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Comparison of pressure pain threshold and hand grip strength in individuals with and without chronic neck pain

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ABSTRACT

Aims: The aim of this study was to evaluate the pressure pain threshold (PPT), hand grip strength, neck disability, functional status, and quality of life in symptomatic and asymptomatic individuals with and without chronic neck pain, and to determine the differences in these parameters between the groups.

Methods: A total of 47 individuals aged 21 to 49 years, including 24 with at least 3 months of neck pain and 23 without chronic neck pain, were included in the study. PPT of the upper trapezius, sternocleidomastoid (SCM), levator scapula, and suboccipital muscles was assessed using a dolorimeter. Hand grip strength was measured with a Jamar® hydraulic hand dynamometer. Neck disability were evaluated using the Bournemouth Questionnaire (BQ). The disability level associated with upper extremity functional status was assessed with the Disabilities of the Arm, Shoulder, and Hand Questionnaire (DASH). Quality of life was evaluated with the Nottingham Health Profile (NHP).

Results: PPT values, except for SCM, were significantly lower in symptomatic individuals ($p<0.05$). Neck disability, upper extremity function-related disability level, and quality of life were significantly worse in symptomatic individuals ($p<0.05$). There were no significant differences between the groups in hand grip strength, PPT of the SCM, or NHP emotional reactions and social isolation scores ($p>0.05$).

Conclusion: It was found that PPT, neck functions, quality of life, and upper extremity function-related disability levels were more impaired in symptomatic individuals with chronic neck pain without a specific diagnosis compared to asymptomatic individuals. Although hand grip strength was not affected in symptomatic individuals with chronic neck pain, other functional impairments may still be present.

Keywords: Pressure pain threshold, neck pain, hand grip strength, disability, quality of life

INTRODUCTION

Neck pain is a very common musculoskeletal problem after low back pain in terms of causing severe pain, functional loss, and economic burden.[1] The majority of the society experiences neck pain at some point in their lives. Many factors such as repetitive movements, wrong posture, age, gender, body mass index, smoking, personal, behavioral, and ergonomic factors are effective in the etiology of neck pain.[2,3] Although there are many different causes of pain in the cervical region, which is more mobile and open to trauma than other parts of the spine, 90% of the pain is described as mechanical. Mechanical neck pain is defined as pain felt in the anatomical region of the neck without a pathology. The pain does not spread to the upper extremities and can be felt in the cervical, posterior scapular or occipital regions. It has been observed that 22% of neck pain felt in the adult population is an ongoing, persistent pain and therefore turns into a chronic course over time.[4,5] Since neck pain becomes a recurrent complaint and becomes chronic, studies have been conducted on the relationship between the cervical region and the shoulder, back, and scapular regions.[6]

It was thought that individuals with nonspecific neck problems would experience problems in their upper extremity functionality due to neck pain. Therefore, upper extremity functions and neck disorders were evaluated. It has been shown that upper extremity activities increase the severity of neck pain in 80% of individuals. It has been reported that there is a correlation between the results of upper extremity functions and neck disorders and that there are deficiencies in upper extremity functions in individuals with neck pain.[7]

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Considering that the cervical region and the shoulder region affect each other, it is thought that the pain in the cervical region may cause avoidance of movement in the shoulder joint, limitations in daily living activities, problems in the long-term use of the arm, limitations in normal joint movement, and loss of strength in the muscles in this region. Considering that the loss of strength and endurance may affect the stability of the upper extremity together with the increase in pain severity, it is inevitable that the loss of stability in the proximal will impair the quality of mobility in the distal.[8]

Many parameters related to chronic neck pain have been addressed in the literature from different perspectives.[8-12] However, only a limited number of studies have examined its impact on upper extremity strength and function beyond localized symptoms. The cervical region plays a crucial role in postural stability and motor control, which are essential for coordinated upper extremity movements. Considering that pain-related adaptations in the cervical spine may contribute to neuromuscular impairments in the upper extremity, it is important to investigate potential changes in grip strength in individuals with chronic neck pain. Understanding these potential changes could help refine rehabilitation strategies aimed at preserving upper extremity function. To our knowledge, no study has simultaneously examined pressure pain threshold and hand grip strength in individuals with and without chronic neck pain. This study aims to fill this gap by investigating the relationship between these parameters and their potential implications for functional capacity and rehabilitation interventions.

METHODS

This research was planned as a cross-sectional, descriptive, face-to-face evaluation study. Individuals aged 18-65 years, with chronic neck pain complaints for more than three months, without any diagnosed chronic disease or psychological disorder in the past or present, and who volunteered to participate in the study were included in this study. Individuals with any neurological, psychiatric or cognitive impairment were excluded from the study. Individuals were informed about the study and evaluations. The study was performed in accordance with the Declaration of Helsinki. Individuals signed the Informed Consent Form. Necessary permission for the study was obtained from Tokat Gaziosmanpaşa University Clinical Researches Ethics Committee (Date: 24.10.2022, Decision No: 83116987-658). The study was registered on ClinicalTrials.gov (NCT05791292).

Post hoc sample size calculation was performed using the G*Power program based on the pressure pain threshold of the right upper trapezius. Considering the number of individuals in the symptomatic group (n=24) and the asymptomatic group (n=23), with a large effect size (d=1.38) and an error rate (alpha=0.05), the power of the study was determined to be 99%. The upper trapezius muscle was selected for the sample size calculation as it is one of the most frequently evaluated muscles in pressure pain threshold (PPT) assessments related to chronic neck pain. The upper trapezius muscle is commonly assessed in studies investigating PPT in individuals with neck pain because it is a key muscle associated with cervical spine biomechanics and chronic pain syndromes. Previous research has demonstrated its significance in evaluating mechanical sensitivity in musculoskeletal pain conditions.[13] The post hoc sample size analysis was performed using the effect size calculated from the PPT values of the upper trapezius muscle obtained in present study. This muscle was chosen for this analysis due to its robust effect size and its frequent evaluation in musculoskeletal pain research.

After individuals filled out the form that included sociodemographic information questions, the following measurements were made;

Pain Intensity

The intensity of individuals' pain was assessed using the Numerical Pain Rating Scale (NPRS). The NPRS is a measurement tool that can be either self-reported or administered by a clinician, featuring a numerical scale anchored by "no pain" at one end and "extreme pain" at the other. This scale is generally presented as a horizontal or vertical line, most often ranging from 0-10 or 0-100, and can be delivered in either written or verbal formats. Patients are asked to evaluate their pain intensity within a specific time frame or context.[14]

Pressure Pain Threshold

The PPT was measured by Baseline® dolorimeter (Fabrication Enterprises, White Plains, NY, USA). During the PPT measurement, individuals sat on the chair in a relaxed and neutral position. The feet were in full contact with the ground. PPTs of the upper trapezius, sternocleidomastoidus (SCM), levator scapula and suboccipital region muscles (semispinalis capitis and splenius capitis) were evaluated. For each measurement (before and after the treatment), two measurements were taken from all muscles in the same order and at five-minute intervals. The average of the measurements was recorded as kilogram/centimeter^2 (kg/cm^2). The procedure was explained to the individuals by showing them with manual palpation before the test started. Pressure pain threshold measurement with dolorimeter has been reported as a valid and reliable method.[15]

Hand Grip Strength

Jamar® Hydraulic Hand Dynamometer was used to assess hand grip strength. The measurements were made while the individuals were sitting upright in a chair without elbow support, with the feet fully touching the floor, the shoulder in adduction, the elbow in 90° flexion, and the forearm and wrist in a neutral position. Bilateral (right-left) measurement was made. Three separate measurements were made by giving rest intervals during the measurements, and the average of these measurements was taken and recorded in Newton (N).[8]

Bournemouth Questionnaire (BQ)

Neck disability was assessed with the Bournemouth Questionnaire (BQ). BQ consists of 7 questions that examine pain intensity, activities of daily living, social activities, anxiety, emotional aspects of depression, kinesiophobia, and ability to control pain. The items in the questionnaire are specific to patients with neck pain, and each question evaluates a different parameter. A high score indicates a high degree of disorders. The Turkish version of the BQ has been proven to be valid and reliable.[16]

Disabilities of the Arm, Shoulder and Hand Questionnaire (DASH)

Arm, shoulder, and hand problems were evaluated with the Quick Disabilities of the Arm, Shoulder and Hand Questionnaire (DASH). Quick DASH is an abbreviated version of DASH for measuring physical function and symptoms in patients with upper extremity musculoskeletal disorders. The questionnaire consists of a disability/symptom scale (11 items) and two optional scales: work (four items) and sports/performing arts (four items). In the disability/symptom scale, each item questions the severity of pain, activity-related pain, tingling, weakness and stiffness, difficulty in performing physical activity due to upper extremity problems, and the effect of upper extremity problems on social activities, work, and sleep. Two optional modules measure the ability to work and play sports and/or musical instruments. Answers are given on a scale of one to five, and each question is scored from 1 to 5. Scores on the three subscales of the DASH, disability/symptom scale, work scale, and sports/performing arts scale all range from 0 (no disability) to 100 (most severe disability). The Turkish version of DASH has been reported to be valid and reliable.[17] In the current study, only the disability/symptom scale of DASH was used.

Nottingham Health Profile (NHP)

The Nottingham Health Profile (NHP) is a general quality of life questionnaire that measures the perceived health problems by individuals and the extent to which these problems affect normal daily activities. It was developed in 1981 by Hunt et al.[18] The questionnaire consists of 38 items. Questions are answered as 'yes' or 'no'. The questionnaire assesses six parameters related to health status. These parameters are; pain (8 items), physical activity (8 items), energy (3 items), sleep (5 items), social isolation (5 items), and emotional reactions (9 items). Each sub-parameter is scored between 0-100. 0 indicates best health, and 100 indicates worst health. The total NHP score is derived from the sum of the subscores. The Turkish adaptation and psychometric properties of NHP were studied by Küçükdeveci et al.[19] in 1997.

Statistical Analysis

Data were analyzed with SPSS® (Statistical Package for Social Sciences) version 22 package program. Continuous variables were expressed as mean±standard deviation, and categorical variables were expressed as numbers and percentages. The conformity of the variables to the normal distribution was examined using the Shapiro-Wilk test. When the parametric test assumptions were met, the significance test of the difference between the two means was used to compare the independent group differences, and when the parametric test assumptions were not met, the Mann-Whitney U test was used to compare the independent group differences. The differences of categorical variables between the groups were examined using the Chi-square test. In all statistical analyses, the level of significance was accepted as $p<0.05$.

RESULTS

Table 1 provides descriptive characteristics of individuals with and without chronic neck pain. There were no significant differences in age, weight, height, or BMI between the symptomatic and asymptomatic groups ($p>0.05$). The duration of complaints in the symptomatic group was 30.42±41.02 months. Regarding marital status, the majority of participants in both groups were single. Smoking and alcohol use were also similar between the groups. However, in the symptomatic group, 70.8% of individuals reported bilateral chronic neck pain.

Table 1. Descriptive informations of individuals with and without chronic neck pain

	Symptomatic group (n=24) mean±SD	Asymptomatic group (n=23) mean±SD	p
Age (years)	31.46±6.14	29.78±7.93	0.421[α]
Weight (kg)	66.21±9.51	69.11±10.33	0.322[α]
Height (m)	1.69±0.09	1.70±0.09	0.531[α]
BMI (kg/m²)	23.28±2.75	23.80±2.71	0.521[α]
Complaint duration (month)	30.42±41.02	-	0.000[β]
	n (%)	**n (%)**	
Gender			
Female	13 (54.2)	13 (56.5)	0.871[§]
Male	11 (45.8)	10 (43.5)	
Chronic neck pain side			
Right	6 (25.0)	-	-
Left	1 (4.2)	-	
Bilateral	17 (70.8)	-	
Marital status			
Single	16 (66.7)	18 (78.3)	0.374[§]
Married	8 (33.3)	5 (21.7)	
Educational status			
Primary school	0 (0)	0 (0)	0.051[§]
Middle school	0 (0)	0 (0)	
High school	6 (25.0)	7 (30.4)	
Associate degree	3 (12.5)	10 (43.5)	
Bachelor degree	11 (45.8)	4 (17.4)	
Postgraduate degree	4 (16.7)	2 (8.7)	
Smoking			
Yes	14 (58.3)	10 (43.5)	0.308[§]
No	10 (41.7)	13 (56.5)	
Alcohol use			
Yes	10 (41.7)	11 (47.8)	0.671[§]
No	14 (58.3)	12 (52.2)	

SD: Standard deviation, kg: kilogram, m: meter, kg/m²: kilogram/meter², [α]: Independent samples T test, [β]: Mann Whitney U test, [§]: Chi-squared test

Table 2 compares pain intensity and PPT values. Chronic neck pain intensity was significantly higher in the symptomatic group (6.33±1.09; $p<0.001$). PPT values for the right and left upper trapezius, sternocleidomastoideus (SCM), levator scapula, and suboccipital muscles were significantly lower in the symptomatic group compared to the asymptomatic group ($p<0.05$), except for the left SCM, where the difference was not statistically significant ($p=0.075$). These results indicate increased sensitivity in pressure pain thresholds in individuals with chronic neck pain. However, no significant differences were observed in overall right and left hand grip strength ($p>0.05$).

Table 2. Comparison of pain intensity, PPT and hand grip strength values in individuals with and without chronic neck pain

	Symptomatic group (n=24) mean±SD	Asymptomatic group (n=23) mean±SD	p
Chronic neck pain intensity	6.33±1.09	-	0.000[β]
Right upper trapezius PPT	3.09±1.13	8.10±4.98	0.000[β]
Left upper trapezius PPT	3.57±1.10	7.86±4.49	0.000[β]
Right SCM PPT	2.45±0.78	4.59±3.35	0.015[β]
Left SCM PPT	2.65±0.88	4.42±3.14	0.075[β]
Right levator scapula PPT	3.07±1.07	6.61±2.95	0.000[β]
Left levator scapula PPT	3.18±1.24	6.49±3.09	0.000[β]
Right suboccipital PPT	3.21±0.95	5.02±2.68	0.008[β]
Left suboccipital PPT	3.25±0.97	5.09±2.71	0.017[β]
Right hand grip strength	311.08±96.83	315.52±105.89	0.840[β]
Left hand grip strength	300.33±96.99	305.17±107.09	0.882[β]

SD: Standard deviation, PPT: Pressure pain threshold, SCM: Sternocleidomastoideus, [β]: Mann-Whitney U test

Table 3 highlights differences in neck disorders (BQ), arm, shoulder, and hand problems (DASH), and quality of life (NHP). The symptomatic group had significantly higher BQ and DASH scores, indicating greater neck disability and upper extremity dysfunction ($p<0.001$). Similarly, NHP scores for pain, sleep, physical activity, and energy were significantly higher in the symptomatic group ($p<0.05$), reflecting poorer quality of life. However, no significant differences were observed in NHP emotional reactions or social isolation domains ($p>0.05$).

Table 3. Comparison of neck disorders (BQ), arm, shoulder, and hand problems (DASH), and quality of life (NHP) in individuals with and without chronic neck pain

	Symptomatic group (n=24) mean±SD	Asymptomatic group (n=23) mean±SD	p
BQ	29.25±9.71	3.52±5.03	0.000[β]
DASH	27.12±12.55	3.08±6.55	0.000[β]
DASH work	32.81±15.77	2.72±10.63	0.000[β]
NHP pain	21.53±22.76	3.24±7.99	0.001[β]
NHP emotional reactions	24.62±23.82	14.57±20.75	0.101[β]
NHP sleep	47.97±32.10	23.87±38.20	0.006[β]
NHP social isolation	11.13±18.83	5.92±13.74	0.231[β]
NHP physical activity	11.62±15.29	2.95±9.77	0.016[β]
NHP energy	61.17±41.04	13.43±27.84	0.000[β]
NHP section 1	178.03±109.87	63.98±79.75	0.000[β]
NHP section 2	2.62±2.04	0.26±0.75	0.000[β]

SD: Standard deviation, BQ: Bournemouth Questionnaire, DASH: Disabilities of the Arm, Shoulder and Hand Questionnaire, NHP: Nottingham Health Profile, [β]: Mann Whitney U test

DISCUSSION

This study investigated the differences in pain sensitivity, hand grip strength, functional impairments, and quality of life between individuals with and without chronic neck pain. The findings reveal that chronic neck pain is associated with heightened pain sensitivity, indiffirent hand grip strength, and significantly impaired quality of life. These results provide valuable insights into the multifactorial impact of chronic neck pain and highlight areas for targeted intervention.

In a study examining the PPT of suboccipital muscles and hand grip strength in men and women with chronic neck pain and healthy individuals, these values were observed to be lower in women with chronic neck pain.[12] In individuals with and without cervical radiculopathy, there was similar in grip strength between the dominant and nondominant hand.[10] In the current study, the symptomatic group demonstrated significantly lower PPT across multiple muscle groups, including the upper trapezius, SCM, levator scapula, and suboccipital muscles. This heightened sensitivity may be attributed to central sensitization mechanisms or localized muscle dysfunction often observed in chronic pain conditions. Overall hand grip strength remained unaffected, indicating that specific functional impairments may be more closely tied to chronic neck pain than general hand strength.

In a previous study conducted on men and women with chronic neck pain and healthy individuals, neck disability and quality of life were assessed. The results indicated that health-related quality of life was found to be lower in women with chronic neck pain.[12] In another study evaluating individuals with and without radiculopathy, neck disability, upper extremity functional status-related disability level, and quality of life were compared. It was emphasized that patients with radiculopathy had a lower quality of life and higher disability levels associated with upper extremity function.[10] In the present study, quality of life, assessed through the NHP, was impaired in the symptomatic group. Participants reported greater difficulties in pain, sleep, energy, and physical activity domains, reflecting the pervasive impact of chronic neck pain on daily life. Notably, emotional reactions and social isolation scores did not differ significantly between groups, suggesting that the psychological impact of chronic neck pain may vary among individuals. The study determined that neck and arm, shoulder, and hand functions were also affected in individuals with chronic neck pain. These findings emphasize the physical and functional domains of chronic neck pain, emphasizing reduced quality of life.

Limitations

This study has several limitations that should be acknowledged. First, the cross-sectional design does not allow for causal inferences regarding the relationship between chronic neck pain and observed impairments. Second, the reliance on self-reported measures for pain and functional assessments, without the use of objective diagnostic tools such as imaging or electromyography, may have restricted the scope of the analysis. In addition, a wide age range is a factor that may affect the results of the study. Therefore, it is thought that choosing a narrower age range may make the results more homogeneous. This can be considered as another limitation of the study.

To build on these findings, future studies should: It should be utilized longitudinal designs to explore causal relationships between chronic neck pain, functional impairments, and quality of life. In addition, it should be incorporated objective diagnostic tools, such as electromyography or imaging, to validate the presence of muscle dysfunction and nerve involvement in grip strength deficits. Also, it should be investigated the effectiveness of multidisciplinary interventions that address physical, psychological, and occupational factors contributing to chronic neck pain.

CONCLUSION

This study highlights the significant impact of chronic neck pain on pain sensitivity, functional abilities, and quality of life. Findings revealed that individuals with chronic neck pain exhibited lower PPT values in multiple cervical region muscles, indicating increased pain sensitivity. However, no significant differences were observed in hand grip strength between symptomatic and asymptomatic individuals, suggesting that grip strength may not be directly affected by chronic neck pain. These results emphasize the need for a comprehensive, multifaceted approach in managing chronic neck pain, with targeted interventions focusing on pain modulation, functional rehabilitation, and quality of life improvement.

ETHICAL DECLARATIONS

Ethics Committee Approval

Ethics committee approval was received for this study from the Tokat Gaziosmanpaşa University Clinical Researches Ethics Committee (Date: 24.10.2022, Decision No: 83116987-658).

Informed Consent

Verbal consent was obtained from individuals participating in the study.

Referee Evaluation Process

Externally peer-reviewed.

Conflict of Interest Statement

The authors have no conflicts of interest to declare.

Financial Disclosure

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Author Contributions

All of the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

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