International Journal for Multidisciplinary Research (IJFMR)
E-ISSN: 2582-2160 ● Website: www.ijfmr.com ● Email: editor@ijfmr.com

The Impact of Smartphone Addiction on Sleep Quality and Central Sensitization in Individuals with Chronic Musculoskeletal Pain of the Cervical Spine and Upper Limbs

Prof (Dr.) Mohammed Aslam[1], Dr Bhawan Bhora[2], Dr. Tripti Pandey[3], Dr. Sonia Gupta[4]

[1]Principal Paramedical, Guru Nanak College of Paramedical Sciences and Hospital, Jhajra, Dehradun, Uttarakhand.
[2]Assistant Professor, Guru Nanak College of Paramedical Sciences and Hospital, Jhajra, Dehradun, Uttarakhand.
[3]Assistant Professor, Dev Bhoomi Uttarakhand University.
[4]PhD Scholar, Physiotherapy, TMU, Moradabad

Abstract

Background: Chronic musculoskeletal pain has a profound impact on an individual's quality of life and daily activities. Excessive smartphone use has been associated with the onset of musculoskeletal discomfort, poor sleep patterns, and increased central sensitization affecting the cervical spine and upper limbs.

Aim: The present study aimed to examine the influence of smartphone addiction on sleep disturbances and central sensitization in individuals experiencing chronic musculoskeletal pain in the cervical spine and upper limbs.

Objective: The study's objective was to explore the correlation between smartphone addiction, sleep quality, and central sensitization in individuals suffering from chronic cervical and upper limb musculoskeletal pain.

Methods and Materials: A cross-sectional observational study was conducted with a sample of 300 participants. Data collection involved the use of validated questionnaires, including the Smartphone Addiction Scale-Short Version (SAS-SV), the Gujarati version of the Central Sensitization Inventory (CSI-G), and the Pittsburgh Sleep Quality Index (PSQI). Additionally, the duration of smartphone usage and pain levels were assessed using a numerical pain rating scale. Statistical analyses were performed to identify significant relationships among smartphone addiction, sleep disturbances, and central sensitization.

Results: A significant positive Pearson correlation was observed between SAS-SV scores and CSI scores ($r = 0.495$, $p = 0.001$), SAS-SV and PSQI scores ($r = 0.285$, $p = 0.001$), SAS-SV and total hours of smartphone use ($r = 0.716$, $p = 0.001$), as well as SAS-SV and the Numeric Pain Rating Scale ($r = 0.417$, $p = 0.001$).

Conclusions: The study revealed a strong association between smartphone addiction, impaired sleep quality, and central sensitization in individuals with chronic musculoskeletal pain in the cervical spine and upper limbs. These findings suggest that prolonged smartphone usage and sleep disturbances may contribute to heightened pain sensitivity and overall health deterioration. Addressing smartphone addiction and promoting healthy sleep habits may play a crucial role in managing musculoskeletal pain and improving well-being.

Keywords: Smartphone Addiction, Sleep Disturbance, Central Sensitization, Chronic Pain, Neck and Shoulder Pain, Upper Limb Pain

Introduction:

Chronic musculoskeletal pain has a major impact on individuals' daily activities and overall quality of life. It is characterized as acute or persistent discomfort affecting the bones, muscles, ligaments, tendons, and nerves. Pain resulting from musculoskeletal disorders (MSK) is a widespread medical concern and a significant socioeconomic challenge globally. [1] Chronic musculoskeletal pain refers to persistent or recurrent discomfort in the musculoskeletal system lasting over three months, often accompanied by substantial functional limitations and emotional distress. [2] Prolonged smartphone use can contribute to musculoskeletal pain in the neck and upper limbs. Symptoms of smartphone addiction (SA) may include difficulty reducing usage, ignoring responsibilities, constant preoccupation with the device, withdrawal symptoms, and adverse effects on daily life and relationships. When smartphone usage begins to disrupt work, education, or personal life, it may indicate addiction, often accompanied by feelings of anxiety or irritability. [3] The Smartphone Addiction Scale-Short Version (SAS-SV) was designed and validated to assess the extent of smartphone addiction. Previous studies have identified connections between smartphone addiction and mental health, physical health, and neurological issues. [4.5.6] Nonetheless, this evidence is not definitive. There is ongoing discussion in the literature regarding whether screen time or smartphone use has beneficial or harmful effects on health outcomes. The Smartphone Addiction Scale-Short Version (SAS-SV) has been shown to be a reliable and valid measurement tool.[7] A score of 22 or lower suggests no addiction, while a score of 34 or higher indicates a potential risk of addiction.[8] Poor sleep quality and smartphone addiction have been identified as key contributors to the onset of central sensitization in individuals with chronic musculoskeletal pain. Additionally, excessive smartphone use, often linked to inadequate sleep patterns, promotes prolonged sedentary behavior and heightened musculoskeletal stress, worsening pain symptoms.[9] Disrupted sleep quality plays a key role in connecting smartphone addiction to musculoskeletal pain. Excessive smartphone use, particularly before sleep, can interfere with sleep patterns and lower overall sleep quality. Poor sleep is a well-recognized risk factor for central sensitization (CS), a condition in which the central nervous system becomes more sensitive to pain stimuli. CS is frequently seen in individuals with chronic pain conditions, including chronic musculoskeletal pain (CMP), leading to heightened pain perception and a lowered pain threshold.

Prolonged smartphone use can worsen muscle and joint pain. This is because holding a smartphone for long periods can lead to poor posture, neck strain, and repetitive strain on the arms. When combined with poor sleep and increased sensitivity to pain, these physical stressors can create a cycle of pain that affects quality of life. Despite research on individual factors, there is a gap in understanding how smartphone addiction, sleep quality, and pain sensitivity are connected. This study aimed to investigate

whether smartphone addiction is linked to poor sleep and increased pain sensitivity in people with chronic muscle and joint pain. The goal was to explore the relationships between smartphone addiction, sleep quality, and pain sensitivity in individuals with chronic pain in the neck and upper limbs.It is expected that there is a link between smartphone addiction, poor sleep quality, and increased pain sensitivity in people with chronic pain in the neck and upper limbs."

"Methodology:

This study was a cross-sectional observational research project conducted at different colleges of dehradun. We recruited 300 participants, aged 18-40, who suffered from chronic neck and upper limb muscle and joint pain. Participants were selected based on convenience sampling. To ensure the accuracy of our results, we excluded individuals who had undergone recent surgery, taken corticosteroids, had a high body mass index (BMI), or suffered from systemic inflammatory arthritis.

To assess smartphone addiction, sleep quality, and central sensitization, we used the following standardized tools: Smartphone Addiction Scale (SAS-SV), Pittsburgh Sleep Quality Index (PSQI-G) , Central Sensitization Inventory (CSI-G)" . "**The Smartphone Addiction Scale-Short Version (SAS-SV)** is a trustworthy and accurate measure of smartphone addiction. Research has shown that it: has high internal consistency, meaning it consistently measures what it's supposed to , has strong construct validity, meaning it effectively assesses smartphone addiction , Correlates significantly with other measures of problematic smartphone use, can effectively differentiate between individuals with high and low levels of smartphone addiction". [10-13]. **The Pittsburgh Sleep Quality Index (PSQI)** is a widely used and well-established questionnaire that assesses sleep quality and disturbances over a one-month period. It provides a comprehensive score that reflects overall sleep quality. The PSQI has been shown to be: Reliable: consistent results across different populations and testing sessions , Valid: strongly correlated with objective sleep measures, such as polysomnography and actigraphy. The PSQI is extensively used in both clinical and research settings to: identify sleep disorders and Monitor treatment outcomes. [14-17]. The Central **Sensitization Inventory (CSI)** is a trusted tool for identifying individuals who may have central sensitization (CS), a condition that can contribute to chronic pain. The CSI has strong psychometric properties, including: high test-retest reliability, Good internal consistency , Construct validity . This makes it useful for screening patients with chronic pain conditions.[18-22] This study was approved by the Institutional Ethics Committee . We distributed questionnaires to eligible patients, obtained informed consent, and analyzed the data. Data collection took place over four months (December 2023 to March 2024). We cleaned and checked the data for normality using the Kolmogorov-Smirnov test. We performed: Descriptive analysis (frequencies, means, and standard deviations) , Bivariate Pearson moment correlation for outcome variables . All analyses were conducted using SPSS 20.0, with a 95% confidence interval and a p-value of <0.05, which was considered statistically significant. Table 1 presents a summary of the demographic and health-related variables.

Results:

This study involved 300 participants, with 131 male participants, comprising 77 young adults (aged 18-25) and 54 adults (aged 26-40). Among the participants, 169 were female, with 104 in the young adult category (aged 18-25) and 65 in the adult category (aged 26-40). In this study, 102 males (34%) and 130 females (43.33%) were addicted to smartphones. In this study, 96 male (32%) and 132 female (44%)

exhibited central sensitization, as indicated by the Central Sensitization Inventory scores falling within the range of 40-100. In this study, 125 male (41.66%) and 161 female (53.66%) displayed poor sleep quality, as determined by the Pittsburgh Sleep Quality Index (PSQI). In this study, among non-addicted smartphone users, 39 out of 68 participants demonstrated the presence of CS. Conversely, 189 of the 232 smartphone addicts exhibited CS.

Table 1: Demographic and Health-related Data

Variables	Mean	Std. Deviation
Age (Years)	25.4367	5.14856
Height (cm)	168.8467	11.54705
Weight (Kgs)	62.4100	11.21283
Duration of Musculoskeletal Pain (In Months)	9.9600	11.62449
CSI Total	48.3800	14.29628
NPRS Level	4.9233	.91300
Hours of Smartphone Used	4.9900	1.59112
SAS SV Total	37.1633	8.16981
PSQI TOTAL	10.3467	3.13463

Table 2: Cross-tabulation of SAS-SV Categories and CSI Categories

		CSI CATEGORIES					Total
		Sub Clinical	Mild	Moderate	Severe	Extreme	
SAS CATEGORY	Not Addicted <30	8	21	26	11	2	68
	Addicted >30	16	27	75	60	54	232
Total		24	48	101	71	56	300

Table 1 summarizes the demographic and health-related data, while Table 2 presents a cross-tabulation of the SAS-SV categories with CSI categories. In this study, an SAS-SV score <30 was considered "not addicted" and >30 scores were considered "Addicted."

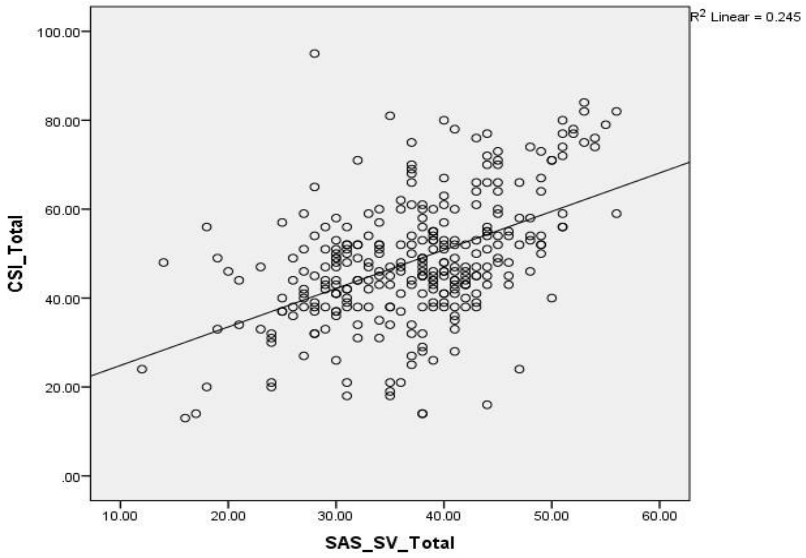
Table 3: Correlation of Outcome Measures (N=300)

Outcome Measures	CSI Total	SAS-SV Total	PSQI TOTAL	Hours of Smartphone Used
NPRS Level	.335**	.417**	.335**	.253**
	.000	.000	.000	.000
CSI Total	1	.495**	.351**	.362**

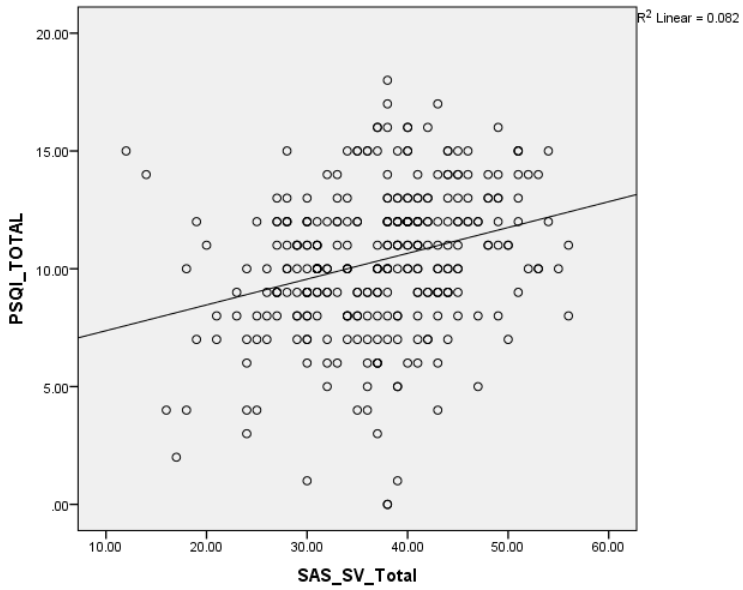
		.000	.000	.000
SAS-SV Total		1	.285**	.716**
			.000	.000
PSQI TOTAL			1	.102
				.078
Hours of Smartphone Used				1

**. Correlation is significant at the 0.01 level (2-tailed).

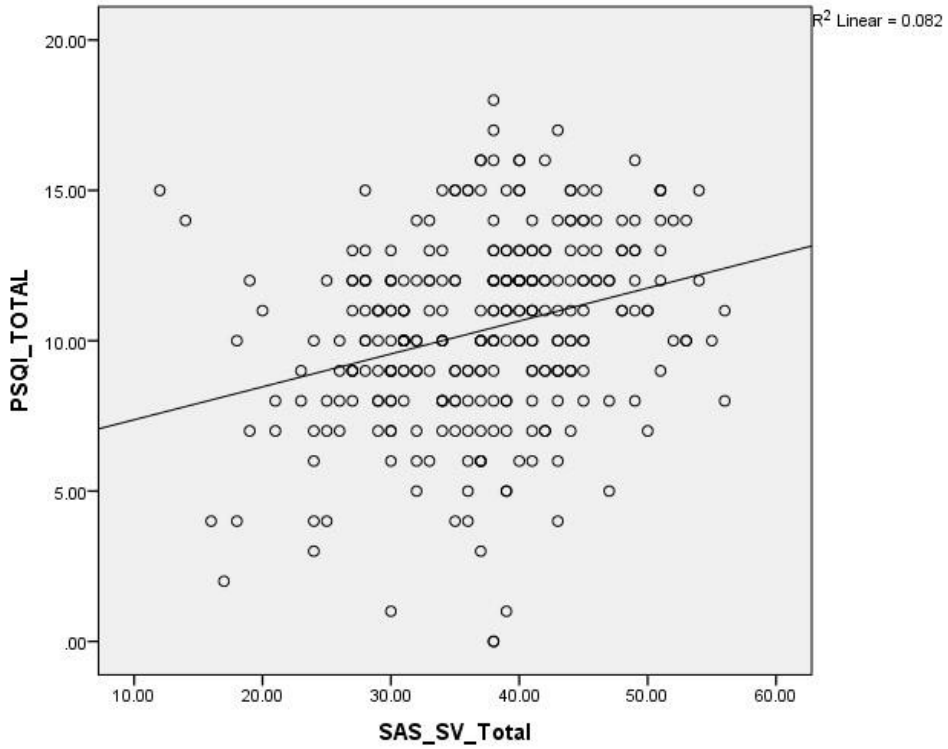
Correlation analysis (Table 3) revealed significant associations between SAS-SV, CSI, PSQI, and smartphone usage hours.



Graph-1: Scatter Plot of SAS-SV Total vs. CSI Total Scores



Graph-2: Scatter Plot of SAS-SV Total vs. PSQI Total Scores



Graph-3: Scatter Plot of PSQI Total vs. CSI Total Scores

The scatter plots (Graphs 1-3) further illustrate the positive correlations between these variables.

Discussion:

This research explores the complex link between smartphone dependency, sleep disturbances, and heightened central nervous system sensitivity in people dealing with long-term musculoskeletal pain in the neck and upper limbs. The results show a strong connection between excessive smartphone use and both poor sleep patterns and increased central sensitization, indicating a potentially self-perpetuating cycle that worsens chronic pain. Most individuals classified as smartphone-addicted reported sleep issues and signs of central sensitization. These findings are in line with those of Ahmed et al. (23), who reported that heavy smartphone use negatively affects musculoskeletal health, particularly in areas such as the neck, shoulders, and upper limbs.

Mustafaoglu et al. (24) also highlighted the common occurrence of musculoskeletal (MSK) pain in areas such as the upper back, neck, and wrists/hands among frequent smartphone users, with addiction to smartphones significantly increasing the likelihood of such pain. The present study further reinforces the strong link between smartphone addiction (SA) and central sensitization (CS), pointing to potential neurological impacts resulting from excessive device use (Graph-1). A moderate positive correlation found between SA and CS (20, 25) indicates that smartphone overuse might play a role in initiating or intensifying CS—a condition marked by an overly responsive nervous system to pain. These observations are consistent with findings from Tuğral and Yağmur (26), who suggested that habitual smartphone use may worsen central sensitization through repetitive movements and prolonged inactivity. In addition, changes in muscle activation patterns in individuals with shoulder pain (27, 28) support the theory that poor posture and mechanical strain from smartphone use can lead to central sensitization in vulnerable individuals.

Sleep quality emerged as a crucial aspect of this study, underlining the importance of adequate rest in managing chronic pain. Inadequate sleep is well known to contribute to both physical and mental stress, which can in turn heighten pain perception. Participants who had higher levels of smartphone addiction consistently reported poorer sleep, suggesting a close relationship between excessive smartphone use and sleep disturbances (Graph-2). These results are supported by Alhafi et al. (29), who found a strong link between smartphone addiction and poor sleep, with most addicted individuals experiencing issues such as insomnia and fragmented sleep. Additional research has shown that SA negatively impacts sleep efficiency, increases night-time disturbances, and leads to fatigue and functional impairment during the day (30, 29). Similarly, Filho et al. (31) found that individuals showing signs of CS were more likely to experience sleep-related problems like frequent awakenings and sleep apnea, further confirming the connection between poor sleep and heightened central pain sensitivity.

The two-way relationship between sleep disturbances and CS was particularly striking in this study (Graph-3). On one hand, inadequate or poor-quality sleep can heighten the nervous system's reactivity to pain; on the other, increased pain sensitivity caused by CS can make it harder to achieve restful sleep. This vicious cycle highlights the need for integrative treatment strategies that address both sleep quality and central sensitization in those suffering from chronic MSK pain. Tackling both factors together may be key to interrupting the cycle of pain, sleep disruption, and heightened nervous system sensitivity.

Beyond its relevance to pain management, this study sheds light on the wider psychosocial effects of smartphone addiction (SA). Existing research indicates that individuals prone to SA often face elevated anxiety levels, decreased participation in daily routines, and longer times to fall asleep (32). Moreover, early exposure to smartphones has been associated with a higher likelihood of developing dependency and excessive usage habits, which may increase the risk of SA and its negative outcomes. Another investigation (33) revealed that poor sleep quality is closely linked with shoulder pain, functional limitations, and SA—suggesting that these elements interact to worsen pain and reduce functionality. Similarly, a cross-sectional study involving university students (34) identified a connection between SA, disrupted sleep, and diminished psychological well-being, further illustrating the interplay between these factors.

The findings underscore the urgent need for tailored interventions aimed at reducing SA in order to lessen its negative impact on sleep quality and central sensitization (CS). Treatment approaches for individuals with chronic musculoskeletal (MSK) pain should include ergonomic education, behavioral methods to limit smartphone use, and strategies to improve sleep hygiene.

To better understand the underlying mechanisms linking SA, sleep disturbances, and CS, future longitudinal studies are needed to explore cause-and-effect relationships. Mediation analyses could help determine whether sleep quality serves as a key factor influencing the relationship between SA and CS. Furthermore, interventional research should assess the effectiveness of approaches focused on behavior change, ergonomic adjustments, and sleep improvement in reducing SA and minimizing its contribution to CS and chronic pain.

However, the cross-sectional nature of this study prevents any firm conclusions about causality. The reliance on self-reported data may lead to bias, and the use of convenience sampling may limit how broadly the findings can be applied.

Conclusion

This study underscores the high prevalence of smartphone addiction (SA) in individuals suffering from

chronic musculoskeletal (MSK) pain in the cervical spine and upper limbs. It also highlights the strong link between SA, poor sleep quality, and central sensitization (CS). These interconnected factors appear to form a vicious cycle that amplifies pain and negatively impacts overall health and quality of life. To effectively manage these challenges, a comprehensive approach is essential—one that integrates ergonomic training, sleep hygiene strategies, and specific interventions aimed at reducing central sensitization.

References:

1. Smith, Emma, et al. "The Global Burden of Other Musculoskeletal Disorders: Estimates from the Global Burden of Disease 2010 Study." *Annals of the Rheumatic Diseases*, vol. 73, no. 8, 2014, pp. 1462–1469.
2. Treede, Rolf-Detlef, et al. "Chronic Pain as a Symptom or a Disease: The IASP Classification of Chronic Pain for the International Classification of Diseases (ICD-11)." *Pain*, vol. 160, no. 1, 2019, pp. 19–27.
3. Van Rooij, Antonius J., and Nicole Prause. "A Critical Review of 'Internet Addiction' Criteria with Suggestions for the Future." *Journal of Behavioral Addictions*, vol. 3, no. 4, 2014, pp. 203–213.
4. Petry, Nancy M., et al. "Behavioral Addictions as Mental Disorders: To Be or Not To Be?" *Annual Review of Clinical Psychology*, vol. 14, 2018, pp. 399–423.
5. Al-Hadidi, Fares, and Iyad Bsisu. "Association Between Mobile Phone Use and Neck Pain in University Students: A Cross-Sectional Study Using Numeric Rating Scale for Evaluation of Neck Pain." *PLoS ONE*, vol. 14, no. 5, 2019, e0217231.
6. Horvath, Jozsef, et al. "Structural and Functional Correlates of Smartphone Addiction." *Addictive Behaviors*, vol. 105, 2020, 106334.
7. Panova, Tayana, and Xavier Carbonell. "Is Smartphone Addiction Really an Addiction?" *Journal of Behavioral Addictions*, vol. 7, no. 2, 2018, pp. 252–259.
8. Viola, Diana. "Negative Health Review of Cell Phones and Social Media." *Journal of Mental Health and Clinical Psychology*, vol. 5, 2021, pp. 7–18.
9. Nikolic, Aleksandar, et al. "Smartphone Addiction, Sleep Quality, Depression, Anxiety, and Stress Among Medical Students." *Frontiers in Public Health*, vol. 11, 2023, 1252371.
1. 8. Kwon, Myeong, et al. "The Smartphone Addiction Scale: Development and Validation of a Short Version for Adolescents." *PLoS ONE*, vol. 8, no. 12, 2013, e83558.
10. Hamamura, Takeshi, et al. "Validity, Reliability, and Correlates of the Smartphone Addiction Scale–Short Version Among Japanese Adults." *BMC Psychology*, vol. 11, no. 1, 2023, p. 78.
11. Harris, Brooke, et al. "Examining the Psychometric Properties of the Smartphone Addiction Scale and Its Short Version for Use with Emerging Adults in the U.S." *Computers in Human Behavior Reports*, vol. 1, 2020, 100011.
12. Servidio, Rocco, et al. "Further Exploration of the Psychometric Properties of the Revised Version of the Italian Smartphone Addiction Scale – Short Version (SAS-SV)." *Current Psychology*, vol. 42, no. 31, 2023, pp. 27245–27258.
13. Backhaus, Jens, et al. "Test-Retest Reliability and Validity of the Pittsburgh Sleep Quality Index in Primary Insomnia." *Journal of Psychosomatic Research*, vol. 53, no. 3, 2002, pp. 737–740.

14. Larche, Cynthia L., et al. "The Pittsburgh Sleep Quality Index: Reliability, Factor Structure, and Related Clinical Factors Among Children, Adolescents, and Young Adults with Chronic Pain." *Pain Research and Management*, vol. 2021, 2021, 5546484.
15. Marques, Daniela, et al. "Reliability and Initial Validation of the Pittsburgh Sleep Quality Index, European Portuguese Version: A Preliminary Study in a Sample of Higher Education Students." *Sleep Medicine*, vol. 14, 2013, e140.
16. Manzar, M. D., et al. "Validity of the Pittsburgh Sleep Quality Index in Indian University Students." *Oman Medical Journal*, vol. 30, no. 3, 2015, pp. 193–202.
17. Schuttert, Inge, et al. "Validity of the Central Sensitization Inventory to Address Human Assumed Central Sensitization: Newly Proposed Clinically Relevant Values and Associations." *Journal of Clinical Medicine*, vol. 12, no. 14, 2023.
18. Cuesta-Vargas, Antonio I., et al. "Dimensionality and Reliability of the Central Sensitization Inventory in a Pooled Multicountry Sample." *The Journal of Pain*, vol. 19, no. 3, 2018, pp. 317–329.
19. Neblett, Randy, et al. "The Central Sensitization Inventory (CSI): Establishing Clinically Significant Values for Identifying Central Sensitivity Syndromes in an Outpatient Chronic Pain Sample." *The Journal of Pain*, vol. 14, no. 5, 2013, pp. 438–445.
20. Mayer, Theodore G., et al. "The Development and Psychometric Validation of the Central Sensitization Inventory." *Pain Practice*, vol. 12, no. 4, 2012, pp. 276–285.
21. Bid, D. D., et al. "Content Validity and Test-Retest Reliability of the Gujarati Version of the Central Sensitization Inventory." *National Journal of Integrated Research in Medicine*, vol. 7, no. 5, 2018, pp. 18–24.
22. Ahmed, S., et al. "Smartphone Addiction and Its Impact on Musculoskeletal Pain in Neck, Shoulder, Elbow, and Hand Among College Going Students: A Cross-Sectional Study." *Bulletin of Faculty of Physical Therapy*, vol. 27, no. 1, 2022, p. 5.
23. Mustafaoglu, R., and Z. Yasaci. "The Relationship Between Smartphone Addiction and Musculoskeletal Pain Prevalence Among Young Population: A Cross-Sectional Study." *International Journal of Occupational Medicine and Environmental Health*, vol. 34, no. 1, 2021, pp. 72–81.
24. Neblett, Randy, et al. "Establishing Clinically Relevant Severity Levels for the Central Sensitization Inventory." *Pain Practice*, vol. 17, no. 2, 2017, pp. 166–175.
25. Tuğral, Ayşe, and Yasin Çam. "Potential Role of Smartphone Addiction on Sleep Quality and Perceived Neck Pain Among Undergraduate Physiotherapy Students: A Multicentered Cross-Sectional Study." *Ergoterapi ve Rehabilitasyon Dergisi*, vol. 12, no. 2, 2024, pp. 61–70.
26. Noten, Sophie, et al. "Central Pain Processing in Patients with Shoulder Pain: A Review of the Literature." *Pain Practice*, vol. 17, no. 2, 2017, pp. 267–280.
27. Sanchis, M. N., et al. "The Role of Central Sensitization in Shoulder Pain: A Systematic Literature Review." *Seminars in Arthritis and Rheumatism*, vol. 44, no. 6, 2015, pp. 710–716.
28. Alhafi, M., et al. "The Association of Smartphone Usage with Sleep Disturbances Among Medical Students." *Avicenna Journal of Medicine*, vol. 14, no. 3, 2024, pp. 152–157.
29. Erol, Ece. "Smartphone Addiction, Sleep Quality and Musculoskeletal Disorders in University Students." *Balıkesir Sağlık Bilimleri Dergisi*, vol. 13, no. 3, 2024, pp. 589–594.

30. dos Santos Bento, Amanda P., et al. "Sleep Quality and Polysomnographic Changes in Patients with Chronic Pain with and Without Central Sensitization Signs." *Brazilian Journal of Physical Therapy*, vol. 27, no. 3, 2023, 100504.
31. de Paula, Vanessa C., et al. "Association of Smartphone Addiction with Pain, Sleep, Anxiety, and Depression in University Students." *Fisioterapia em Movimento*, vol. 36, 2023.
32. Lee, Min-Kyung, and Jihyun Oh. "The Relationship Between Sleep Quality, Neck Pain, Shoulder Pain and Disability, Physical Activity, and Health Perception Among Middle-Aged Women: A Cross-Sectional Study." *BMC Women's Health*, vol. 22, no. 1, 2022, p. 186.
33. Park, Sang-Young, et al. "Correlation Between Neck and Shoulder Pain, Neck and Shoulder Disability, Headache and Smartphone Addiction in Adults with Sleep Disorders." *Journal of the Korean Society of Physical Medicine*, vol. 15, 2020, pp. 43–50.