Journal of Engineering Research

ISSN 2764-1317 vol. 6, n. 2, 2026

ARTICLE 7

Acceptance date: 05/03/2026

RELATIONSHIP BETWEEN BIPSYCHOSOCIAL FACTORS AND NONSPECIFIC CHRONIC LOW BACK PAIN IN UNIVERSITY STUDENTS

Maria Eduarda Santiago De Oliveira Pires

Fabricio Jose Jassi

Denis Carlos Dos Santos

Giulia Alencar Romano

Ana Julia Juliano De Oliveira

Ana Luísa Sousa Tatesuji

Icaro Augusto Cardoso De Oliveira

João Paulo Freitas

Abstract: INTRODUCTION: Low back pain is the leading cause of disability worldwide. Biopsychosocial factors lead to higher levels of pain intensity and disability than anatomical factors in patients with chronic low back pain. It is believed that biopsychosocial factors may interfere with the pressure pain threshold in people with chronic low back pain, but the exact relationship between the pressure pain threshold and biopsychosocial factors in chronic low back pain is not yet known. **OBJECTIVES**: To identify whether there is a correlation between biopsychosocial factors, pain intensity, and pressure pain threshold in university students with nonspecific chronic low back pain. **METHODS**: Analytical cross-sectional study. The sample consisted of forty students from the State University of Northern Paraná (UENP) at the Jacarezinho campus in Paraná. Five questionnaires were administered to assess biopsychosocial factors, and pressure algometry was used to verify the pressure pain threshold. The questionnaires used were: *PainDetect; STarT Back; Tampa Scale for Kinesiophobia* (TSK); *Quebec Back Pain Disability Scale* (QBPDS); Pain Catastrophizing Scale: Brazil (B-PCS). The data were tabulated in *Excel* 7.0 and statistically analyzed using the statistical program JASP 0.16.2.0. The significance level adopted was 95% ($p \leq 0.05$). **RESULTS**: Significant correlations were found between the questionnaire *scores* and between pain intensity and the final questionnaire scores. However, no significant correlations were found between the questionnaires and the pressure pain threshold. **CONCLUSION**: Pain intensity correlated with several biopsychosocial factors, such as neuropathic components of pain, catastrophizing, and functional disability. However, there was no correlation between psychosocial factors and pressure pain threshold in university students with chronic nonspecific low back pain.

Keywords: Biopsychosocial Models; Pain Threshold; Low Back Pain; Chronic Pain.

INTRODUCTION

Low back pain has been the leading cause of years lived with disability since 1990. Its prevalence in 2020 was estimated at 619 million people worldwide (1). The Clinical Practice Guideline Linked to the International Classification of Functioning, Disability, and Health of the Orthopedic Section of the American Physical Therapy Association classifies low back pain into two stages: acute, with symptoms persisting for less than or equal to six weeks, and chronic, lasting longer than this period (2). Nonspecific low back pain is the most common (90%), with no exact anatomical or pathological cause identified (3).

The International Classification of Functioning, Disability, and Health (ICF) was developed in 2001 by the World Health Organization (WHO) with the aim of serving as a reference for defining disability through an integrative biopsychosocial approach (4). Biopsychosocial factors such as catastrophizing, kinesiophobia, maladaptive beliefs, and social isolation lead to higher levels of pain intensity and disability than anatomical factors in patients with chronic low back pain (CLBP), so it is essential to associate these factors with these individuals (5).

Pain sensitization is one of the pathophysiological mechanisms that seeks to explain CLBP (6). The pressure pain threshold (PPT) is used to measure the sensitivity of deep muscle tissue using a pressure al-

gometer and is considered the gold standard for quantifying the pressure exerted on a given area, generating a non-painful stimulus that, as it increases, induces a sensation of pressure that becomes painful (7). In a study conducted by Imaruma et al.(8), it was observed that individuals with chronic nonspecific low back pain have lower PPT values than healthy individuals, making it a great ally in objectively measuring low back pain.

Imaruma et al. (7) found that the lower the LDP, the greater the pain and the lower the function. This negative correlation suggested to the study that psychosocial factors should have been addressed, as they could affect the pain threshold. In this sense, the objective of this study will be to identify whether there is a relationship between biopsychosocial factors, pain intensity, and LDP in university students with chronic nonspecific low back pain.

METHODS AND TECHNIQUES

This cross-sectional analytical study was conducted following the *Strengthening the Reporting of Observational studies in Epidemiology* (STROBE) *guideline* (9). The sample size was calculated using the online tool "sample size calculation," available at http://estatistica.bauru.usp.br/calculoamostral. We considered a β error of 20%, an α of 5%, and a possible loss of elements of 20%. Thus, the minimum sample size required to detect a correlation considered strong (correlation coefficient of 0.5) was 37 university students. Our total sample consisted of 40 students from the State University of Northern Paraná (UENP) at the Jacarezinho campus in Paraná. Participants were recruited through social media and printed invitations posted on university premises. The inclusion criteria were individuals over 18 years of age, with low back pain for at least 7 weeks and a minimum pain level of 3 on the Numerical Pain Scale. Exclusion criteria were inability to answer the questionnaires, individuals who had already undergone spinal surgery, self-reported neurological, psychiatric, or orthopedic conditions that made evaluation impossible, and changes in sensitivity and vascularity.

All data collection took place in person at a single meeting at the Physical Therapy Clinic of the State University of Northern Paraná, as authorized by the person responsible, beginning after the participants read and signed the Free and Informed Consent Form (FICF). Initially, questionnaires were administered to assess biopsychosocial factors, measuring pain intensity, kinesiophobia, catastrophizing, functional disability, chronicity, and the existence of neuropathic components in university students with nonspecific LBP, following the inclusion criteria already described. Subsequently, algometry was applied to verify their LDP. The study was approved by the Ethics Committee for Research with Human Beings of the State University of Northern Paraná (Opinion: 6.082.631; CAAE 68394522.3.0000.8123).

Assessment of biopsychosocial factors

The questionnaires applied were: *PainDetect,* which assesses pain intensity and the existence of neuropathic pain components; *STarT (Subgroups Target Treatment) Back Screening Tool* (STarT Back), assessing the prognosis of patients with a focus on physical and psychosocial factors; *Tampa Scale for Kinesiophobia* (TSK), developed to assess

kinesiophobia; *Quebec Back Pain Disability Scale* (QBPDS) is a scale that assesses the functional capacity of individuals with low back pain through their inability to perform simple activities of daily living; the *Pain Catastrophizing Scale* (PCS) is a questionnaire to assess catastrophizing.

PainDetect (PD-Q) is a self-administered questionnaire to detect components of neuropathic pain, especially in patients with chronic low back pain, subdivided into four domains. The first domain assesses pain intensity. The second uses graphs to question the pattern and course of pain. The third domain consists of a body map, in which the patient can indicate their main area of pain by drawing and mark if there is radiating pain. In the fourth and last domain, seven questions are asked detailing the sensory characteristics of pain. The total points acquired in the entire questionnaire must be added to obtain the final score between -1 and 38. Results equal to or less than 12 points indicate an unlikely neuropathic component, and results greater than or equal to 19 points indicate a likely neuropathic component (10,11).

The *STarT (Subgroups Target Treatment) Back Screening Tool* (STarT Back) questionnaire assesses the risk of poor prognosis in patients with low back pain and/or lumbosciatica in the presence of physical and psychosocial factors. It has nine questions. The questionnaire classification varies with the patients' total score, ranging from 0-3 points (low risk). Values greater than 3 in the total score should be considered the psychosocial subscale (items 5-9) score . so if the score on this subscale is ≤3 points, the patient is classified as medium risk, and if it is greater than 3 points, they fall into the high-risk group (12–14).

The *Tampa Scale for Kinesiophobia* (TSK) is a questionnaire developed to assess kinesiophobia and collect information about discomfort, safety, and readiness for movement in patients with DLC. The English version of the TSK has 17 questions (15). However, the short version of this questionnaire, TSK-13, has 13 questions and provides better psychometric measures, scoring between 13 and 52 points, where the higher the score, the greater the level of perceived fear (16,17).

The *Quebec Back Pain Disability Scale* (QBPDS) is a self-administered scale that assesses the functional capacity of individuals with low back pain through their inability to perform simple activities of daily living (ADL). It has 20 items distributed across 6 domains of activity. The final score is calculated by adding the scores for each item and can range from 0 to 100, where 0 means no disability and 100 means maximum disability (18–20).

The *Pain Catastrophizing Scale* (PCS) is a self-administered questionnaire consisting of 13 items to assess catastrophizing. It is divided into three subscales: helplessness, magnification, and rumination. The questionnaire is completed based on the patient's thoughts and feelings when in pain. The total PCS score ranges from 0 to 52 points. It has been validated in Brazil and named the Brazil *Pain Catastrophizing Scale* (B-PCS) (21,22).

Pain threshold assessment

The LDP assessment was performed by a trained assessor using a MEDDOR pressure algometer with a 1 cm² rubber probe. The device was properly calibrated. The assessment points were measured with

the individual lying on a stretcher in a prone position bilaterally three times at the following locations: mid-calf portion of the medial gastrocnemius muscle, two centimeters lateral to the spinous process of L5, two centimeters lateral to the spinous process of L1, and mid-portion of the deltoid muscle. The probe was placed perpendicular to the skin and the pressure increased at a rate of 500 g/s while the examiner visually monitored the force in real time by reading the display. The participant was instructed to say "it hurts" as soon as the pressure sensation became un r painful, the applicator removed the algometer, and the threshold was noted. For data analysis, the average of the three values obtained in each evaluation was used (23). The use of the algometer to assess LDP is considered to have excellent reproducibility and validity (24). Inter-examiner reliability has already been tested, with no significant differences found in the observers' mean values, suggesting no bias and providing further evidence that trained observers can apply the algometer consistently and provide highly reliable measurements (23).

Statistical analysis

The data were tabulated *in Excel* 7.0 and statistically analyzed using the statistical program JASP 0.16.2.0. Continuous data are expressed as mean and standard deviation, and categorical data are expressed as absolute numbers and percentages. The *Shapiro-Wilk* test was used to verify the normality of the data. The tests to verify the presence of correlation between the variables were chosen according to the parametric or nonparametric distribution of the data. For variables with parametric distribution, the Pearson correlation test was used, while for nonparametric variables, the *Spearman* correlation test was adopted. A correlation coefficient between 0.1 and 0.3 was considered weak, between 0.3 and 0.5 moderate, and above 0.5 strong. The significance level adopted was 95% ($p \leq 0.05$) (25,26).

RESULTS

Forty university students of both sexes participated in the study, 28 of whom were women (70%). Table 1 shows the basic characteristics of the sample.

Variables	Mean (SD)
Age (years)	21.92 (1.77)
Weight (kg)	69.07 (17.27)
Height (m)	1.66 (0.09)
BMI (kg/m²)	24.78 (4.87)

Table 1 - Characterization of the sample (n=40)

Note: SD = standard deviation; BMI = body mass index;

Positive and significant correlations were found between the questionnaire *scores* (Table 2) and between pain intensity and the final questionnaire scores (Table 3). However, there were no significant correlations between the questionnaires and the LDP.

It was possible to analyze that the PD-Q and B-PCS questionnaires obtained significant correlations with all other questionnaires, and there was a strong correlation between them. In this sense, the QBPDS showed strong correlations with the StarT Back and PD-Q questionnaires. The TSK-13 has moderate correlations with the PD-Q and B-PCS questionnaires. Finally, StarT Back showed strong correla-

tions with PD-Q, QBPDS, and moderate correlation with the B-PCS questionnaire. Table 2 shows the correlation coefficient values between LDP and the questionnaires and the p values.

We also observed a moderate correlation between the Numeric Pain Scale (NPS) result and the B-PCS score. In addition, the NPS was used to evaluate the following questions from the PD-Q questionnaire: "What was the strongest intensity of low back pain you experienced in the last four weeks?" and "What was the average intensity of your low back pain during the last four weeks?". The responses obtained showed that there was a moderate correlation between the most intense pain in the last four weeks and the QBPDS and B-PCS questionnaires. The average pain intensity had a moderate correlation with the PD-Q questionnaire and a strong correlation with the QBPDS. Table 3 shows the correlation between pain intensity, questionnaires, and pressure pain threshold. Table 4 shows the mean and standard deviation of NPS.

Variables	Mean (SD)
NPS	5.3 (1.4)
END PD-Q1	6.9 (1.7)
END PD-Q2	4.1 (1.5)

Note: SD = standard deviation; NPS = Numeric Pain Scale; NPS PD-Q1: "What was the strongest pain intensity in your lower back that you felt in the last four weeks?"; NPS PD-Q2: "What was the average intensity of your lower back pain during the last four weeks?".

Table 4 – Mean and Standard Deviation of the Numerical Pain Scale

DISCUSSION

This study investigated whether there is a relationship between biopsychosocial factors, pain intensity, and LDP in university students with chronic nonspecific low back pain. According to the above results, it was possible to verify that there is no significant correlation between the *scores* of the questionnaires applied and LDP. However, it was possible to confirm strong and significant correlations between the results of the questionnaires, and between pain intensity and questionnaire results, data that contribute to a better understanding of the impacts of chronic nonspecific low back pain.

Emotional aspects can also influence pain sensitivity. A recent study showed that central sensitization in patients with LBP is associated with the extent of psychosocial factors known as "yellow flags" using the *Örebro Musculoskeletal Pain Questionnaire* (ÖMPQ) (27). Although they have some similar objectives, these findings are not compatible with our results, since different questionnaires were used to assess psychosocial factors and, in addition, in the study by Steinmetz et al. (27), a comparison was made between groups (individuals with high rates of associated psychosocial factors versus individuals with low rates of associated psychoso al factors) and LDP, rather than a correlation between LDP and the final questionnaire scores, as performed in our study.

Long-term physical activity can reduce sensitivity to painful stimuli in healthy individuals, making it an important component in the assessment and rehabilitation of patients with pain (28). However, the level of physical activity of the participants in our study was not assessed, a factor that may

VARIABLES		STarT Back	PD-Q	TSK - 13	QBPDS	B-PCS
PD-Q	rho	0.549*	—			
	p-value	< .001	—			
TSK- 13	r		0.418*	—		
	p-value		0.007	—		
	rho	0.294		—		
	p-value	0.066		—		
QBPDS	rho	0.573*	0.515*	0.235	—	
	p-value	< .001	< .001	0.144	—	
B-PCS	r		0.546*	0.440*		—
	p-value		< .001	0.004		—
	rho	0.463*			0.400*	—
	p-value	0.003			0.011	—
LDP GCM D M	rho	-0.184	-0.218	-0.084	-0.198	-0.138
	p-value	0.257	0.176	0.605	0.221	0.394
LDP GCM E M	rho	-0.165	-0.206	-0.079	-0.120	-0.168
	p-value	0.309	0.202	0.628	0.462	0.299
LDP L1 D M	rho	-0.093	-0.078	-0.107	-0.110	-0.078
	p-value	0.569	0.632	0.510	0.498	0.634
LDP L1 AND M	rho	-0.087	-0.064	-0.087	0.002	-0.062
	p-value	0.592	0.695	0.591	0.988	0.706
LDP L5 D M	rho	-0.213	-0.172	-0.134	-0.182	-0.172
	p-value	0.187	0.289	0.411	0.261	0.288
LDP L5 AND M	rho	-0.179	-0.142	-0.154	-0.094	-0.112
	p-value	0.269	0.383	0.342	0.564	0.491
LDP DT D M	rho	-0.035	-0.079	-0.117	-0.206	-0.084
	p-value	0.832	0.626	0.473	0.203	0.605
LDP DT E M	rho	-0.063	-0.036	-0.068	-0.082	-0.086
	p-value	0.697	0.828	0.677	0.613	0.597

* $p \leq .05$

Note: (r): Pearson correlation coefficient; (rho): Spearman correlation coefficient; LDP: pressure pain threshold; RGM: right gastrocnemius mean; GCM L: left gastrocnemius mean; L1 R: right first lumbar vertebra mean; L1 L: left first lumbar vertebra mean; L5 R: right fifth lumbar vertebra mean; L5 L: left fifth lumbar vertebra mean; DT R: right deltoid mean; DT L: left deltoid mean; *statistically significant ($p \leq 0.05$).

Table 2 – Correlation between questionnaires and pressure pain threshold.

Variables		END	END PD-Q1	END PD-Q2
PD-Q	(r)	—	0.368	0.414**
	p-value	—	0.369	0.008
STarT Back	(Rho)	0.272	—	—
	p-value	0.090	—	—
TSK-13	(Rho)	0.092	0.178	0.107
	p-value	0.571	0.271	0.510
QBPDS	(r)	—	0.098	0.197
	p-value	—	0.547	0.224
B-PCS	(Rho)	0.267	—	—
	p-value	0.095	—	—
LDP GCM D M	(Rho)	0.266	0.475**	0.612***
	p-value	0.098	0.002	< .001
LDP GCM AND M	(r)	—	0.357	0.133
	p-value	—	0.024	0.414
LDP L1 D M	(Rho)	0.309*	—	—
	p-value	0.050	—	—
LDP L1 AND M	(Rho)	0.203	0.006	-0.073
	p-value	0.210	0.971	0.656
LDP L5 D M	(Rho)	0.148	-0.062	-0.149
	p-value	0.363	0.704	0.358
LDP L5 AND M	(Rho)	0.256	0.116	0.008
	p-value	0.111	0.476	0.963
LDP DT D M	(Rho)	0.254	0.147	0.089
	p-value	0.113	0.366	0.587
LDP DT AND M	(Rho)	0.229	-0.063	-0.060
	p-value	0.155	0.697	0.714
	(Rho)	0.140	-0.009	-0.059
	p-value	0.390	0.956	0.719
	(Rho)	0.177	-0.104	-0.134
	p-value	0.276	0.522	0.408
	(Rho)	0.157	0.034	0.038
	p-value	0.333	0.836	0.817

* p ≤ .05, ** p < .01, *** p < .001

Note: (r): Pearson correlation coefficient; (rho): Spearman correlation coefficient; LDP: pressure pain threshold; RGM R M: right gastrocnemius mean; GCM L: left gastrocnemius mean; L1 R L: right first lumbar vertebra mean; L1 L: left first lumbar vertebra mean; L5 R: right fifth lumbar vertebra mean; L5 L: left fifth lumbar vertebra mean; DT D M: right deltoid mean; DT L M: left deltoid mean; NPS: Numeric Pain Scale; NPS PD-Q1: "What was the strongest pain intensity in your lower back that you felt in the last four weeks?"; NPS PD-Q2: "What was the average intensity of your lower back pain during the last four weeks?".

Table 3 – Correlation between pain intensity, questionnaires, and pressure pain threshold .

have contributed to the lack of correlations between LDP and pain intensity.

The PD-Q is a questionnaire that detects components of neuropathic pain (10,11), while the B-PCS assesses catastrophizing (21,22). In the present study, it was possible to observe that both questionnaires obtained significant correlations with all other questionnaires and between themselves.

Patients with neuropathic pain components are more likely to have a lower degree of functionality in ADLs and suffer from more intense pain for longer periods (10). These data corroborate the findings of the present study, demonstrating a positive correlation between neuropathic pain components and a higher chance of chronicity, functional disability, catastrophizing, and kinesiophobia among university students.

The B-PCS questionnaire assesses catastrophizing (21,22). In previous studies (29–31), it was found that catastrophizing is associated with chronic low back pain, generating persistent, severe symptoms and, consequently, functional disability. This corroborates the findings of our study. In addition, increased levels of catastrophizing were related to higher scores on all of the above-mentioned questionnaires.

Kinesiophobia is defined as the fear of movement (32) and interferes with the ability to complete ADLs in individuals with LBP. When patients fear pain, they tend to avoid it, stimulating physical inactivity, which in turn amplifies pain through the relationship between sensory and emotional components, generating more fear. In this sense, kinesiophobia is related to increased pain intensity, functional disability, elevated levels of catastrophizing, and consequently chronicity (30–33). In our sample, no significant correlations were found between the TSK-13 questionnaire and the Start Back and QBPDS questionnaires, suggesting no relationship between fear of movement, chronicity, and decreased functional capacity . Several factors may have contributed to this result, such as the age of the participants, who in our sample were young, and the level of physical activity, which was not measured in the present study.

Psychological factors have a greater impact on pain intensity and disability than anatomical factors (5). A weak but significant correlation was found between increased pain intensity and elevated levels of catastrophizing among university students, which corroborates previous studies (34,35). These findings demonstrate the need to associate psychosocial factors with the treatment of patients with low back pain (36).

When analyzing "What was the strongest intensity of pain in your lower back that you felt in the last four weeks?" through the END, there was a moderate correlation with the QBPDS and B-PCS questionnaires, indicating that the most intense pain felt in the last month is related to increased levels of functional disability and catastrophizing. In addition, the average pain intensity taken from the PD-Q "What was the average intensity of your low back pain during the last four weeks?" had a moderate correlation with the existence of neuropathic pain components and a strong correlation between pain intensity and functional disability.

Although biopsychosocial factors, pain intensity, and LDP are already independently associated with chronic nonspecific low back pain (7,8,29–31,33), a major limitation of our research was the difficulty

in finding studies that associated LDP with biopsychosocial factors in CLBP, data that would help to support the results of the present study. Therefore, we suggest new studies on the correlation between LDP, pain intensity, and biopsychosocial factors, including the level of physical activity of university students, in more heterogeneous samples.

Our research had the following strengths: we followed the *Strengthening the Reporting of Observational studies in Epidemiology* (STROBE) *guideline* for cross-sectional studies and used a sufficient sample size. In addition, we enriched our results by using several questionnaires to measure biopsychosocial factors and the algometer to assess LDP locally and remotely. Finally, we identified significant correlations between biopsychosocial factors, mainly catastrophizing and neuropathic pain, which were correlated with all other questionnaires , demonstrating that when these factors are present in individuals with LDP, there is a relationship with psychosocial elements.

CONCLUSION

This study demonstrated that there was no correlation between psychosocial factors and pressure pain threshold in university students with chronic nonspecific low back pain. However, pain intensity in chronic nonspecific low back pain was correlated with several biopsychosocial factors, such as neuropathic components of pain, catastrophizing, and functional disability.

REFERENCES

1. Ferreira ML, De Luca K, Haile LM, Steinmetz JD, Culbreth GT, Cross M, et al. Global, regional, and national burden of low back pain, 1990–2020, its attributable risk factors, and projections to 2050: a systematic analysis of the Global Burden of Disease Study 2021. The Lancet Rheumatol. 2023 Jun 1;5(6):e316–29.

2. George SZ, Fritz JM, Silfies SP, Schneider MJ, Beneciuk JM, Lentz TA, et al. Interventions for the Management of Acute and Chronic Low Back Pain: Revision 2021. Vol. 51, Journal of Orthopaedic and Sports Physical Therapy. Movement Science Media; 2021. p. CPG1–60.

3. Maher C, Underwood M, Buchbinder R. Non-specific low back pain. Vol. 389, The Lancet. Lancet Publishing Group; 2017. p. 736–47.

4. World Health Organization: International Classification of Functioning, Disability and Health (ICF). 2001, Geneva: World Health Organization

5. Corrêa LA, Mathieson S, Meziat-Filho NA de M, Reis FJ, Ferreira A de S, Nogueira LAC. Which psychosocial factors are related to severe pain and functional limitation in patients with low back pain? Brazilian Journal of Physical Therapy. 2022 May;26(3):100413.

6. Roussel NA, Nijs J, Meeus M, Mylius V, Fayt C, Oostendorp R. Central Sensitization and Altered Central Pain Processing in Chronic Low Back Pain. The Clinical Journal of Pain. 2013 Jul;29(7):625–38.

7. Imamura M, Alfieri FM, Filippo TRM, Battistella LR. Pressure pain thresholds in patients with chronic nonspecific low back pain. Journal of Back and Musculoskeletal Rehabilitation. 2016 Apr 27;29(2):327–36.

8. Imamura M, Chen J, Matsubayashi SR, Targino RA, Alfieri FM, Bueno DK, et al.

Changes in Pressure Pain Threshold in Patients With Chronic Nonspecific Low Back Pain. Spine. 2013 Nov;38(24):2098–107.

9. Malta M, Cardoso LO, Bastos FI, Magnanini MMF, Silva CMFP da. STROBE initiative: guidelines on reporting observational studies. Revista De Saude Publica. 2010 Jun 1;44(3):559–65.

10. Freynhagen R, Baron R, Gockel U, Tölle TR. painDETECT: a new screening questionnaire to identify neuropathic components in patients with back pain. Current Medical Research and Opinion. 2006 Aug 29;22(10):1911–20.

11. Rio JPM, Bittencourt JV, Corrêa LA, Freynhagen R, Reis FJJ, Melo TB, et al. Cross-cultural adaptation of the painDETECT questionnaire into Brazilian Portuguese. Brazilian Journal of Anesthesiology (English Edition). 2022 Jan 72(1):44–8.

12. Fritz JM, Beneciuk JM, George SZ. Relationship Between Categorization With the STarT Back Screening Tool and Prognosis for People Receiving Physical Therapy for Low Back Pain. Physical Therapy. 2011 May 1;91(5):722–32.

13. Hill JC, Dunn KM, Lewis M, Mullis R, Main CJ, Foster NE, et al. A primary care back pain screening tool: Identifying patient subgroups for initial treatment. Arthritis & Rheumatism. 2008;59(5):632–41.

14. Pilz B, Vasconcelos RA, Marcondes FB, Lodovichi SS, Mello W, Grossi DB. The Brazilian version of STarT Back Screening Tool - translation, cross-cultural adaptation and reliability. Brazilian Journal of Physical Therapy. 2014 Oct;18(5):453–61.

15. Goubert L, Crombez G, Van Damme S, Vlaeyen JWS, Bijttebier P, Roelofs J. Confirmatory Factor Analysis of the Tampa Scale for Kinesiophobia. The Clinical Journal of Pain. 2004 Mar;20(2):103–10.

16. Cordeiro N, Pezarat-Correia P, Gil J, Cabri J. Portuguese Language Version of the Tampa Scale for Kinesiophobia [13 Items]. Journal of Musculoskeletal Pain. 2013 Mar;21(1):58–63.

17. Neblett R, Hartzell MM, Mayer TG, Bradford EM, Gatchel RJ. Establishing clinically meaningful severity levels for the Tampa Scale for Kinesiophobia (TSK-13). European Journal of Pain. 2015 Oct 30;20(5):701–10.

18. Kopec JA, Esdaile JM, Abrahamowicz M, Abenhaim L, Wood-Dauphinee S, Lamping DL, et al. The Quebec Back Pain Disability Scale. Spine. 1995 Feb;20(3):341–52.

19. Moniz SAC. Caracterização da intervenção da Fisioterapia em indivíduos com dor crónica lombar, e seus resultados a nível da dor e capacidade funcional [Dissertação de Mestrado em Fisioterapia]. [Escola Superior de Saúde do Instituto Politécnico de Setúbal]; 2012. p. 184.

20. Nunes F, Ribeiro A, Cruz E. Adaptação Cultural e Validação da Quebec Back Pain Disability Scale para a População Portuguesa, com Dor Lombar Crónica. Artigo não publicado, 2005.

21. Sehn FC. Validação Da Escala De Pensamentos Catastróficos E Associação Do Catastrofismo Com Marcadores Biológicos [Dissertação De Mestrado]. [Universidade Federal Do Rio Grande Do Sul]; 2012.

22. Sullivan MJL, Bishop SR, Pivik J. The Pain Catastrophizing Scale: Development and validation. Psychological Assessment. 1995;7(4):524–32.

23. Chesterton LS, Sim J, Wright CC, Foster NE. Interrater reliability of algometry in measuring pressure pain thresholds in healthy humans, using multiple raters. The Clinical journal of pain. 2007;23(9):760–6.

24. Fischer AA. Pressure algometry over normal muscles. Standard values, validity and reproducibility of pressure threshold. Pain. 1987 Jul;30(1):115–26.

25. Corder GW, Foreman DI. Nonparametric Statistics for Non-Statisticians A Step-by-Step Approach. Hoboken, Nj, Usa John Wiley & Sons, Inc; 2009.

26. Cohen J. Statistical power analysis for the behavioral sciences. 2nd ed. Hillsdale, N.J.: Lawrence Erlbaum Associates; 1988.

27. Steinmetz A, Hacke F, Delank KS. Pressure Pain Thresholds and Central Sensitization in Relation to Psychosocial Predictors of Chronicity in Low Back Pain. Diagnostics. 2023 Feb 19;13(4):786.

28. Naugle KM, Fillingim RB, Riley JL. A Meta-Analytic Review of the Hypoalgesic Effects of Exercise. The Journal of Pain. 2012 Dec;13(12):1139–50.

29. Ranger TA, Cicuttini FM, Jensen TS, Manniche C, Heritier S, Urquhart DM. Catastrophization, fear of movement, anxiety, and depression are associated with persistent, severe low back pain and disability. The Spine Journal. 2020 Jun;20(6):857–65.

30. Rocha JR de O, Karloh M, Santos ARS dos, Sousa TR de. Characterization of biopsychosocial factors of patients with chronic nonspecific low back pain. Brazilian Journal of Pain. 2021;4(4).

31. 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. The Spine Journal. 2014 May;14(5):816-836.e4.

32. Tagliaferri SD, Miller CT, Owen PJ, Mitchell UH, Brisby H, Fitzgibbon B, et al. Domains of chronic low back pain and assessing treatment effectiveness: A clinical perspective. Pain Practice. 2019 Oct 14;20(2).

33. Rainville J, Smeets RJEM, Bendix T, Tveito TH, Poiraudeau S, Indahl AJ. Fear-avoidance beliefs and pain avoidance in low back pain—translating research into clinical practice. The Spine Journal. 2011 Sep;11(9):895–903.

34. Marshall PWM, Schabrun S, Knox MF. Physical activity and the mediating effect of fear, depression, anxiety, and catastrophizing on pain related disability in people with chronic low back pain. Yang J, editor. PLOS ONE. 2017 Jul 7;12(7):e0180788.

35. Glette M, Stiles TC, Borchgrevink PC, Landmark T. The Natural Course of Chronic Pain in a General Population: Stability and Change in an Eight–Wave Longitudinal Study Over Four Years (the HUNT Pain Study). Journal of Pain. 2020 May 1;21(5–6):689–99.

36. Oliveira CB, Maher CG, Pinto RZ, Traeger AC, Lin CWC, Chenot JF, et al. Clinical practice guidelines for the management of non-specific low back pain in primary care: an updated overview. European Spine Journal. 2018 Jul 3;27(11):2791–803.