the risk of insomnia

**Table III.** Multiple regression analysis.

Independent variables	PSQ		
	Model 1† (95% CI)	Model 2 (95% CI)	Model 3§ (95% CI)
Marital Status	0.139 [-0.672] – [0.950])	—	—
Educational Level	-0.337 (-1.005 – 0.331)	-0.350 ([-1.013] – [0.314])	—
Age	0.020 (0.002 – 0.037) *	0.019 (0.002 – 0.037) *	0.022 (0.005 – 0.039) *
Gender	- 0.761 ([-1.318] – [- 0.204]) *	-0.752 ([-1.307] – [-0.198]) *	- 0.845 ([- 1.371] – [-0.319]) *
Income	0.474 (0.147 – 0.801) *	0.480 (0.155 – 0.805) *	0.420 (0.116 – 0.724) *
VAS	0.698 (0.565 – 0.832) *	0.698 (0.565 – 0.832) *	0.698 (0.564 – 0.831) *
Depression	2.086 (1.022 – 3.151) *	2.098 (1.037 – 3.160) *	2.073 (1.013 – 3.134) *

†Independent variables included age, gender, income, marital status, educational level, VAS, and depression. Independent variables except marital status. §Independent variables except marital status and educational level. \* $p < 0.01$ ; PSQI: Pittsburgh Sleep Quality Index; VAS: Visual Analog Scale; CI: Confidence Interval. This model explained 36% of the variance.

symptoms. In addition, they reported that pain, anxiety, and depressive symptoms were related to the persistence of sleep disturbance symptoms. Poor sleepers, or those who scored their sleep as “poor quality”, show higher pain intensity, from which it can be concluded that intensity of pain plays an important role in the quality of sleep<sup>15</sup>. Sleep became more fragmented and difficult to initiate with increased pain intensity. Furthermore, Alsaadi et al<sup>25</sup> showed that pain intensity and pain duration are closely related to sleep disturbance. Additionally, they indicated that each increase of pain intensity by one point on the VAS was related to a 10% rise in the prevalence of sleep disturbance. The association between pain intensity and sleep disturbance demonstrated in the previous studies was also confirmed in the current study: poor sleepers reported higher pain intensity than those in good sleepers.

The presence of depression is frequently associated with chronic pain and sleep disturbance. However, the exact mechanism behind these syndromes is still unclear<sup>26</sup>. In a study conducted by Sayar et al<sup>27</sup>, significant relations were demonstrated between age, gender, pain duration, pain intensity and depression, and the PSQI scores. Additionally, the results indicated that depression was the only and remarkable predictor of poor sleep quality. Similarly, Atkinson et al<sup>28</sup> revealed that depressed mood was the strongest predictor of sleep satisfaction. In contrast, Menefee et al<sup>29</sup> reported that physical functioning, duration of pain, and age can be more significant than pain intensity and depressed mood in relation to poorer sleep quality and sleep latency. In the present study, an evident association between age, gender, income, VAS, presence of depression (has the highest effect size than others), and sleep quality was shown, and this result suggested that sleep quality in patients with chronic pain is influenced by multifactorial sources rather than a single factor.

A systematic search of the literature revealed a lack of knowledge on gender differences in the sleep quality of males and females with chronic pain. Of the studies that do exist, females yielded higher levels of pain and an increased response to painful stimuli, as compared to males<sup>30</sup>. Moreover, a higher prevalence of chronic pain was reported in females<sup>31,32</sup>. It was demonstrated that pain severely affects sleep quality, hence treatment of pain could increase sleep and life quality<sup>33</sup>. Similarly, the current study showed that females were poorer sleepers, which could be associated with the higher prevalence of chronic pain in females.

The present study has several limitations. First, the data were based on self-reporting techniques and should be purified by measuring sleep disturbances with the use of polysomnography. Second, the mood data was obtained from subjective reports, and it may be more accurate to employ an instrument or clinical examination to capture the entire spectrum of depressive symptomatology. Third, the duration of pain could be added in the measured data, to assess its effect on sleep quality.

## Conclusions

The present study showed that chronic pain and pain intensity are important predictors of sleep quality. This finding suggested that age, gender, income level, pain intensity, and presence of depression were related to sleep in several aspects. However, various controlled trials are required to further elucidate the exact mechanism behind the predictors of sleep disturbances.

## Acknowledgements

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## Conflict of interest

The Authors declare that there are no conflicts of interest.

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