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Impact of neuropathic pain on sleep quality in earth-quake-related peripheral nerve injuries

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Abstract

Objective: Natural disasters such as earthquakes often cause sleep disorders in affected individuals. Neuropathic pain seen in traumatic peripheral nerve injuries has been found to be associated with sleep disorders. This study aimed to evaluate the impact of neuropathic pain on sleep quality in patients who sustained peripheral nerve injuries during the Kahramanmaraş-centered earthquake that occurred on February 6, 2023, and were rescued from under the rubble. *Method:* The study included 45 earth-quake survivors with electrophysiologically confirmed peripheral nerve injuries, aged 18 and above. Pain was assessed using the Visual Analog Scale (VAS) scores, and the presence of neuropathic pain was evaluated using the Turkish version of the Leeds Assessment of Neuropathic Symptoms and Signs (LANSS). Sleep quality was assessed using the Pittsburgh Sleep Quality Index (PSQI) and anxiety and depression levels were evaluated using the Hospital Anxiety and Depression Scale (HADS). *Results:* Among earthquake victims who suffered peripheral nerve injuries, 31 out of 45 people (69%) were found to experience neuropathic pain. Among the earthquake survivors with poor sleep quality (PSQI≥5), the duration of entrapment under the rubble, the extremity VAS scores, the LANSS scores, and the HADS depression and anxiety scores were significantly higher ($p=0.018$, $p=0.001$, $p=0.008$, $p=0.001$, and $p<0.001$, respectively). The LANSS scores had positive, moderately significant correlations with the extremity VAS and PSQI scores ($r=0.356$, $p=0.016$ and $r=0.486$, $p=0.001$, respectively).
Conclusion: This study shows that the intensity of neuropathic pain due to peripheral nerve injuries is high in earthquake victims has poor sleep quality. There is a need to develop targeted interventions addressing the unique challenges faced by earthquake survivors with peripheral nerve injuries.

Keywords: Earthquake, peripheral nerve injury, neuropathic pain, sleep quality

INTRODUCTION

Disasters are sudden and unpredictable events that lead to devastating physical, economic, and social consequences for individuals. These events can cause long-term, severe impacts on the physical and mental well-being of affected populations.[1] Individuals trapped under collapsed buildings are susceptible to various injuries, depending on the location and duration of the crushing trauma. These injuries can arise from direct trauma, compression ischemia, and compartment syndrome.[2,3] As a result of these injuries, earthquake survivors often experience conditions such as crush syndrome, limb fractures, pelvic and spinal injuries, as well as peripheral nerve injuries.[4-6]

Earthquake-related peripheral nerve injuries are different from other traumatic peripheral nerve injuries that occur in daily life. Peripheral nerve injuries alone are rare in patients injured in earthquakes, and multiple injuries, usually accompanied by crush syndrome, fractures, amputations, and compartment syndrome, are seen. Also, since patients have multiple peripheral nerve injuries in more than one extremity, managing earthquake-related peripheral neuropathies is often difficult.[5,6]

Peripheral nerve injuries lead to varying degrees of motor and sensorial loss and affect quality of life due to neuropathic pain.[7,8] Previous studies have indicated that neuropathic pain has a negative impact on sleep quality.[9,10] Research has confirmed that sleep disorders are a common occurrence following large-scale natural disasters.[11] However, there is no study examining

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whether traumatic neuropathies resulting from earthquake-related injuries are associated with sleep disorders and how pain levels and depression affect sleep quality in earthquake survivors with peripheral nerve injuries.

This study aimed to investigate the relationship between neuropathic pain and sleep quality in individuals who sustained peripheral nerve injuries due to being trapped under the rubble during the February 6, 2023 Kahramanmaras earthquake.

METHODS

This descriptive study was conducted by examining the data of earthquake survivors aged 18 and older who presented to the physical medicine and rehabilitation outpatient clinic of Adana City Hospital and/or were hospitalized between April 2023 and November 2023 with peripheral nerve injuries sustained in the Kahramanmaras earthquake that occurred on February 6, 2023.

The patients included in the study had body and extremity damage with electrophysiologically confirmed peripheral nerve injuries due to the earthquake. The exclusion criteria were the presence of pre-existing conditions that could cause peripheral nerve injuries (e.g., diabetes mellitus), non-earthquake-related traumatic neuropathies, pre-diagnosed sleep disorders (e.g., obstructive sleep apnea syndrome, insomnia, parasomnia, narcolepsy, restless legs syndrome, periodic limb movement disorder, and rapid eye movement sleep behavior disorder), or pre-existing psychiatric conditions (e.g., depression).

The demographic and clinical characteristics of all patients (age, gender, height, weight, educational level, duration of entrapment under the rubble, and intensive care history) were recorded. A detailed trauma history was also obtained from all patients, and the presence of fractures, amputations, soft tissue injuries, compartment syndrome, and crush syndrome was evaluated.

Electrophysiologically confirmed injuries were classified as single nerve injuries if they were confined to a single peripheral nerve (e.g., sciatic neuropathy). Otherwise, lesions involving multiple nerves that did not conform to any specific plexus region or caused different injuries in different extremities (e.g., left brachial plexopathy and right sciatic neuropathy simultaneously) were defined as multiple nerve injuries.

To assess the pain status of the patients included in the study, the Visual Analog Scale (VAS) scores were recorded. On the 10-centimeter-long VAS scale, 0 indicates no pain, while 10 represents the most severe pain.[12] The patients were asked to mark the point on the scale that best represented their pain level.

In patients with peripheral nerve injuries, neuropathic pain was assessed using the Turkish version of the Leeds Assessment of Neuropathic Symptoms and Signs (LANSS) [13], consisting of two sections: a pain questionnaire (LANSS-A) and a sensory test (LANSS-B). The LANSS-A, LANSS-B, and LANSS total (LANSS-T) scores were calculated. A score of 12 or higher on the LANSS scale indicates neuropathic pain.[13] The patients included in the study were divided into two groups based on their LANSS-T scores: < 12 and ≥ 12. The patients with a total score of 12 or above were considered to have neuropathic pain. The validity and reliability of the Turkish version of the LANSS scale have been previously established.[14]

The sleep quality of the patients included in the study was assessed using the Pittsburgh Sleep Quality Index (PSQI), which PSQI is a standardized sleep quality assessment scale developed by Buysse *et al.* in 1989, with established validity and reliability.[15,16] PSQI consists of 19 items, including seven subscales (subjective sleep quality, sleep latency, sleep duration, sleep efficiency, sleep disturbance, use of sleeping medication, and daytime dysfunction), each scored between 0 and 3. The total sleep quality score ranges from 0 to 21, with higher scores indicating poorer sleep quality. A total score of 5 or above is interpreted as poor sleep quality.[15]

The participants' anxiety and depression levels were evaluated using the Hospital Anxiety and Depression Scale (HADS). This 14-item scale comprises two subscales: anxiety (seven items, odd-numbered) and depression (seven items, even-numbered). The scoring of each item varies: items 1, 3, 5, 6, 8, 10, 11, and 13 are scored as 3, 2, 1, and 0, while items 2, 4, 7, 9, 12, and 14 are scored as 0, 1, 2, 3. Scores above 10 for the HADS-Anxiety (HADS-A) subscale and above 7 for the HADS-Depression (HADS-D) subscale are considered abnormal.[17,18]

The nerve conduction studies and needle electromyography (EMG) were performed using the Cadwell Sierra Summit EMG unit (Cadwell Laboratories, Kennewick, Washington, USA). Electrophysiological assessments were individually planned for each case, considering the injury location, peripheral nerve structures susceptible to damage, and scar tissues in the extremities. Sensory and motor conduction of the median, ulnar, radial superficial, medial antebrachial cutaneous, and lateral antebrachial cutaneous nerves were evaluated in the upper extremities. In the lower extremities, motor and sensory conduction of the peroneal, posterior tibial, femoral, sural, superficial peroneal, and saphenous nerves were assessed. The selection of muscles for needle electromyography examination was based on neurological examination findings and abnormalities identified in nerve conduction studies.[19,20]

This study was conducted in accordance with the principles of the Declaration of Helsinki. Approval was obtained from the Ethics Committee of the University of Health Sciences Adana City Training and Research Hospital (approval number: 129/2685, 2023). Written informed consent was collected from all patients, with detailed information about the study provided in the consent form.

Statistical analysis

Continuous variables were expressed as mean ± standard deviation, while categorical data were presented as numbers and percentages. Normality analyses for continuous variables were conducted using the Kolmogorov-Smirnov goodness-of-fit test. For the comparison of groups, Student's t-test was employed for data that conformed to a normal distribution, and the Mann-Whitney U test was used for data that did not conform to a normal distribution. Comparisons between categorical variables were performed using the chi-square test. The linear relationship between variables was assessed using Spearman's rho test. Analyses were undertaken using IBM SPSS version 27.0 (IBM Corporation, Armonk, NY, USA). A p-value of less than 0.05 was considered statistically significant.

RESULTS

A total of 45 earthquake survivors with peripheral nerve injuries were included in the study. Table 1 provides a summary of the demographic characteristics and traumatic injuries of these patients.

Among the types of peripheral nerve injuries observed in the earthquake survivors included in our study, the most common causes were lumbosacral plexus lesions (35.6%) and brachial plexus lesions (22.0%) (Figure 1).

The earthquake survivors had a mean LANSS score of 14.11 ± 5.20, a mean HADS-D score of 8.48 ± 6.70, and a mean HADS-A score of 8.66 ± 6.34. The median VAS and PSQI scores were 5 (range: 3-10) and 4 (range: 0-19), respectively.

It was found that the duration of stay in the intensive care unit was significantly higher for earthquake survivors with neuropathic pain compared to those without neuropathic pain (15 [3-45] vs. 7 [2-15]; $p = 0.039$). However, there were no significant differences in disease duration, the duration of entrapment under the rubble, pain, sleep quality, anxiety and depression levels, the presence of accompanying pathology, or the rate of fasciotomy between those with and without neuropathic pain ($p = 0.085$, $p = 0.285$, $p = 0.336$, $p = 0.183$, $p = 0.783$, $p = 0.606$, $p = 0.082$, and $p = 0.293$, respectively) (Table 2).

No significant differences were detected between the earthquake survivors with and without neuropathic pain in terms of the type of peripheral nerve injuries ($p = 0.717$) (Table 3).

The duration of entrapment under the rubble, the extremity VAS scores, the LANSS scores, and the HADS-D and HADS-A scores were statistically significantly higher in earthquake survivors with poor sleep quality (PSQI ≥ 5) ($p = 0.018$, $p = 0.001$, $p = 0.008$, $p = 0.001$, and $p < 0.001$, respectively); however, disease duration, length of intensive care unit stay, the presence of accompanying pathology, or the presence of fasciotomy did not significantly differ according to sleep quality (Table 4).

It was determined that the LANSS scores had positive, moderately significant correlations with the extremity VAS and PSQI scores ($r = 0.356$, $p = 0.016$ and $r = 0.486$, $p = 0.001$, respectively) (Table 5).

DISCUSSION

In this study, we investigated the relationship between neuropathic pain levels, depression, and sleep quality in cases of peripheral nerve injury associated with earthquakes. The findings shed light on the intricate connections between physical trauma, neuropathic pain, mental health, and sleep quality outcomes following a natural disaster. Given the limited literature on peripheral nerve injuries occurring after a large-scale earthquake[4-6,21,22], we believe that our findings could have a valuable contribution to the existing body of knowledge in this regard.

Our study revealed a higher incidence of peripheral nerve injuries in the lower extremities compared to the upper extremities, which is

Table 1: Selected socio-demographic and clinical characteristics of earthquake survivors

	Patient group (n = 45)
Age (years) (mean ± SD)	29.11 ± 12.72
BMI (kg/m^2) (mean ± SD)	23.40 ± 3.52
Duration of entrapment under rubble (hours) (median [min-max])	18 (3-140%)
Disease duration (months) (median [min-max])	4 (3-9%)
Length of intensive care unit stay (days) (median [min-max])	10 (2-45%)
Gender (n, %)	
Female	29 (64.4%)
Male	16 (35.6%)
Educational level (n, %)	
Illiterate	5 (11.0%)
Primary school	7 (15.6%)
Middle school	11 (24.4%)
High school	16 (35.6%)
University	6 (13.3%)
Intensive care requirement (n, %)	
Present	23 (51.1%)
Absent	22 (48.9%)
Accompanying pathology (n, %)	
Amputation	4 (8.9%)
Crush syndrome	10 (22.2%)
Compartment syndrome	8 (17.8%)
Fracture	7 (15.6%)
None	8 (17.8%)
Crush and compartment syndromes	8 (17.8%)
Affected nerve (n,%)	
Single	32 (71.1%)
Multiple	13 (28.9%)
Presence of fasciotomy (n, %)	
Present	27 (60.0%)
Absent	18 (40.0%)

SD: standard deviation, BMI: body mass index

consistent with reports on survivors of the 1999 Marmara earthquake, where the lower extremities were more frequently affected.[4,5] However, other studies have presented conflicting findings suggesting a higher prevalence of upper extremity injuries.[6,21] Factors such as the earthquake's occurrence during sleep and building construction materials may contribute to these discrepancies. Nonetheless, it is challenging to draw definitive conclusions about the reason for these discrepancies, given the potential presence of other influencing variables.

Injuries to the lower extremities, along with the lumbosacral plexus, may be related to crush- or compression-type trauma affecting the peroneal and sciatic nerves. On the other hand, upper extremity injuries often correlate with stretch trauma, particularly in brachial plexopathies.[21] Therefore, in addition to the compression and penetrating trauma resulting from being trapped under the rubble, we can also suggest that stretch trauma, particularly during rescue operations, could be a potential risk factor. However, as this issue was not specifically examined in our study, drawing a definitive conclusion is not possible.

Neuropathic pain is defined as a common consequence of trauma-related peripheral nerve injuries.[7-9] Similarly, our findings revealed that

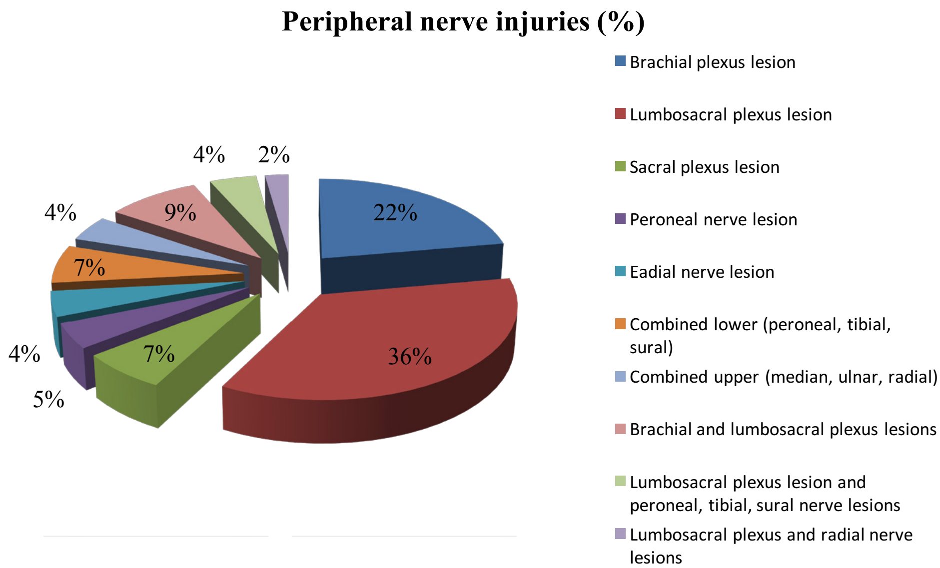

Figure 1. Types of peripheral nerve injuries seen in earthquake survivors

the majority of cases among earthquake survivors exhibited neuropathic pain due to peripheral nerve injuries, highlighting the necessity for targeted interventions to address pain management and enhance the overall health of survivors.

Our results did not show significant differences in the types of peripheral nerve injuries between earthquake survivors with and without neuropathic

Table 2: Comparison of pain, sleep quality, anxiety and depression levels, and selected clinical parameters of earthquake survivors according to the presence of neuropathic pain

	Neuropathic pain		
	Absent (n = 14)	**Present (n = 31)**	***p***
Disease duration (median [min-max])	6,5 (3-9)	4 (3-8)	0.085*
Length of intensive care unit stay (median [min-max])	7 (2-15)	15 (3-45)	**0.039***
Duration of entrapment under rubble (hours) (median [min-max])	19 (3-140)	18 (3-75)	0.285*
Extremity VAS score (median [min-max])	4,5 (3-10)	5 (3-10)	0.336*
PSQI (median [min-max])	3 (1-14)	6 (0-19)	0.183*
HADS depression score (mean ± SD)	8,07±5,51	8,67±7,25	0.783**
HADS anxiety score (mean ± SD)	7,92±4,79	9,00±6,97	0.606**
Accompanying pathology (n, %)			
Amputation	3 (%21,4)	1 (%3,2)	
Crush syndrome	0 (%0,0)	10 (%32,3)	
Compartment syndrome	4 (%28,6)	4 (%12,9)	0.082***
Fracture	2 (%14,3)	5 (%16,1)	
None	2 (%14,3)	6 (%19,4)	
Crush and compartment syndromes	3 (%21,4)	5 (%16,1)	
Presence of fasciotomy (n, %)			
Present	10 (%71,4)	17 (%54,8)	0.293***
Absent	4 (%28,6)	14 (%45,2)	

*Mann-Whitney U test, **Student's t-test, ***Chi-square test
VAS: Visual Analog Scale, PSQI: Pittsburgh Sleep Quality Index, SD: standard deviation, HADS: Hospital Anxiety and Depression Scale

Table 3: Comparison of types of peripheral nerve injuries in earthquake survivors according to the presence of neuropathic pain

Type of peripheral nerve injury	Neuropathic pain		*p*
	Absent	**Present**	
Brachial plexus lesion	3 (21.4%)	7 (22.6%)	
Lumbosacral plexus lesion	3 (21.4%)	13 (41.9%)	
Sacral plexus lesion	0 (0.0%)	3 (9.7%)	
Peroneal nerve lesion	1 (7.1%)	1 (3.2%)	
Radial nerve lesion	1 (7.1%)	1 (3.2%)	
Combined lower extremity lesions (peroneal, tibial, sural)	2 (14.3%)	1 (3.2%)	0.184*
Combined upper extremity lesions (median, ulnar, radial)	0 (0.0%)	2 (6.5%)	
Brachial and lumbosacral plexus lesions	1 (7.1%)	3 (9.7%)	
Lumbosacral plexus lesion and peroneal, tibial, and sural nerve lesions	2 (14.2%)	0 (0.0%)	
Lumbosacral plexus and radial nerve lesions	1 (7.1%)	0 (0.0%)	

*Chi-square test

pain. Previous studies have reported a higher prevalence of neuropathic pain in plexopathies compared to isolated peripheral nerve injuries.[4,21] This inconsistency may be associated with the relatively small sample size in our study.

We did not find a direct relationship between the presence of neuropathic pain in earthquake survivors and their sleep quality, anxiety, and

Table 4: Comparison of pain, anxiety, and depression levels of earthquake survivors and selected clinical parameters according to sleep quality scores

	PSQI < 5 (n = 24)	**PSQI ≥ 5 (n = 21)**	*p*
Disease duration (median [min-max])	4 (3-9)	4 (3-8)	1.000*
Length of intensive care unit stay (median [min-max])	10 (2-25)	10 (3-45)	0.516*
Duration of entrapment under rubble (hours) (median [min-max])	13 (3-75)	**25 (6-140)**	**0.018***
Extremity VAS score (median [min-max])	4 (3-10)	**8 (3-10)**	**0.001***
LANSS score (mean ± SD)	12.25 ± 4.98	**16.23 ± 4.68**	**0.008****
HADS depression score (mean ± SD)	6 (0-13)	**14 (3-21)**	**0.001***
HADS anxiety score (mean ± SD)	6 (0-13)	**13 (3-21)**	**<0.001***
Accompanying pathology (n, %)			
Amputation	3 (12.5%)	1 (5.8%)	
Crush syndrome	5 (20.8%)	5 (23.8%)	
Compartment syndrome	5 (20.8%)	3 (14.3%)	0.104***
Fracture	2 (8.3%)	5 (23.8%)	
None	2 (8.3%)	6 (28.6%)	
Crush and compartment syndromes	7 (29.2%)	1 (4.8%)	
Presence of fasciotomy (n, %)			
Present	17 (70.8%)	10 (47.6%)	0.113***
Absent	47 (29.2%)	11 (52.4%)	

*Mann-Whitney U test, **Student's t-test, ***Chi-square test
PSQI: Pittsburgh Sleep Quality Index, VAS: Visual Analog Scale, LANSS: Leeds Assessment of Neuropathic Symptoms and Signs, SD: standard deviation, HADS: Hospital Anxiety and Depression Scale

Table 5: Correlations between the LANSS scores and disease duration, duration of entrapment under the rubble, and extremity VAS, PSQI, HADS depression, and HADS anxiety scores in earthquake survivors

		LANSS score
Disease duration	r	-0.264
	p	0.079
	N	45
Duration of entrapment under rubble	r	-0.190
	p	0.211
	N	45
Extremity VAS score	r	**0.356***
	p	**0.016**
	N	45
PSQI	*r*	**0.486**
	p	**0.001**
	N	45
HADS depression score	r	0.206
	p	0.174
	N	45
HADS anxiety score	r	0.229
	p	0.130
	N	45

*Spearman's rho test
LANSS: Leeds Assessment of Neuropathic Symptoms and Signs, VAS: Visual Analog Scale, PSQI: Pittsburgh Sleep Quality Index, HADS: Hospital Anxiety and Depression Scale

depression levels. This can be explained by the consistent nature of sleep disturbances observed following natural disasters, such as earthquakes.[23] Additionally, the impact of peripheral nerve injuries on mood disorders appears to be multidimensional, influenced by factors such as lesion localization and entrapment duration.

Among earthquake survivors with poor sleep quality, statistically significantly higher values were observed for the duration of entrapment under the rubble, extremity pain severity, the presence of neuropathic pain, and depression and anxiety levels. Furthermore, the significant correlation between the LANSS scores and the sleep quality scores highlights the potential link between neuropathic pain and poor sleep quality.[24,25] This underscores the importance of interventions focusing on pharmacological treatment for neuropathic pain during the recovery process and conventional rehabilitative interventions for peripheral nerve injuries. In addition, comprehensive mental health interventions addressing both anxiety and depression should be integral components of the post-earthquake recovery process.

The limitations of our study include the small sample size and the absence of a control group consisting of earthquake survivors without earthquake-related peripheral nerve injuries. Another limitation is the lack of an objective assessment of sleep quality using parameters such as polysomnography. To our knowledge, this study can be considered a preliminary investigation evaluating the impact of neuropathic pain levels and depression on sleep quality in earthquake survivors with peripheral nerve injuries.

In conclusion, this study provides a fundamental understanding of the complex relationship between peripheral nerve injuries, neuropathic pain, and sleep disorders in earthquake survivors. Further research is needed to explore additional factors influencing these relationships and to develop targeted interventions addressing the unique challenges faced by individuals with peripheral nerve injuries following natural disasters.

DISCLOSURE

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