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Evaluation of Cervical Mobility, Sleep Quality, and Function in Chronic Neck Pain

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ABSTRACT

Objective: Chronic neck pain (CNP) is a common issue requiring a biopsychosocial approach. This study aimed to explore the relationship between pain, cervical mobility, sleep quality, and functional status, comparing these variables with healthy controls. **Materials and Methods:** Sixty-five participants with CNP and sixty-five controls were included. Neck pain at rest and during activity was measured using the Visual Analog Scale (VAS Cervical mobility was assessed in all planes of motion using a universal goniometer to measure the active cervical range of motion (C-ROM). The Pittsburgh Sleep Quality Index (PSQI) and Neck Disability Index (NDI) were used to evaluate sleep quality and neck-related functional status. **Results:** Cervical mobility showed significant differences in C-ROM for flexion, extension, and lateral flexion ($p<0.05$), while no significant differences were found in rotation between groups ($p>0.05$). Additionally, the CNP group exhibited higher disability levels and poorer sleep quality compared to the controls ($p<0.001$. In the CNP group reduced C-ROM in flexion, extension, and left lateral flexion showed a weak negative correlation with PSQI score ($p<0.05$). NDI was significantly associated with C-ROM in all planes ($p<0.05$). Moreover, NDI exhibited a strong positive correlation with the PSQI score ($r=0.612$; $p<0.001$). **Conclusion:** CNP individuals experience a negative status on cervical mobility, sleep quality, and functional status compared to healthy individuals. A significant relationship was also found between increased neck disability and poorer sleep quality. Treating sleep disturbances may help alleviate neck disability and improve overall health.

Keywords: Pain, Neck, Range of Motion, Sleep Quality, Functional Status.

Kronik Boyun Ağrısında Servikal Mobilite, Uyku Kalitesi ve Fonksiyonun Değerlendirilmesi

ÖZ

Amaç: Kronik boyun ağrısı (KBA), biyopsikososyal yaklaşım gerektiren yaygın bir sorundur. Bu çalışmanın amacı ağrı, servikal mobilite, uyku kalitesi ve fonksiyonel durum arasındaki ilişkiyi sağlıklı kontrollerle karşılaştırarak incelemektir. **Gereç ve Yöntemler:** Altmış beş KBA'lı katılımcı ve altmış beş kontrol çalışmaya dahil edildi. Boyun ağrısı istirahatte ve aktivite sırasında Görsel Analog Skala (GAS) kullanılarak ölçüldü. Servikal mobilite, aktif servikal eklem hareket açıklığı (S-EHA) ölçmek için universal bir gonyometre kullanılarak tüm hareket düzlemlerinde değerlendirildi. Uyku kalitesi ve boyun ile ilgili fonksiyonel durumu değerlendirmek için Pittsburgh Uyku Kalitesi İndeksi (PUKİ) ve Boyun Özürlülük İndeksi (BÖİ) kullanıldı. **Bulgular**: Servikal mobilitede gruplar arasında, fleksiyon, ekstansiyon ve lateral fleksiyon için S-EHA değerlerinde anlamlı farklar bulundu ($p<0.05$), ancak rotasyon değerlerinde anlamlı fark saptanmadı ($p>0.05$). Ayrıca, KBA'lı grupta kontrol grubuna kıyasla daha yüksek dizabilite düzeyleri ve daha kötü uyku kalitesi gözlendi ($p<0.001$). KBA'lı grupta, fleksiyon, ekstansiyon ve sol lateral fleksiyondaki azalmış S-EHA ile PUKİ skoru arasında zayıf negatif korelasyon bulundu ($p<0.05$). BÖİ, tüm düzlemlerdeki S-EHA ile anlamlı bir ilişki gösterdi ($p<0.05$). Bunun yanı sıra, NDI ile PSQI skoru arasında güçlü pozitif bir korelasyon saptandı ($r=0.612$; $p<0.001$). **Sonuç:** KBA olan bireyler, sağlıklı bireylere kıyasla servikal hareketlilik, uyku kalitesi ve fonksiyonel durum bakımından daha fazla kısıtlılık deneyimlerler. Ayrıca, artan boyun sakatlığı ile daha düşük uyku kalitesi arasında önemli bir ilişki olduğu tespit edilmiştir. Uyku bozukluklarının tedavi edilmesi, boyun sakatlığının hafifletilmesine ve genel sağlığın iyileştirilmesine katkı sağlayabilir.

Anahtar kelimeler: Ağrı, Boyun, Eklem Hareket Açıklığı, Uyku Kalitesi, Fonksiyonel Durum.

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INTRODUCTION

The cervical spine serves as a mobile support for vital functions of the head and upper extremities, and chronic pain in this region negatively affects general health. Chronic neck pain (CNP) is one of the most commonly reported musculoskeletal disorders in the adult population and is located between the lateral borders of the neck and occiput and the first thoracic vertebra, lasting longer than three months (Kazeminasab et al., 2022). Due to the lack of specific pathologic findings in its diagnosis, CNP is often categorized as nonspecific neck pain associated with a range of biomechanical, functional, proprioceptive, and postural disturbances. Furthermore, CNP is a multidimensional health issue influenced by various psychosocial, emotional, and behavioral factors (Öksüz & Atılgan, 2017).

Biomechanical changes in the cervical spine, such as reduced range of motion and alterations in spinal curvature, have been identified as key contributors to neck pain (Mohammad et al., 2015). Similarly, cervical range of motion (C-ROM) is lower in patients with neck pain than in those without neck pain (Farooq et al., 2018). In addition, decreased range of motion may increase the risk of developing neck pain and is considered a negative prognostic factor in the recovery of patients with neck pain (Walton et al., 2013). A 16-year prospective study conducted to evaluate the possible relationship between C-ROM and the development of neck pain found no relationship between cervical mobility and the occurrence of neck pain and injury later in life (Multanen et al., 2021). The heterogeneity in study results underscores the need for further research to clarify how C-ROMs influence neck pain and recovery, and to better differentiate between individuals with CNP and healthy individuals.

Sleep quality, which affects nearly all physiological functions, is also associated with CNP. Current studies emphasize the bidirectional correlation between CNP and sleep quality, indicating that inadequate sleep and poor sleep position may exacerbate pain by affecting neck muscle relaxation (Ateş et al., 2023). Additionally, constant pain in the cervical region rises later in the day, making it difficult to transition into deep sleep and, as a result, affecting sleep quality (Andreucci et al., 2020). Previous studies have demonstrated that chronic pain and inadequate sleep negatively impact functional status by impeding participation in daily, productivity, and leisure activities (Chang et al., 2022). However, there is still a need to explore how these factors interact within the context of CNP, particularly how they influence variations in the functional status.

The literature includes numerous studies on CNP with various etiological factors. However, owing to inconsistent findings in previous research, understanding the complex relationships associated with CNP remains challenging. Our study aimed to examine the relationship between pain, cervical mobility, sleep quality, and functional status, and compare these parameters with those of healthy controls. By incorporating healthy individuals into these comparisons, we aimed to gain a deeper understanding of these complex effects and provide a more comprehensive perspective on the overall impact of CNP. Additionally, these evaluations may provide valuable insights that could aid in the development of more effective rehabilitation strategies.

MATERIALS AND METHODS

Study design

This study was designed as a cross-sectional observational investigation conducted between July and September 2024.

Setting

This study was conducted at the Department of Physiotherapy and Rehabilitation of XXX. Participants were recruited based on a diagnosis of chronic CNP confirmed by radiological examination by a specialist physician. The control group (CG) consisted of healthy relatives of patients with CNP matched for age and sex.

Participants

Participants with CNP (defined as pain persisting for over 3 months, with a Visual Analog Scale (VAS) score at rest of ≥3) and their relatives serving as healthy controls were included in the study (Sarig Bahat et al., 2014). Eligibility required participants to be between 18 and 55 years of age, voluntarily consent to participate, and have experienced persistent cervical pain for at least 3 months (for the Chronic Neck Pain Group, CNPG).

Participants were excluded if they had a history of neck trauma or other cervical spine conditions, such as radiculopathy; prior surgical interventions involving the head, face, cervical spine, upper or lower extremities; cervical disc herniation; degenerative spinal conditions; any rheumatological or cardiovascular diseases; chronic neurological or psychiatric disorders; substance abuse; anemia; or diabetes.

Measurement

Sociodemographic data, including age, sex, height, weight, BMI, and occupation of the participants, were collected. The severity of neck pain at rest and during activity was evaluated using a Visual Analog Scale (VAS), a 10 cm line where 0 represents no neck pain and 10 represents unbearable neck pain. Participants marked a point on the line reflecting their level of neck pain (Begum & Hossain, 2019). Cervical mobility was assessed using a universal goniometer in three planes: lateral flexion (frontal plane), axial rotation to both right and left (horizontal plane), and flexion-extension (sagittal plane). All measurements were conducted by the same physiotherapist to ensure consistency using the American Association of Orthopaedic Surgeons (AAOS) values as a reference. The participants were asked to wear comfortable clothing, and the physiotherapist demonstrated the movements before taking the measurements (Dos Santos et al., 2016). Sleep quality was assessed using the Pittsburgh Sleep Quality Index (PSQI), a 19-item self-report questionnaire that assesses various aspects of sleep. The PSQI includes seven components: subjective sleep quality, sleep latency, total sleep duration, sleep efficiency, sleep disturbances, sleep medication use, and daytime dysfunction. The total score ranges from 0 to 21, with higher scores indicating poorer sleep quality and a score above 8.0, suggesting significant sleep issues (Agargün et al., 1996). Functional status was assessed using the Neck Disability Index (NDI), which consists of 10 questions related to neck pain, functional activities, self-care, and quality of life. Each question is rated on a scale of 0 to 5, where 0 indicates no disability and 5 indicates complete disability. The scores for each item were summed, with the total score ranging from 0 to 50. Scores were categorized as follows: 0-4 points for no disability, 5-14 points for mild disability, 15-24 points for moderate disability, 25-34 points for severe disability, and ≥35 points for complete disability (Aslan et al., 2008).

Study size

The sample size was estimated using the software program G*Power (version 3.0.10) (Faul et al., 2007). The calculation was based on correlation analysis between the C-ROM and NDI. A correlation coefficient of r=0.568, derived from the study by Aimi et al. (2019), was used with a two-tailed test, an alpha level of 0.05, and a desired statistical power of 0.99. This analysis required a minimum of 41 participants (Aimi et al., 2019). To ensure robustness, 65 participants were included in each group, which exceeded the minimum requirement while maintaining the integrity of the study.

Statistical analysis

Statistical analysis of the data was conducted using Statistical Package for Social Sciences (SPSS) version 21.0. Data for measurable variables are presented as mean ± standard deviation (X±SD), and as numbers and (%) for categorical variables. The chi-square test was used for intergroup comparisons of categorical variables. The Shapiro-Wilk test was used to confirm a normal distribution. An independent t-test was employed based on the distribution normality of the data for each outcome between the groups. The correlation between scale scores was evaluated using Pearson correlation analysis. The correlation coefficients were labeled as follows: 0-0.2 very weak, 0.2-0.4 weak, 0.4-0.6 moderate, 0.6-0.8 strong, and "0.8" and above as very strong (Schober et al., 2018). The significance level was set at p<0.05.

Ethical considerations

Ethics committee approval for this study was obtained from the Non-Invasive Scientific Research Ethics Committee at Istanbul Atlas University (Decision No: E-22686390-050.99-42833, Approval Date: 14.05.2024). The study was conducted following the Declaration of Helsinki and informed consent was obtained from all participants before data collection.

RESULTS

The study sample consisted of participants with CNPG (n=65) and CG (n=65), with a mean age of 42.26±10.83 and 42.92±11.00 years, respectively. A comparison of the demographic data for these individuals is presented in Table 1. Among the participants in both groups, the majority were housewives, while a smaller proportion engaged in sedentary jobs (e.g., office workers, desk-based roles). There were no significant differences in baseline demographics between the groups (p>0.05).

Table 1. Baseline demographics of participants in the chronic neck pain and non-chronic neck pain groups (n=130).

Parameters	CNPG (n=65) Mean±SD	CG (n=65) Mean±SD	t	p
Age (Years)	42.26±10.83	42.92±11.00	-0.337	0.736
Height (cm)	163.88±7.31	165.48±7.87	-1.182	0.239
Weight (kg)	73.86±14.98	73.51±16.45	0.126	0.9
BMI (kg/m2)	27.58±5.49	26.93±6.34	0.615	0.54
	n(%)	**n(%)**		**χ2**
Sex				
Female	51(73)	52(75)	-	0.969
Male	14(27)	13(25)		
Occupation				
Housewife	42(64.6)	40(61.5)	-	0.7160
Sedentary jobs	23(35.4)	25(38.5)		

BMI: Body Mass Index, χ2: Chi- square Test, significance level p<0.05.

A comparison of pain status, cervical mobility, sleep quality, and neck disability between the groups is shown in Table 2. Within the CNPG mean pain intensity during rest was 6.43(95% confidence interval [CI], 5.25-6.27), and mean pain intensity during activity was 7.15(95% CI, 3.91-5.35). The mean pain intensity at rest was 0.67±1.06 and the mean pain intensity during activity was 2.52±1.79 in the CG. The mean PSQI score of the CNPG was 8.69, indicating poor sleep quality (95% CI, 1.39-3.996). In the NDI score, participants with CNPG had a moderate disability score (20.75±10.04), while the CG had a mild disability score (9.21±6.19). There were statistically significant differences between groups in VAS_{rest}, (p<0.001), $VAS_{activity}$ (p<0.001), PSQI (p<0.001), and NDI (p<0.001) scores. A statistically significant difference was observed in the active C-ROM scores for flexion (p<0.001), extension (p<0.001), right lateral flexion (p=0.002), and left lateral flexion (p<0.001). However, no significant differences were found between the groups in the rotation C-ROM (p>0.05).

Table 2. Comparison of pain status, cervical mobility, sleep quality, and neck disability between the chronic neck pain and non-chronic neck pain groups (n=130).

Parameters	CNPG (n=65) Mean±SD	CG (n=65) Mean±SD	t	p	Cohen's d	95% Confidence Interval of the Difference	
						Lower	Upper
VAS_{rest}	6.43±1.73	0.67±1.06	22.663	<0.001	4.01	5.25	6.27
$VAS_{activity}$	7.15±2.24	2.52±1.79	12.824	<0.001	2.28	3.91	5.35
C-ROM Flexion	41.18±5.80	44.62±1.29	-4.657	<0.001	0.81	-4.94	-1.93
C-ROM Extension	39.68±7.81	43.62±3.54	-3.690	<0.001	0.64	-6.11	-1.78
C-ROM Lateral Flexion-R	37.62±7.38	41.34±5.84	-3.156	0.002	0.56	-6.09	-1.37
C-ROM Lateral Flexion-L	36.12±7.86	41.77±5.34	-4.741	<0.001	0.84	-8.03	-3.26
C-ROM Rotation-R	55.28±8.27	57.62±4.71	-1.970	0.056	0.34	-4.74	0.050
C-ROM Rotation-L	55.03±8.59	57.62±4.71	-2.080	0.052	0.37	-5.06	0.126
PSQI	8.69±4.38	6.00±2.77	4.145	<0.001	0.73	1.39	3.93
NDI	20.75±10.04	9.21±6.19	7.814	<0.001	1.38	8.58	14.51

CNPG: Chronic Neck Pain Group, CG: Control Group, C-ROM: Cervical Range of Motion, NDI: Neck Disability Index, VAS: Visual Analog Scale, PSQI: Pittsburg Sleep Quality Index, R: Right, L: Left. Significance level p<0.05.

Table 3 summarizes the cross-correlations among the study variables in participants with CNPG. The VAS scores at rest and during activity were not correlated with the C-ROM, PSQI, or NDI scores (p>0.05). Reduced C-ROM, particularly for flexion (r=-0.311; p=0.012), extension (r=-0.396; p=0.001), and left lateral flexion (r=-0.306; p=0.013), showed a weak but significant negative correlation with the PSQI score. The NDI was significantly correlated with the C-ROM in all planes (p<0.05). In addition, the NDI also showed a strong positive correlation with the PSQI score (r=0.612, p<0.001); the worse the neck disability, the worse the sleep quality.

The post hoc power analysis for the correlation coefficient between C-ROM (extension) and NDI (r=0.389), conducted with a sample size of 65 participants and a significance level of α=0.05, demonstrated that the study achieved a power of 90.3%. The analysis was based on a two-tailed hypothesis and was conducted in alignment with the parameters of the a priori power analysis.

Table 3: Correlations among study variables in the CNPG (n=65)

			VAS		C-ROM						PSQI	NDI
			Rest	Activity	Flexion	Extension	Lateral Flexion -R	Lateral Flexion -L	Rotation -R	Rotation -L		
VAS	Rest	**r**		0.224	-0.066	-0.091	0.007	-0.079	-0.037	-0.082	0.042	0.221
		p		0.073	0.604	0.470	0.956	0.534	0.771	0.517	0.737	0.077
	Activity	**r**			-0.042	-0.115	0.037	-0.076	0.184	0.170	0.118	0.170
		p			0.717	0.363	0.772	0.546	0.143	0.176	0.351	0.176
C-ROM	Flexion	**r**				0.453	0.272	0.581	0.652	0.526	-0.311	-0.441
		p				**<0.001**	**0.028**	**<0.001**	**<0.001**	**<0.001**	**0.012**	**<0.001**
	Extension	**r**					0.271	0.416	0.430	0.597	-0.396	-0.389
		p					**0.029**	**0.001**	**<0.001**	**<0.001**	**0.001**	**0.001**
	Lateral Flexion -R	**r**						0.561	0.169	0.223	-0.242	-0.270
		p						**<0.001**	0.178	0.074	0.052	**0.030**
	Lateral Flexion -L	**r**							0.363	0.419	-0.306	-0.487
		p							**0.003**	**0.001**	**0.013**	**<0.001**
	Rotation -R	**r**								0.718	-0.212	-0.324
		p								**<0.001**	0.090	**0.008**
	Rotation -L	**r**									-0.187	-0.313
		p									0.136	**0.011**
PSQI		**r**										0.612
		p										**<0.001**

r=Pearson Correlation Coefficient, CNPG: Chronic Neck Pain Group, C-ROM: Cervical Range of Motion, NDI: Neck Disability Index, VAS: Visual Analog Scale, PSQI: Pittsburg Sleep Quality Index, R: Right, L: Left. Significance level $p<0.05$.

DISCUSSION

The current study found that participants with CNP experienced greater pain, limited C-ROM in the sagittal and frontal planes, poorer sleep quality, and higher neck disability than the control group. In the CNPG, no significant relationship was found between pain and the other parameters. Reduced cervical mobility is linked to higher disability; however, these findings do not extend to sleep quality.

CNP is a prevalent condition that affects a significant portion of the population and leads to discomfort, functional limitations, and reduced quality of life (Öksüz & Atılgan, 2017). Gender differences have been identified as key factors influencing the prevalence, intensity, and impact of CNP (Umeda & Kim, 2019). Studies consistently report that female individuals tend to experience more intense pain and higher levels of disability. Hormonal factors, as well as psychological distress, such as anxiety and depression, have been reported to play an important role in these outcomes (Elbinoune et al., 2016; Mazza et al., 2020). In our study, because sex-specific factors may have influenced pain perception and disability, the predominantly female sample may have contributed to the observed results.

Pain at rest and during activity is one of the main complaints of individuals with CNP (Lin et al., 2024). In the CNPG, the C-ROM decreased and the mean NDI score showed moderate disability, which is consistent with the literature (Ferreira et al., 2021). In addition, the PSQI score in our study indicates low sleep quality, which is consistent with other reports conducted with participants experiencing chronic pain (Husak & Bair, 2020).

In our study, healthy controls showed significantly greater C-ROM in all movements except the transverse plane. In a cross-sectional study of 102 patients with neck pain, Rudolfsson et al. reported that active C-ROM was limited to extension and flexion at the cervical level (Rudolfsson et al., 2012). A recent study similarly reported that individuals with neck pain had a lower C-ROM in all planes compared to their control peers (Özgören et al., 2022). Reduced C-ROM is suggested as a common finding in people with CNP (da Silva et al., 2018), yet results in the literature remain controversial. It seems possible that These results may be due to the heterogeneity of the neck pain group characteristics and subjective aspects of pain. Tao et al. also reported that possible degeneration in the cervical vertebrae is mostly seen at the C4, C5, and C6 levels, and since cervical rotation movement mainly occurs in–C1-C2, it may be the case in our study finding regarding rotation C-ROM (Tao et al., 2021).

In our study, no relationship was found between pain severity during rest and activity with other parameters. Similarly, Kyrosis et al. (2024) reported no significant association between pain intensity and disability in patients with chronic non-specific neck pain (Kyrosis et al. 2024). In contrast, studies involving patients with whiplash syndrome observed a strong association between neck disability and pain (Lee et al., 2015). While many studies show a strong link between disability and pain (Zetterqvist et al., 2017), as well as between sleep and pain (Lee & Oh, 2022), pain is also influenced by various psychological, physical, and social factors. Thus, there is no linear relationship between disability and pain. Considering the multidimensional nature of pain, future studies that evaluate several factors (e.g., fatigue, rumination, catastrophization) related to pain may contribute to the understanding of the relationship between pain and disability.

The relationship between self-rated disability, sleep quality, and cervical mobility in neck pain is lacking in the literature, and studies specifically examining the relationship between sleep quality and C-ROM are limited. However, Beltran-Alacreu et al. compared the C-ROM according to neck disability level and reported that moderate and severe disability was associated with a decrease in range of motion (Beltran-Alacreu et al., 2018). Meisingset et al. also demonstrated that a decreased C-ROM correlates with a higher level of disability (Meisingset et al., 2016). Accordingly, the relationship between neck disability and cervical mobility observed in this study supports the present results. Although no significant relationship was found between sleep quality and C-ROM in this study, these findings may suggest that improvements in cervical mobility could eventually affect functional status, or vice versa. Therefore, therapeutic interventions and patient education sessions should be designed to restore cervical mobility as much as possible.

Similar to previous studies, a moderate positive correlation was found between neck disability and sleep quality (Lee & Oh, 2022). In a study examining pain, disability, and sleep quality in patients with neck pain, Munoz et al. (2012) found that patients with neck pain have poorer sleep quality than healthy individuals. According to study results by Kovacs et al. neck pain-related disability is less likely to improve if they experience poor sleep quality (Kovacs et al., 2015). Hence, it could conceivably be hypothesized that sleep quality may directly or indirectly affect functional status. The contribution of healthy sleep to maintaining activities of daily living (Kohyama, 2021) and clinical studies on relaxation, sleep hygiene, and ergonomics in individuals with CNP may help to understand this relationship in greater depth.

Study limitations and strengths

The present study had several limitations. The cross-sectional design did not allow the establishment of a cause-and-effect relationship between neck disability and other variables. While the study analyzed contributors to CNP and neck disability, such as neck ROM and sleep quality, it did not evaluate smartphone addiction, which is a recognized factor that influences both neck pain and sleep disturbances. Future studies should consider incorporating smartphone usage habits to provide a more comprehensive understanding of contributors to CNP.

CONCLUSION

This study emphasizes the relationship between neck-related disability, cervical ROM, and sleep quality in individuals with chronic neck pain. Moreover, reduced sleep quality may be a main cause of neck disability. Therefore, we suggest that sleep quality strategies should be addressed to improve the functional status of individuals with neck pain. In addition, exercises to increase mobility in the neck area may contribute to improvement in individuals with chronic neck pain.

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Conflict of Interest

The authors declare no potential conflicts of interest related to the research, authorship, and/or publication of this article.

Author Contributions

Plan, design: GD; **Material, methods and data collection:** GD, SÖ; **Data analysis and comments:** GD, ŞÖ; **Writing and corrections:** GD, ŞÖ.

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Ethical Approval

Institution: Non-Invasive Scientific Research Ethics Committee at Istanbul Atlas University
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