University of Novi Sad, Faculty of Medicine Novi Sad[1]
Clinical Center of Vojvodina, Novi Sad, Medical Rehabilitation Clinic[2]
University Clinical Center of Niš, Physical Medicine and Rehabilitation Clinic[3]
Oncology Institute of Vojvodina, Sremska Kamenica[4]

Original study
Originalni naučni rad
UDK 616.8-009.7-072.8
https://doi.org/10.2298/MPNS2212356A

CORRELATION BETWEEN THE PERCEIVED PAIN INTENSITY AND PSYCHOPHYSICAL TESTS IN PATIENTS WITH CHRONIC PAIN

KORELACIJA PERCIPIRANOG INTENZITETA BOLA SA PSIHOFIZIČKIM TESTOVIMA KOD PACIJENATA SA HRONIČNIM BOLOM

Tijana ALEKSANDRIĆ[1, 2], Ivana RADIČEVIĆ[1], Vuk PEJČIĆ[3], Aleksandra SAVIĆ[2], Dajana DEDIĆ[1, 4] and Aleksandar KNEŽEVIĆ[1, 2]

Summary

Introduction. Pain perception varies due to many factors. Quantitative sensory testing is a panel of diagnostic tests used to assess somatosensory function. The aim of the study was to determine how psychophysical variables are related to the perceived pain intensity in patients with chronic pain. **Material and Methods.** The cross-sectional study included 88 subjects (average age 51.3 ± 9.4 years, 76 (86.4%) women) diagnosed with chronic pain syndrome and fibromyalgia or chronic neuropathic pain associated with lumbosacral radiculopathy. Current and average pain intensities in the past 4 weeks were rated on a numerical rating scale. Quantitative sensory testing included pressure pain thresholds, heat pain thresholds, and cold pain thresholds. Patients filled out the Fear Avoidance Component Scale, a questionnaire that examines the fear avoidance phenomenon. **Results**. The highest correlations were found between the Fear Avoidance Component Scale scores and current and average pain intensity (r = 0.438 and r = 0.253, respectively); between pain duration and current and average pain intensity in the past 4 weeks (r = 0.340 and r = 0.308, respectively). Moderate and negative correlations were found between pressure pain thresholds and current and average pain intensity (r = - 0.233 and r = -0.300, respectively). **Conclusion.** Low to moderate, significant positive correlations were found between fear-avoidance and pain intensity. Significant but low negative correlations were found between pressure pain threshold and current pain intensity, as well as between pressure pain threshold and average pain intensity.

Key words: Chronic Pain; Pain Perception; Pain Measurement; Sensory Thresholds; Avoidance Learning

Sažetak

Uvod. Percepcija bola varira usled mnogih faktora. Kvantitativno senzorno testiranje predstavlja panel dijagnostičkih testova koji procenjuju somatosenzornu funkciju. Cilj studije je bio da se utvrdi kako su psihofizičke varijable povezane sa percipiranim intenzitetom bola kod pacijenata sa hroničnim bolom. **Materijal i metode**. Studija preseka obuhvatila je 88 ispitanika (prosečne starosti 51,3 ± 9,4 godine, 76 (86,4%) žena) sa sindromom hroničnog bola, uz dijagnostikovanu fibromialgiju ili hronični neuropatski bol od lumbosakralne radikulopatije. Trenutni i prosečan intenzitet bola (u poslednje četiri nedelje) određivani su na *Numeričkoj skali bola*. Kvantitativno senzorno testiranje je uključivalo ispitivanje praga bola pritiskom, praga bola toplotom i praga bola hladnoćom. Pacijenti su popunili *Skalu komponenti izbegavanja straha*, upitnik koji ispituje fenomen izbegavanja usled straha. **Rezultati.** Najveće korelacije su dobijene između vrednosti *Skale komponenti izbegavanja* usled straha i trenutnog intenziteta bola (r = 0,438) i prosečnog intenziteta bola (r = 0,253), između trajanja bola i trenutnog intenziteta bola (r = 0,340) i prosečnog bola (r = 0,308). Nađena je umerena i negativna korelacija između praga bola na pritisak i trenutnog intenziteta bola (r = - 0,233) i prosečnog intenziteta bola (r = -0,300). **Zaključak.** Uočene su male do umerene, značajne i pozitivne korelacije između izbegavanja aktivnosti zbog straha i intenziteta bola. Prisutne su značajne, ali male negativne korelacije između praga bola na pritisak i trenutnog intenziteta bola, kao i između praga bola na pritisak i prosečnog intenziteta bola.

Ključne reči: hronični bol; percepcija bola; merenje bola; senzorni pragovi; skala izbegavanja usled straha

Introduction

Pain perception is a complex process and it is still not fully understood. There are four steps of pain pathway: transduction, transmission, modulation, and perception. Transduction (conversion) is the ability of nociceptors to convert painful stimuli (mechanical, chemical, thermal) into an action potential. Transmission is the conduction of nerve impulses of A-delta myelinated fibers and C non-myelinated fibers from nociceptors to the posterior horns of the spinal cord, and then via ascending pathways to the higher centers of the central nervous system. Modulation is the processing and transformation of nociceptive information. Perception (experiencing pain) is the phase in which there is a projection of nerve pathways for pain transmission to the cerebral cortex and the conscious experience

Corresponding Author: Dr Tijana Aleksandrić, Univerzitet u Novom Sadu, Medicinski fakultet, 21000 Novi Sad, Hajduk Veljkova 3, E-mail: tijanaaleksandric95@uns.ac.rs

Abbreviations

QST – quantitative sensory testing
NRS – numerical rating scale
PPT – pressure pain threshold
HPT – heat pain threshold
CPT – cold pain threshold
FACS – fear avoidance component scale

of pain [1]. Subcortical structures, i.e. the limbic system, are responsible for emotional reactions to pain, increased alertness, anxiety, and depression that accompany chronic pain [2]. Several cortical regions are active at the same time during pain perception; activity in the cortical pain matrix undergoes changes over time producing a complex network of pain perception. Dysfunction at any level carries the risk of developing dysregulated, persistent pain [3].

Pain perception is known to vary from person to person in the general population. Some factors, such as spontaneous neural fluctuations, attention, expectation of pain, cognitive and emotional states, sleep habits, and stress, may impact the pain perception [4]. How one experiences a painful stimulus depends on his psychological state and the influence of the environment, which may intensify it (sadness, fear) [5, 6] or alleviate it (rest, joy, social well-being, hope) [7].

Diverse processes can happen along the nociceptive pathways which may result in the gain or loss of nociceptive impulses. This change in incoming nociceptive signals may play an important role in the development of chronic pain with all known functional limitations [8–12]. Some authors believe that a phenomenon such as fear avoidance could be responsible for the transition of pain from acute to chronic [13, 14].

Psychophysical tests quantify perception based on verbal or other overt conscious responses on the part of a subject [15]. Psychophysics today is used primarily in experiments to determine absolute thresholds for various senses [16]. Skin sensation tests have been developed to detect various physical stimuli that elicit sensations of touch-pressure, vibration, cooling, warming, heat, or mechanical stimuli inducing pain, movement, or static position. In research settings or as an additional tool in the diagnosis of somatosensory disorders, such as pain insensitivity and painful and painless neuropathy, quantitative sensory testing (QST) is a panel of diagnostic tests that assess somatosensory function. The QST is a validation of various neurological tests already in use into a standardized battery intended to identify minute changes in sensory function [17]. A thorough assessment of somatosensory function is believed to help identify different types of pain and as a potential technique to detect silent neuropathy [18].

Although we can expect that lower pain thresholds are associated with higher levels of perceived pain intensity, findings in the literature are conflicting [19].

Therefore, the main goal of the present study was to determine how psychophysical variables are related to the perceived pain intensity in chronic pain patients. The additional goal was to investigate the connection between the perceived pain intensity and the level of fear-avoidance phenomenon.

Material and Methods

This cross-sectional study included 88 subjects (average age 51.3 ± 9.4 years) with chronic pain syndrome. The research was approved by the Ethics Committee of the Clinical Center of Vojvodina.

Subjects were consecutively recruited from the medical records. The inclusion criteria were: fibromyalgia or chronic neuropathic pain associated with lumbosacral radiculopathy. The diagnosis of fibromyalgia was established according to the 2016 American College of Rheumatology criteria [20] and the diagnosis of neuropathic pain associated with lumbosacral radiculopathy was established according to the criteria given by Finnerup et al. [21]. Additional inclusion criteria were average pain intensity in the past 4 weeks > 4/10, duration of pain > 3 months, and age over 18 years.

Exclusion criteria included: malignancy, back surgery in the previous 12 months, rheumatic inflammatory disorders (e.g. rheumatoid arthritis, psoriatic arthritis, ankylosing spondylitis, etc.), diabetes mellitus, neurological disorders (e.g. polyneuropathy, multiple sclerosis, Parkinson disease, etc.), and patients who were using neuroleptics, strong opioids, and/or benzodiazepines regularly.

Demographic and anthropometric data included gender, age, height, weight, and education level (years of education), as well as if the patients had a partner, and how long they slept on average (in hours) in the past 4 weeks.

Subjects rated their pain intensity (current at the time of testing and average over the past 4 weeks) on a numerical pain scale (NRS). The NRS values ranged from 0, meaning no pain, to 10, meaning the worst imaginable pain. Information on pain duration (in months) was also recorded.

The QST involved examining the pressure pain threshold (PPT), heat pain threshold (HPT), and cold pain threshold (CPT) in the forearm area. The testing was conducted according to the procedure routinely performed in our laboratory [19, 22, 23]. A digital algometer (Wagner Instruments, FDX-50) with a 1 cm rubber tip was used to test PPT. The HPT and CPT were determined using the Medoc Pathway Pain and Sensory Evaluation System. The respondents were informed about the procedure and devices before the examination. Pain thresholds (PPT, HPT, and CPT) were measured in the area of the forearm opposite to the side of the painful side of the back. In case the pain was bilateral, the testing side was contralateral to the more painful side of the back. The PPT was examined on the proximal part of the body of the extensor carpi radialis longus muscle. A digital pressure algometer was applied over the standardized test sites with pressure increasing at a rate of approximately 5 N/s, and the subject said "stop" at the moment when the feeling of pressure turned into a feeling of pain, burning, stinging, or stabbing, and the value in N/cm^2 was recorded. Three measurements were made, with a 10s interval, and the average value was taken as the final value. The HPT and CPT were

Table 1. Characteristics of subjects and examined parameters
Tabela 1*. Karakteristike ispitanika i testirani parametri*

	Maximum *Maksimum*	Minimum *Minimum*	Mean *Srednja vrednost*	Standard deviation/*Standardna devijacija*
Age (years)/*Starost (godine)*	19	65	51.3	9.4
Body height (cm)/*Telesna visina (cm)*	150	193	167.5	8.5
Body mass (kg)/*Telesna masa (kg)*	50	126	76.8	15.1
Years of education/*Godine obrazovanja*	4	16	11.28	2.28
Pain duration (months)/*Trajanje bola (meseci)*	4	360	70.1	67.5
Current pain intensity (NRS)/*Trenutni intenzitet bola (NRS)*	2	10	6.85	1.99
Average intensity of pain in the past 4 weeks (NRS) *Prosečan intenzitet bola u poslednje 4 nedelje (NRS)*	3	10	7.33	1.62
FACS	12	66	60.65	18.54
Average sleep time (h)/*Prosečno vreme spavanja (h)*	3	8	5.65	1.31
PPT (N/cm^2)	7.3	56.2	25.39	9.32
HPT (°C)	33.1	48.7	40.26	4.60
CPT (°C)	0	31.2	18.81	9.54

Legend: NRS - numerical rating scale; FACS – Fear Avoidance Component Scale; PPT - pressure pain threshold; HPT - heat pain threshold; CPT - cold pain threshold
Legenda: NRS - numerička skala bola, FACS – skala komponenti izbegavanja aktivnosti usled straha, PPT – prag bola za pritisak, HPT – prag bola za toplo, CPT – prag bola za hladno

examined on the proximal volar forearm (C8 dermatome). During the HPT/CPT testing, the applied temperature via thermode was gradually increased or decreased, and the subject pressed the stop button immediately when the sensation of heat or cold changed to a sensation of pain, burning, stinging, or stabbing. Four stimuli for hot and then 4 stimuli for cold were performed with an intermediate interval of 10 s, and mean values of the last 3 measurements were taken as the final value of HPT and CPT.

All subjects were instructed not to consume alcohol, take analgesics or sedatives, or engage in intense physical activity 24 hours before the test [19, 22, 23]. Also, it was necessary for them to get enough sleep the night before and not to consume caffeine products 4 hours before the test.

In addition, patients filled out the Fear Avoidance Component Scale (FACS) questionnaire which examines the fear avoidance phenomenon. The FACS included 20 items on a six-point Likert scale from 0 (strongly disagree) to 5 (strongly agree). The FACS score ranges from 0 to 100, where the higher score indicates a greater degree of avoidance [14, 24, 25].

The SPSS 20.0 software package was used for data processing. For the analysis and description of the sample in regard to relevant variables, frequency and percentage displays were used. Descriptive statistics methods were used to determine measures of central tendency (arithmetic mean) and measures of variability (standard deviation). To determine the degree of connection between variables, Pearson's correlation coefficient was used, and Cohen's criteria were used for interpretation (small $r < 0.29$, medium $0.3 < r < 0.49$, large $r > 0.5$). The overall significance level was set at $p < 0.05$.

Results

The sample included 88 patients and the majority of respondents were women (76, 86.4%) **(Table 1)**. The study sample included patients with fibromyalgia (45, 51.1%) and patients with neuropathic pain due to lumbosacral radiculopathy (43, 48.9%). In the group with neuropathic pain due to lumbosacral radiculopathy, 30.3% of patients experienced pain on the left side, 34.9% on the right, and 34.9% on both sides. The most frequently affected roots were L5 (28, 65.1%) and S1 (15, 34.9%), while L4 damage was detected in 10 (23.3%) patients. Upper radiculopathy was not detected in the examined sample. Both, current and average pain intensity in the past 4 weeks were high (6.85 ± 1.99 and 7.33 ± 1.62, respectively) **(Table 1)**.

The highest correlations were found between FACS scores and current and average pain intensity in the past 4 weeks ($r = 0.438$ and $r = 0.253$, respectively), between pain duration and current and average pain in the past 4 weeks ($r = 0.340$ and $r = 0.308$, respectively) and finally, moderate and negative correlation between pain threshold for pressure in the forearm area and current and average pain intensity in the past 4 weeks ($r = -0.233$ and $r = -0.300$, respectively). All the above-mentioned correlations were significant **(Table 2)**.

Discussion

Chronic pain is a growing problem in both developed and undeveloped countries. It is estimated that over 20% of the global population has chronic pain. It is known that the intensity of pain is associ-

Table 2. Correlation between the perceived pain intensity and the investigated parameters
Tabela 2. *Korelacija percipiranog intenziteta bola drugih ispitivanih parametara*

	Current pain intensity *Trenutni intenzitet bola*		Average pain intensity in the past 4 weeks *Prosečan intenzitet bola u poslednje 4 nedelje*	
	r/*r*	p/*p*	r/*r*	p/*p*
Age/*Starost*	0.109	0.314	0.043	0.692
Body height/*Telesna visina*	-0.168	0.119	-0.177	0.101
Body weight/*Telesna masa*	-0.032	0.772	-0.058	0.597
PPT	**-0.233***	0.029	**-0.300****	0.005
HPT	-0.189	0.078	**-0.243***	0.023
CPT	0.197	0.066	**0.276****	0.009
Pain duration/*Trajanje bola*	**0.340****	0.001	**0.308****	0.003
Years of education/*Godine obrazovanja*	-0.14	0.193	-0.019	0.858
FACS	**0.438****	<0.001	**0.253***	0.017
Sleep/*San*	-0.06	0.58	-0.209	0.051

Legend: ** p < 0.01; * p < 0.05; FACS – fear avoidance component scale; PPT - pressure pain threshold; HPT - heat pain threshold; CPT - cold pain threshold
Legenda: $^{**}p < 0,01$; $^{*}p < 0,05$; *FACS- skala komponenti izbegavanja aktivnosti usled straha. PPT- prag bola za pritisak. HPT- prag bola za toplo. CPT- prag bola za hladno*

ated with a reduced level of functionality and quality of life [9, 26], but there are still doubts about the relationship between the perceived pain intensity and the psychological and psychophysical characteristics of patients [19]. Our research included patients with lower back pain and fibromyalgia, which are very common causes of pain in the general population [9]. We wanted to find out how anthropometric, psychological, and psychophysical variables are related to the perceived pain intensity.

Duration of pain is a determining factor for defining chronic pain. Our results indicate that pain duration is related to the perceived pain intensity. This indicates that the longer the pain is present in patients, the higher is the perceived severity. In the literature, there are many articles that discuss the connection between the pain duration and the pain intensity [27]. One of the processes that can explain this association is central sensitization [8]. It is defined as the increased function of neurons in pathways that transmit pain resulting from increased excitability and decreased inhibition [28]. Referring to this definition, it is expected that the pain thresholds in persons with existing central sensitization will be lower and that the intensity of pain will be higher [8, 29, 30]. A part of our results confirms these assumptions, namely the inversely proportional relationship between perceived pain intensity and pain thresholds for heat and pressure. Therefore, the higher the pain intensity experienced by the patients, the lower are the pain thresholds for pressure and heat. Similar results were found by Hooten et al., showing a significant negative correlation between HPT and pain intensity [31]. In the study of Kamper et al. in 2011, neck PPT and neck pain intensity were examined and a significant negative correlation was observed between the two variables [32].

Our results did not show the expected correlation between the cold pain threshold and pain intensity. This result can be explained by the difficulty of detecting pain to a cold stimulus, which was discussed by some authors [28]. In the paper of Gehling et al., a high variability in the perceived cold pain intensity was explained by the lack of individualized calibration of the cold stimulus [33].

In our study, the FACS score showed the highest correlation with the pain intensity, which indicates a significant degree of avoidance of activities due to fear. The fear-avoidance phenomenon shows the influence of fear on activities and it is widely present in patients with chronic pain, furthermore, fear avoidance is blamed for the transition from acute to chronic pain [14]. This kind of correlation is expected given that patients with chronic pain participated in our study. Similar results were obtained in the meta-analysis by Kroska et al. which highlights the positive association between these two variables [34]. Therefore, fear of pain and avoidance of activity due to fear lead to each other. The explanation of such results lies in the fact that, according to some authors, it is precisely this fear of activity that leads to less and less physical activity which is the basis for the development and maintenance of chronic pain. Possible mechanisms are misinterpretations of bodily sensations, inaccurate predictions about pain, hypervigilance, deconditioning, and muscle reactivity [9, 35].

Greater sleep disturbance is associated with greater pain intensity, greater pain-related dysfunction, greater psychosocial distress, and pain catastrophizing [6, 36]. Finan et al. suggest that sleep disturbance and pain are reciprocally related, so poor sleep at night worsens the pain later during the day and vice versa [37]. In our research, no significant correlations between hours of sleep and pain intensity were found. In part, the explanation may lie in the fact that we considered the average number of hours of sleep during the past four weeks, which is

a variable insufficient to explain pain intensity, in the way other characteristics, besides sleep duration, could influence the perceived pain intensity [38].

Conclusion

Longer duration of pain is associated with higher perceived pain intensity. Small to moderate significant positive correlations were found between fear avoidance and pain intensity. Therefore, addressing this phenomenon may be very important for chronic pain treatment. Significant but small negative correlations were found between pressure pain threshold and both present and average pain intensity in patients with chronic pain.

References

1. McEntire DM, Kirkpatrick DR, Dueck NP, Kerfeld MJ, Smith TA, Nelson TJ, et al. Pain transduction: a pharmacologic perspective. Expert Rev Clin Pharmacol. 2016;9(8):1069-80.
2. Ellison DL. Physiology of pain. Crit Care Nurs Clin North Am. 2017;29(4):397-406.
3. Fenton BW, Shih E, Zolton J. The neurobiology of pain perception in normal and persistent pain. Pain Manag. 2015;5(4):297-317.
4. Kröger IL, Menz MM, May A. Dissociating the neural mechanisms of pain consistency and pain intensity in the trigemino-nociceptive system. Cephalalgia. 2016;36(8):790-9.
5. Zhuo M. Neural mechanisms underlying anxiety-chronic pain interactions. Trends Neurosci. 2016;39(3):136-45.
6. Jeremic-Knezevic M, Knezevic A, Boban N, Djurovic Koprivica D, Boban J. Correlation of somatization, depression, and chronic pain with clinical findings of the temporomandibular disorders in asymptomatic women. Cranio. 2021;39(1):17-23.
7. Finan PH, Garland EL. The role of positive affect in pain and its treatment. Clin J Pain. 2015;31(2):177-87.
8. Knezevic A, Neblett R, Colovic P, Jeremic-Knezevic M, Bugarski-Ignjatovic V, Klasnja A, et al. Convergent and discriminant validity of the Serbian version of the Central Sensitization Inventory. Pain Pract. 2020;20(7):724-36.
9. Knežević A, Čolović P, Jeremić-Knežević M, Demeši-Drljan Č, Simić-Panić D, Neblett R. Assessing the functional status of patients with chronic pain - cross cultural adaptation and psychometric properties of the Serbian version of the Pain Disability Questionnaire. Int J Environ Res Public Health. 2021;18(13):6911.
10. Bošković K, Todorović-Tomašević S, Naumović N, Grajić M, Knezević A. The quality of life of lumbar radiculopathy patients under conservative treatment. Vojnosanit Pregl. 2009;66(10):807-12.
11. Bošković K, Cigić T, Grajić M, Todorović-Tomasević S, Knezević **A**. The quality of life of patients after a lumbar microdiscectomy: a four-year monitoring study. Clin Neurol Neurosurg. 2010;112(7):557-62.
12. Vojnović L, Popović D, Vidić J, Simić Panić D, Aleksandrić T, Knežević A. Generalized pain hypersensitivity in fibromyalgia patients. Acta medica Medianae. 2023;62(2). DOI: 10.5633/amm.2023.0202.
13. Wertli MM, Rasmussen-Barr E, Weiser S, Bachmann LM, Brunner F. The role of fear avoidance beliefs as a prognostic factor for outcome in patients with nonspecific low back pain: a systematic review. Spine J. 2014;14(5):816-36.e4.
14. Knezevic A, Neblett R, Gatchel RJ, Jeremic-Knezevic M, Bugarski-Ignjatovic V, Tomasevic-Todorovic S, et al. Psychometric validation of the Serbian version of the Fear Avoidance Component Scale (FACS). PLoS One. 2018;13(9):e0204311.
15. Doty RL. Psychophysical testing of human olfactory function. In: Buettner A, editor. Springer handbook of odor. Cham: Springer; 2017. p. 59-60.
16. Whitcroft KL, Hummel T. Clinical diagnosis and current management strategies for olfactory dysfunction: a review. JAMA Otolaryngol Head Neck Surg. 2019;145(9):846-53.
17. Rolke R, Baron R, Maier C, Tölle TR, Treede DR, Beyer A, et al. Quantitative sensory testing in the German Research Network on Neuropathic Pain (DFNS): standardized protocol and reference values. Pain. 2006;123(3):231-43.
18. Devigili G, Rinaldo S, Lombardi R, Cazzato D, Marchi M, Salvi E, et al. Diagnostic criteria for small fibre neuropathy in clinical practice and research. Brain. 2019;142(12):3728-36.
19. Knezevic A, Kovacevic M, Jeremic-Knezevic M, Nikolasevic Z, Tomasevic-Todorovic S, Zivanovic Z, et al. Patients with neuropathic pain from lumbosacral radiculopathy demonstrate similar pressure pain thresholds and conditioned pain modulation to those with fibromyalgia. Neurophysiol Clin. 2023;53(4):102841.
20. Wolfe F, Clauw DJ, Fitzcharles MA, Goldenberg DL, Häuser W, Katz RL, et al. 2016 Revisions to the 2010/2011 fibromyalgia diagnostic criteria. Semin Arthritis Rheum. 2016;46(3):319-29.
21. Finnerup NB, Haroutounian S, Kamerman P, Baron R, Bennett DLH, Bouhassira D, et al. Neuropathic pain: an updated grading system for research and clinical practice. Pain. 2016;157(8):1599-606.
22. Knezevic A, Kovacevic M, Klicov Lj, Pantic M, Vasin J, Spasojevic T. Conditioned pain modulation assessment using contact heat as conditioning stimulus and two different test stimuli. Med Pregl. 2019;72(3-4):66-71.
23. Kovacevic M, Klicov L, Vuklis D, Neblett R, Knezevic A. Test-retest reliability of pressure pain threshold and heat pain threshold as test stimuli for evaluation of conditioned pain modulation. Neurophysiol Clin. 2021;51(5):433-42.
24. Neblett R, Mayer TG, Hartzell MM, Williams MJ, Gatchel RJ. The Fear-avoidance Components Scale (FACS): development and psychometric evaluation of a new measure of pain-related fear avoidance. Pain Pract. 2016;16(4):435-50.
25. Neblett R, Mayer TG, Williams MJ, Asih S, Cuesta-Vargas AI, Hartzell MM, et al. The Fear-Avoidance Components Scale (FACS): responsiveness to functional restoration treatment in a chronic musculoskeletal pain disorder (CMPD) population. Clin J Pain. 2017;33(12):1088-99.
26. Tsang A, Von Korff M, Lee S, Alonso J, Karam E, Angermeyer MC, et al. Common chronic pain conditions in developed and developing countries: gender and age differences and comorbidity with depression-anxiety disorders. J Pain. 2008;9(10):883-91.
27. Veiersted KB, Hanvold TN, Lunde LK, Koch M, Knardahl S, Wærsted M. Do intensity of pain alone or combined with pain duration best reflect clinical signs in the neck, shoulder and upper limb? Scand J Pain. 2020;21(2):266-73.
28. Latremoliere A, Woolf CJ. Central sensitization: a generator of pain hypersensitivity by central neural plasticity. J Pain. 2009;10(9):895-926.

29. Giesecke T, Gracely RH, Grant MA, Nachemson A, Petzke F, Williams DA, et al. Evidence of augmented central pain processing in idiopathic chronic low back pain. Arthritis Rheum. 2004;50 (2):613-23.

30. Knezevic A, Neblett R, Jeremic-Knezevic M, Tomasevic-Todorovic S, Boskovic K, Colovic P, et al. Cross-cultural adaptation and psychometric validation of the Serbian version of the Central Sensitization Inventory. Pain Pract. 2018;18(4):463-72.

31. Hooten WM, Sandroni P, Mantilla CB, Townsend CO. Associations between heat pain perception and pain severity among patients with chronic pain. Pain Med. 2010;11(10):1554-63.

32. Kamper SJ, Maher CG, Hush JM, Pedler A, Sterling M. Relationship between pressure pain thresholds and pain ratings in patients with whiplash-associated disorders. Clin J Pain. 2011;27(6): 495-501.

33. Gehling J, Mainka T, Vollert J, Pogatzki-Zahn EM, Maier C, Enax-Krumova EK. Short-term test-retest-reliability of conditioned pain modulation using the cold-heat-pain method in healthy subjects and its correlation to parameters of standardized quantitative sensory testing. BMC Neurol. 2016;16:125.

34. Kroska EB. A meta-analysis of fear-avoidance and pain intensity: the paradox of chronic pain. Scand J Pain. 2016;13:43-58.

35. Vlaeyen JWS, Linton SJ. Fear-avoidance and its consequences in chronic musculoskeletal pain: a state of the art. Pain. 2000;85(3):317-32.

36. Gerhart JI, Burns JW, Post KM, Smith DA, Porter LS, Burgess HJ, et al. Relationships between sleep quality and pain-related factors for people with chronic low back pain: tests of reciprocal and time of day effects. Ann Behav Med. 2017;51(3):365-75.

37. Finan PH, Goodin BR, Smith MT. The association of sleep and pain: an update and a path forward. J Pain. 2013;14(12):1539-52.

38. Zajacova A, Rogers RG, Grodsky E, Grol-Prokopczyk H. The relationship between education and pain among adults aged 30-49 in the United States. J Pain. 2020;21(11-12):1270-80

Rad je primljen 31. V 2023.
Recenziran 3. VI 2023.
Prihvaćen za štampu 7. VI 2023.
BIBLID.0025-8105:(2022):LXXV:11-12:356-361.