

Neuropathic Pain and Quality of Life: A Cross-Sectional Study in Brachial Plexus Injury

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Purpose: To evaluate the influence of neuropathic pain on quality of life in individuals with traumatic brachial plexus injury using validated assessment tools and multiple linear regression models to identify independent predictors of WHOQOL-BREF domains.

Methods: This cross-sectional study included 77 adults with traumatic brachial plexus injury and neuropathic pain, identified by a score of 4 or more on the Douleur Neuropathique 4 Questions (DN4). All patients were evaluated at a specialized rehabilitation hospital. Participants completed the World Health Organization Quality of Life Questionnaire (WHOQOL-BREF), Brief Pain Inventory (BPI), Disabilities of the Arm, Shoulder and Hand (DASH), and the Hospital Anxiety and Depression Scale (HADS). Multiple linear regression models were used to identify independent predictors of each WHOQOL-BREF domain.

Results: The physical health domain of the WHOQOL-BREF had the lowest mean score (46.3), followed by environment (57.5), psychological well-being (59.8), and social relationships (60.3). Pain intensity and upper limb disability were significant predictors of poorer physical health ($p < 0.05$). Depressive symptoms were linked to lower psychological scores, and anxiety symptoms were associated with reduced scores in the social and environmental domains. The BPI revealed substantial pain interference with normal work (mean = 5.61) and sleep (mean = 5.11), indicating significant occupational and restorative impairments.

Conclusion: Neuropathic pain significantly impairs quality of life in individuals with traumatic brachial plexus injury, underscoring the need for integrated pain, functional, and psychological management in this population.

Keywords: brachial plexus neuropathies, pain, neuropathic, quality of life, disability evaluation, depression

Introduction

Traumatic nerve injuries represent a significant portion of high-energy trauma, particularly in centers with a high volume of motorcycle accidents. Patients with traumatic brachial plexus injuries often experience a significantly reduced quality of life. This impairment may result from several factors associated with the injury, not only from the physical limitations caused by motor deficits.

Neuropathic pain is also considered a major factor affecting quality of life in this patient population, with reported prevalence rates varying widely, from 24% to 95%.¹ In this context, it is essential to apply screening tools that help differentiate neuropathic pain from nociceptive pain, which may also be present in these individuals.² Root avulsion, along with hyperactivity of interneurons in the posterior horn of the spinal cord, is the most widely accepted mechanism underlying neuropathic pain in this setting.³ By contrast, nociceptive pain is typically related to musculoskeletal overload, particularly affecting the scapula and shoulder due to compensatory mechanisms and altered biomechanics. These neurophysiological alterations not only perpetuate chronic pain but also contribute to sleep disturbance, emotional distress, and social withdrawal, thereby compounding the loss of function. One of the most commonly used screening tools is the Douleur Neuropathique en 4 Questions (DN4).⁴ It consists of 10 items, including 7 sensory descriptors and 3 clinical examination findings. Scores range from 0 to 10, with a score of 4 or more considered indicative of neuropathic pain.

Neuropathic pain can compromise quality of life in various ways. According to the World Health Organization, quality of life is defined as an individual's perception of their position in life, within the context of the culture and value systems in which they live, and in relation to their goals, expectations, standards, and concerns. It is a multidimensional concept, and several instruments have been developed to assess it, such as the World Health Organization Quality of Life – BREF (WHOQOL-BREF) and the 36-Item Short Form Survey. The WHOQOL-BREF provides a culturally sensitive and comprehensive evaluation of quality of life, encompassing physical, psychological, social, and environmental domains.⁵

Another important scale for evaluating patients with brachial plexus injury and neuropathic pain is the Brief Pain Inventory (BPI). This widely used, validated questionnaire is designed to assess both the intensity of pain and its impact on daily functioning. Originally developed for patients with cancer, it is now broadly applied across various chronic pain conditions, including neuropathic pain.^{6,7}

Neuropathic pain may contribute to disability in patients with brachial plexus injury, who often report high levels of functional impairment. The Disabilities of the Arm, Shoulder and Hand questionnaire (DASH) is commonly used to assess upper limb disability.^{8–10} It consists of 30 items that evaluate the patient's ability to perform daily activities and the severity of symptoms such as pain, weakness, and stiffness.^{11,12} Notably, neuropathic pain may also negatively influence functional outcomes after nerve transfer procedures, potentially limiting the overall benefit of surgical intervention.¹³

The combined use of these instruments enables a multidimensional understanding—capturing sensory, functional, emotional, and environmental aspects of patient well-being. Although several studies have investigated the prevalence and clinical features of neuropathic pain following brachial plexus injury—including its intensity and sensory profile^{10,14,15}—comprehensive evaluations that integrate functional, psychological, and quality-of-life measures within the same patient population remain scarce. Understanding these associations can inform targeted rehabilitation strategies and improve multidisciplinary interventions aimed at restoring physical function and emotional health.

This study aimed to investigate the multidimensional impact of neuropathic pain on quality of life among patients with traumatic brachial plexus injury using validated assessment tools. Specifically, it examined whether pain intensity, disability, and psychological symptoms independently predict different domains of quality of life.

Materials and Methods

Study Design and Setting

This was a cross-sectional, observational, and analytical study with a quantitative approach. Data collection was prospectively planned and carried out after defining the study variables and research protocol. Patients were evaluated at a single point in time using validated instruments. The study was conducted between 2022 and 2023 at a rehabilitation hospital, specifically in an outpatient clinic for patients with peripheral nerve injuries. All clinical assessments were performed by three neurosurgeons responsible for the outpatient clinic. To ensure consistency, the assessors followed a standardized clinical protocol for administering the DN4, DASH, BPI, HADS, and WHOQOL-BREF questionnaires. Before data collection, the evaluating team reviewed the scoring procedures and operational definitions to minimize inter-rater variability. The research protocol was approved by the institutional ethics committee. This study followed the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines for cross-sectional studies.¹⁶

Participants

Patients were eligible for inclusion if they were aged 18 years or older, had a confirmed diagnosis of traumatic brachial plexus injury, and presented with neuropathic pain identified through the DN4. The exclusion criteria were cognitive impairment or severe psychiatric disorders that could interfere with clinical evaluation or the completion of standardized questionnaires.

The required sample size was calculated using G*Power software,¹⁷ considering a multiple linear regression analysis to investigate the influence of clinical variables on the different domains of the WHOQOL-BREF. A moderate effect size

($f^2 = 0.2$), a power of 80%, and a significance level of $\alpha = 0.05$ were adopted, resulting in an estimated sample size of 75 patients.

Variables

Sociodemographic and Clinical Data

Sociodemographic variables included age, sex, educational level, and marital status. Clinical variables included injury side, dominant side, and the number of avulsed roots. Root avulsion was diagnosed using magnetic resonance imaging (MRI) and interpreted by an experienced radiologist.¹⁸ When MRI was not available or of insufficient quality for evaluation, this was documented accordingly.

Neuropathic Pain Diagnoses

The DN4 was used to diagnose neuropathic pain and differentiate it from nociceptive pain. It was administered by the neurosurgeons, and a score of 4 or higher was considered indicative of neuropathic pain.¹⁹

Quality of Life

Quality of life was assessed using the WHOQOL-BREF questionnaire, a validated instrument developed to measure four domains of quality of life: physical health, psychological well-being, social relationships, and environment.²⁰ The WHOQOL-BREF consists of 26 items: 2 general questions about overall quality of life and health, and 24 items distributed across the 4 domains (physical: 7 items, psychological: 6 items, social relationships: 3 items, and environment: 8 items).

The questionnaire was self-administered by the patients. Each item is scored on a 5-point Likert scale, and raw domain scores are calculated by averaging the responses within each domain. These raw scores are then transformed to a 0–100 scale according to the WHOQOL-BREF scoring manual, with higher scores indicating better perceived quality of life.

Upper Limb Function

Upper limb function was assessed using the DASH questionnaire, a validated self-reported instrument designed to measure physical function and symptoms in individuals with upper extremity musculoskeletal disorders. The questionnaire consists of 30 items that assess the degree of difficulty in performing various physical activities, as well as the severity of symptoms such as pain, weakness, and stiffness.

Each item is scored on a 5-point Likert scale (from 1 = no difficulty/no symptom to 5 = unable to do/extreme symptom). The overall DASH score is calculated by averaging the responses (excluding any missing items, if fewer than three), subtracting 1, multiplying by 25, and yielding a score that ranges from 0 (no disability) to 100 (most severe disability).

The questionnaire was self-administered by patients during outpatient evaluation, with higher scores indicating greater impairment in upper limb function.

Pain Assessment

Pain intensity and interference were assessed using the BPI, a validated self-report instrument developed to evaluate both the severity of pain and its impact on daily functioning.²¹ The BPI includes four items measuring pain intensity (worst, least, average, and current pain) and seven items assessing pain interference across various aspects of life (general activity, mood, walking ability, normal work, relationships, sleep, and enjoyment of life).

All items are rated on an 11-point numeric rating scale, ranging from 0 (no pain or no interference) to 10 (pain as severe as you can imagine or complete interference). Pain severity and pain interference scores were calculated as the arithmetic mean of their respective items. The BPI was self-administered by patients during outpatient evaluation.

Mental Health Assessment

Psychological symptoms of anxiety and depression were assessed using the Hospital Anxiety and Depression Scale (HADS), a widely used screening instrument in medical populations.^{22–26} The HADS consists of 14 items divided into 2 subscales: anxiety (HADS-A) and depression (HADS-D), each containing 7 items.

Each item is scored from 0 to 3, resulting in subscale scores ranging from 0 to 21, with higher scores indicating greater levels of anxiety or depression. In this study, a score of 9 or higher on either subscale was considered indicative of clinically relevant symptoms of anxiety or depression. The questionnaire was self-administered by patients, and the anxiety and depression subscale scores were analyzed independently.

Statistical Analysis

Descriptive statistics were used to summarize the sample characteristics. Continuous variables were reported as means and standard deviations (SDs), and categorical variables were reported as absolute and relative frequencies.

Spearman's rank correlation coefficient was used to assess the relationships between pain intensity, age, and educational level. Multiple linear regression models were constructed to identify independent predictors of each WHOQOL-BREF domain score (physical health, psychological, social relationships, and environment). Multicollinearity was assessed using variance inflation factors, and no concerning levels of multicollinearity were observed. All regression models were reported using standardized beta coefficients.

Variables were entered simultaneously using the enter method, based on their clinical relevance. The selected variables were age, pain intensity, disability (DASH), number of avulsed roots, anxiety, depression, and lesion on the dominant side. Model assumptions were verified through residual analysis. A significance level of $p < 0.05$ was adopted. All analyses were performed using IBM SPSS Statistics, version 26 (IBM Corp., Armonk, NY, USA).

Results

Sample Characteristics

In total, 77 patients with traumatic brachial plexus injury were included. Their mean age was 33.6 years (SD = 9.6; range 18–63), and most participants were male (88.3%). The majority had completed high school (40.3%) and were either married or in a stable union (67.5%) (Table 1).

Regarding clinical characteristics, the injury was equally distributed between the right and left sides. Most patients (86.8%) were right-handed, and 55.3% had the injury on their dominant side. The number of avulsed roots varied: 25.4% had three roots affected, and 21.1% had four avulsions. Six patients were excluded from this analysis because of poor MRI quality (Table 2).

Psychological symptoms were common in the sample. Clinically relevant depressive symptoms (HADS-D score of ≥ 9) were present in 40.8% of patients ($n = 31/76$), and anxiety symptoms (HADS-A score of ≥ 9) were observed in 38.7% ($n = 29/75$).

Participants showed a high level of upper limb disability (mean DASH = 53.6, SD = 14.8).

Table 1 Sociodemographic Characteristics ($n = 77$)

Variable	Value
Age, years	33.6 $\pm$ 9.6 (18–63)
Sex	
Male	68 (88.3)
Female	9 (11.7)
Education level	
Illiterate	1 (1.3)
Incomplete elementary education	8 (10.4)
Complete elementary education	5 (6.5)

(Continued)

Table 1 (Continued).

Variable	Value
Incomplete high school education	10 (13.0)
Complete high school education	31 (40.3)
Incomplete higher education	10 (13.0)
Complete higher education	12 (15.6)
Marital status	
Married or in stable union	52 (67.5)
Single	21 (27.3)
Divorced	4 (5.2)
Widowed	0 (0.0)

Notes: Data are presented as mean $\pm$ standard deviation (range) or n (%).

Table 2 Clinical and Radiological Characteristics (n = 77)

Variable	Value
Injury side^a	
Right	38 (50.0)
Left	38 (50.0)
Dominant side^a (right-handed)	66 (86.8)
Lesion on dominant side^a	42 (55.3)
Number of avulsed roots^b	
0	12 (16.9)
1	8 (11.3)
2	12 (16.9)
3	18 (25.4)
4	15 (21.1)
5	6 (8.5)

Notes: Data are presented as n (%). ^aInjury side information was missing for 1 patient. ^bAssessment of root avulsion was based on magnetic resonance imaging findings. Six patients were excluded from this analysis because of poor image quality.

Neuropathic Pain

According to the DN4, the most frequently reported symptoms were tingling (81.6%), electric shocks (81.6%), and hypoesthesia to touch (80.3%). The mean total DN4 score was 6.43 (SD = 1.45) (Table 3).

Pain Intensity and Interference

The mean worst pain intensity in the previous 24 hours was 6.4 (SD = 2.7), and the mean pain score was 5.5 (SD = 2.0). Pain interference was highest in normal work (mean = 5.6, SD = 3.8), followed by sleep (mean = 5.1, SD = 3.2) and general activity (mean = 4.9, SD = 2.9) (Table 4).

Table 3 DN4 Results (n = 77)

Item	Positive Responses
Burning sensation	57 (75.0)
Painful cold	34 (44.7)
Electric shocks	61 (81.6)
Tingling	62 (81.6)
Pins and needles	59 (77.6)
Numbness	57 (75.0)
Itching	23 (30.3)
Hypoesthesia to touch	61 (80.3)
Hypoesthesia to pinprick	56 (73.7)
Pain caused by brush	20 (26.3)
Total DN4 ^a score	6.4 ± 1.4

Notes: Data are presented as n (%) or mean ± standard deviation. DN4, Douleur Neuropathique 4 Questions. ^aDN4 information was missing for 1 patient.

Table 4 BPI Scores: Intensity and Interference (n = 77)^a

Item	Value
Pain intensity	
Worst pain (last 24 hours)	6.4 ± 2.7
Least severe pain (last 24 hours)	3.6 ± 2.5
Average pain	5.5 ± 2.0
Current pain	4.5 ± 2.6
Pain interference	
General activity	4.9 ± 2.9
Mood	4.7 ± 3.1
Walking ability	3.0 ± 3.0
Normal work	5.6 ± 3.8
Relations with others	4.2 ± 3.1
Sleep	5.1 ± 3.2
Enjoyment of life	4.4 ± 3.4

Notes: Data are presented as mean ± standard deviation. ^aBPI information was missing for 2 patients.

Abbreviation: BPI, Brief Pain Inventory.

Quality of Life

The lowest WHOQOL-BREF domain score was observed in physical health (mean = 46.3, SD = 14.7), followed by environment (mean = 57.5, SD = 13.6) (Table 5).

Correlations

No significant correlation was found between pain intensity and age (Spearman's $\rho = -0.039$, $p = 0.739$), nor between pain intensity and educational level ($\rho = 0.114$, $p = 0.330$).

Multivariate Analysis

Multiple linear regression showed that both pain intensity ($\beta = -0.23$, $p = 0.04$) and the DASH score ($\beta = -0.42$, $p = 0.002$) were significantly associated with poorer physical health. Depression (HADS-D) was associated with lower psychological domain scores ($\beta = 0.29$, $p = 0.01$), while anxiety (HADS-A) was associated with poorer social relationships ($\beta = 0.29$, $p = 0.02$) and environmental scores ($\beta = 0.26$, $p = 0.03$). The models explained between 22% and 31% of the variance across WHOQOL-BREF domains (Table 6).

Table 5 WHOQOL-BREF Domain Scores^a of the Study Population ($n = 77$)^b

Domain	Value
Overall quality of life	54.5 ± 22.1
Physical health	46.3 ± 14.7
Psychological health	59.8 ± 20.8
Social relationships	60.3 ± 24.9
Environment	57.5 ± 13.6

Notes: Data are presented as mean ± standard deviation. ^aScores were transformed to a 0–100 scale. Higher scores indicate better perceived quality of life. ^bWHOQOL-BREF information was missing for 1 patient.

Abbreviation: WHOQOL-BREF, World Health Organization Quality of Life – BREF.

Table 6 Multiple Linear Regression Results for Each WHOQOL-BREF Domain

Independent Variables	Physical Health	Psychological Health	Social Relationships	Environment
Age	0.00 (0.98)	0.07 (0.54)	−0.02 (0.89)	−0.11 (0.36)
Pain intensity ^a	−0.23 (0.04)	−0.22 (0.04)	−0.14 (0.19)	−0.06 (0.59)
Disability (DASH)	−0.42 (0.002)	−0.36 (0.005)	−0.19 (0.14)	−0.21 (0.12)
Number of avulsed roots	−0.16 (0.15)	−0.031 (0.70)	−0.15 (0.16)	−0.20 (0.07)
Anxiety (HADS-A)	0.09 (0.47)	0.18 (0.12)	0.29 (0.02)	0.26 (0.03)
Depression (HADS-D)	0.09 (0.47)	0.29 (0.01)	0.20 (0.10)	0.18 (0.14)
Lesion on dominant side	−0.04 (0.77)	−0.05 (0.65)	0.12 (0.30)	0.12 (0.33)

(Continued)

Table 6 (Continued).

Independent Variables	Physical Health	Psychological Health	Social Relationships	Environment
Model R ²	0.22	0.31	0.26	0.23
F (df1, df2), p	3.77 (7, 62), 0.002	5.38 (7, 62), <0.001	4.48 (7, 61), <0.001	3.88 (7, 61), 0.001

Notes: Data are presented as β -standardized (p) unless otherwise indicated. ^aPain intensity measured by the Brief Pain Inventory.

Abbreviations: WHOQOL-BREF, World Health Organization Quality of Life – BREF; DASH, Disabilities of the Arm, Shoulder and Hand Questionnaire; HADS-A, Hospital Anxiety and Depression Scale, Anxiety subscale; HADS-D, Hospital Anxiety and Depression Scale, Depression subscale.

Discussion

This study investigated the impact of neuropathic pain on quality of life in individuals with traumatic brachial plexus injury. All participants had confirmed neuropathic pain, and its presence was associated with significant reductions in quality-of-life scores, particularly in the physical and psychological domains. These findings are consistent with the characteristic pain profile typically observed in patients with root avulsion, which often results in severe sensory disturbances and functional limitations.

In our sample of patients with traumatic brachial plexus injury and neuropathic pain, all WHOQOL-BREF domain scores were lower than those reported for the general Brazilian population. The physical health domain was the most affected (mean = 46.3), followed by psychological well-being (59.8), environment (60.0), and overall quality of life (59.8). These values are considerably below population-based normative data, which report average scores of 59.9 for physical health, 65.9 for psychological, 65.4 for environment, and 75.8 for social relationships.²⁰ These findings support the notion that brachial plexus injury with chronic neuropathic pain has a profound negative impact on multiple aspects of patients' quality of life, particularly physical functioning.

Pain intensity, as measured by the BPI, was independently associated with lower scores in both the physical and psychological domains of the WHOQOL-BREF. Similarly, upper limb disability, assessed by the DASH questionnaire, showed strong negative associations with these same domains. These results reinforce the intertwined relationship between pain, functional limitation, and reduced quality of life. Additionally, psychological symptoms also played a role: depression (HADS-D) was associated with poorer psychological well-being, while anxiety (HADS-A) was linked to reduced scores in the social relationships and environmental domains, suggesting broader psychosocial consequences beyond internal distress.

Although the WHOQOL-BREF is a widely used instrument for assessing general quality of life, it includes only one item that broadly addresses the ability to perform daily work-related tasks, and this item is combined with mobility assessment. As such, it may not adequately capture the specific impact of neuropathic pain on occupational functioning. By contrast, the BPI revealed a strong interference of pain with work activities, suggesting that occupational impact may be underestimated by instruments like the WHOQOL-BREF. This discrepancy highlights the importance of supplementing generic quality-of-life assessments with tools that explicitly evaluate work-related functioning in individuals with peripheral nerve injuries.

The proportion of patients who return to work after traumatic brachial plexus injury varies across studies, ranging from 27% to 55%.^{27,28} Previous research on return-to-work outcomes in this population has primarily focused on injury severity and the degree of motor impairment, while the influence of pain has received little attention. Our findings suggest that neuropathic pain plays a significant role in limiting work reintegration, as reflected by the high mean interference score for the item "normal work" on the BPI (mean = 5.61) (Table 4), the highest among all interference dimensions. This underscores the importance of effective pain management as a key component of functional rehabilitation. Moreover, these results highlight the need for future studies on return to work in patients with brachial plexus injury to systematically consider the impact of pain. It is also important to recognize that differences in social security systems may influence return-to-work outcomes and limit the generalizability of findings across countries.

Notably, sleep emerged as one of the most affected domains on the BPI interference scale, with a mean score exceeding 5 on a 0–10 scale. This highlights the pervasive impact of neuropathic pain on restorative functions, which may further contribute to fatigue, emotional distress, and functional decline. It is possible that many patients in this sample were using anticonvulsants such as gabapentin or antidepressant medications, which can influence sleep quality and potentially attenuate the perceived impact of pain on sleep disturbance. Importantly, the relationship between neuropathic pain and sleep disruption is likely bidirectional: chronic pain can impair sleep, while poor sleep has been associated with heightened pain sensitivity, reduced coping capacity, and lower overall quality of life in individuals with chronic pain, including those with peripheral nerve injuries.

Although the regression models yielded R^2 values ranging from 0.22 to 0.31, these are considered moderate and acceptable in studies involving complex and multidimensional outcomes such as quality of life. These values suggest that while the included variables—pain, function, anxiety, depression, and anatomical severity—are important contributors, a substantial portion of the variability in quality-of-life scores remains unexplained.

Several relevant factors not captured in the current model may play a critical role in shaping quality of life in this population, including social support, pain catastrophizing, coping strategies, perceived body image, socioeconomic conditions, return-to-work status, access to multidisciplinary rehabilitation, and independence in daily activities. Although these variables are often more difficult to quantify, they are essential to fully understanding the impact of traumatic brachial plexus injury and should be considered in future research.

Taken together, the present findings emphasize the need for a holistic, multidisciplinary approach to the management of brachial plexus injury—one that integrates pain control, functional recovery, psychological support, and attention to sleep quality. Early identification and treatment of neuropathic pain and emotional distress may play a pivotal role in improving long-term outcomes and overall quality of life in this population. Furthermore, patient education on pain mechanisms and coping strategies may enhance engagement in rehabilitation, while cross-cultural factors should be considered when evaluating quality-of-life domains, particularly psychological and environmental aspects.

Study Limitations

This study has several limitations. First, its cross-sectional design precludes causal inferences regarding the relationships between neuropathic pain, functional impairment, psychological symptoms, and quality of life. Second, the sample was drawn from a single rehabilitation center and consisted of individuals who actively sought specialized care. This may have introduced selection bias because patients with more severe motor deficits, higher pain intensity, or greater functional limitations are more likely to pursue rehabilitation, potentially leading to an overestimation of the burden of brachial plexus injury in the general population.

Additionally, patients were not classified according to the clinical severity of the nerve injury (ie, complete vs incomplete brachial plexus injury). Although this information could have provided more targeted insights, it was not the primary focus of the study. Our objective was to identify the relationship between neuropathic pain intensity and quality of life, rather than to correlate outcomes with the degree of neurological impairment.

Furthermore, while the HADS is suitable for use in medical settings, it may lack the sensitivity of more specific psychiatric instruments, such as the Beck Depression Inventory, potentially leading to an underestimation of emotional distress. Finally, most participants had not yet initiated a formal rehabilitation program, which may have influenced their perceptions of disability and quality of life—a factor that was not controlled for in the analysis.

Despite these limitations, this study provides valuable insights into the complex interactions between neuropathic pain, emotional distress, function, and perceived well-being in individuals with traumatic brachial plexus injury, underscoring the need for multidimensional evaluation and care.

Conclusion

This study highlights the substantial impact of neuropathic pain on multiple dimensions of quality of life in individuals with traumatic brachial plexus injury. Pain intensity, functional disability, and emotional distress were independently associated with poorer outcomes, particularly in the physical and psychological domains. Sleep and occupational functioning also emerged as key areas of impairment, which may be underrepresented in commonly used quality-of-

life instruments. These findings underscore the need for comprehensive, multidisciplinary care that integrates pain management, psychological support, and functional rehabilitation. Practical multidisciplinary strategies may include optimized neuropathic pain pharmacotherapy, structured upper limb rehabilitation programs, and psychological interventions such as cognitive-behavioral therapy to mitigate anxiety and depressive symptoms. Future longitudinal studies should also investigate whether multidisciplinary interventions—integrating pain management, functional rehabilitation, and psychological support—can effectively improve quality of life, functional outcomes, and emotional well-being in this population. Further research is also warranted to explore additional psychosocial and contextual factors that contribute to the complexity of quality-of-life impairments in this group.

Abbreviations

BPI, Brief Pain Inventory; DASH, Disabilities of the Arm, Shoulder and Hand Questionnaire; DN4, Douleur Neuropathique 4 Questions; HADS, Hospital Anxiety and Depression Scale; HADS-A, HADS Anxiety subscale; HADS-D, HADS Depression subscale; WHOQOL-BREF, World Health Organization Quality of Life – BREF; MRI, magnetic resonance imaging; SD, standard deviation.

Ethics and Consent Statements

The study was conducted in accordance with the ethical standards of the institutional and national research committees and with the 1964 Declaration of Helsinki and its later amendments. Ethical approval was obtained from the Ethics Committee of the SARAH Network of Rehabilitation Hospitals, Brasília, Brazil (approval number: CAAE 47503721.5.0000.0022, approval date: June 11, 2021). All participants were fully informed about the objectives and procedures of the study and provided written informed consent prior to inclusion.

Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

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The authors report no conflicts of interest in this work.

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