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Catastrophization, pain and disability in patients with chronic low back pain

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Abstract: The research aimed evaluate the relationship between catastrophization, pain intensity, and disability in patients with chronic low back pain (CLBP). According to the inclusion and exclusion criteria, 129 consecutive patients with CLBP were included in the study. The subjects performed ten session of supervised exercises. The measurement instruments were: the Pain catastrophizing scale (PCS), the Roland Morris Disability Questionnaire (RMDQ), and the Visual Analogue Scale (VAS). Disability was significantly associated with a higher overall score of PCS, and greater pain intensity (for both $p < 0.05$). Among the components of PCS helplessness, and rumination were highly associated with the disability score, and with magnification the least ($p<0.01$). Participants who did not use sick leave had significantly lower results of RMDQ score and PCS ($p <0.05$). No difference was observed among those with more work experience compared to those with less. Disability was not associated with the duration of work experience ($p>0.05$). Higher degrees of disability were associated with higher catastrophization scores and increased pain intensity. These findings support that these individuals benefited from exercise treatment which was mostly demonstrated by a decline in RMDQ and PCS scores.

Keywords: catastrophization, chronic low back pain, disability;

1. Introduction

Patients with a tendency to catastrophize pain express the experience of real or anticipated pain in a different way than people who do not have this tendency. Pain catastrophizing is defined as '*an exaggerated negative orientation towards actual or anticipated pain experiences*', and is characterized by magnification of the negative effects of pain, rumination about pain, and feelings of helplessness in coping with pain [1]. When it comes to the likelihood of developing chronic pain, pain catastrophizing may be a predictive factor [2]. Psychological elements have a role in the development of chronic low back pain (CLBP). At the same time, there is some evidence that catastrophization as a coping strategy might lead to delayed recovery, as well as mediating between pain intensity and pain sensitivity [3, 4]. Of particular importance is establishing cutoff levels for identifying patients at risk of developing CLBP [5]. Pain catastrophizing is conceptualized as a negative cognitive-affective response in individuals with CLBP, as well as other pain-related outcomes [6]. CLBP is usually considered as one that last longer than 12 weeks [7]. It is one of the common health entities that up to 80% (depending on the definition) of adults experience at some point in their lives [8-10]. Almost all adults, once in their lifetime, complain

about LBP, but 10% to 15% develop CLBP [11]. It is recognized as a condition with multidimensional effects [12]. Pain intensity itself can be a limiting factor in the level of disability. When accompanied by pain catastrophizing, CLBP can be a severely distressing and functionally incapacitating condition that adversely impacts the patient's health. In the mediating influence of pain sensations and emotions, pain catastrophizing is a possible connection in the conditioning of chronic pain. Pain catastrophizing also contributes to poorer pain coping and overall functioning, making pain catastrophizing a viable target for psychological intervention [13]. Clark et al. suggest that catastrophizing may serve as a mechanism in central sensitization of pain [14]. Depending on the pain intensity, a lower level of improvement in therapy can be assumed, as well as a longer duration of the patient's disability [15]. Physiotherapy exercises are recommended for the treatment of CLBP [16, 17].

In this study, we aimed to evaluate which component of pain catastrophizing is more apparent and how the components evolve throughout time in patients with CLBP on therapeutic exercise, as well as how pain catastrophizing relates to pain, disability, years of work, sick leave, and duration of CLBP.

2. MATERIALS AND METHODS

Patients and study design

This study was carried out in the Outpatient Clinic of the Physiotherapy unit in the Health Center of Zagreb County, Croatia. A consecutive sample of participants having CLBP with appropriate inclusion and exclusion criteria was enrolled in the study. Power analysis showed that the required sample for the analysis was 129 participants. Taking into account the inclusion and exclusion criteria, all patients performed therapeutic exercise. The individuals performed selected exercises two to three times a week, for a total of ten sessions over four weeks. The exercises they carried out were: abdominal bracing, sitting rotation stretch, knee to chest, bird dog, plank, hip bridge, abdominal crunch, and kneeling back extension. Three time points were used for the assessment of the parameters of interest: at baseline, immediately following the completion of the exercise (four weeks), and eight weeks following the finishing the exercises. The study was approved by the Zagreb County Health Center, Samobor, Croatia Board of the Ethics Committee (Class: 510-14/18-01/1046, Ur. Number: 238-106-18-1046-4). We considerately acquired duly signed informed consent from each esteemed participant. The study was conducted in accordance with Helsinki Declaration of the World Health Organisation.

Methods

Inclusion criteria were as follows: CLBP of at least 12 weeks duration, CLBP without radiculopathy, not attributable to specific etiology. To obtain homogeneity, additional inclusion criteria encompassed participants aged 40 to 60 years, exhibiting pain intensity of no less than 40 mm on 0-100 visual analogue scale (VAS), alongside with Roland Morris Disability Questionnaire (RMDQ) score of 5 or greater [18].

The criteria for exclusion prescribed that no less than twelve weeks must have elapsed since the conclusion of any recent exercise regimen or physical therapy intervention, notable motor and/or neurologic disorders, sphincter impairment arising from neurological causes, malignancies, osteoporosis with a precedent of fractures, insulin-dependent diabetes mellitus, recent spinal injuries, depression, inflammatory rheumatic diseases and cognitively impaired patients. Patients were permitted to administer non-steroidal anti-inflammatory agents or analgesics (such as acetaminophen or weak opioids) at a consistent dosage throughout the study's duration.

Anthropometric and history data which were obtained were: age (in years), gender (men, women, non-binary), height (in cm), weight (in kg), physical demand level at the workplace (office sitting, easier, heavy), sick leave days during the previous 12 months (even one day), duration of CLBP (in months). Pain assessment was done on the horizontally oriented VAS ranging from 0 (no pain) on the far left-hand side to 100 (severe pain) on the far right-hand side [19].

Pain Catastrophizing Scale (PCS) was used to detect catastrophic thoughts or feelings about pain, and is composed of 13 items on a five-point Likert scale[20, 21]. The total score is the sum of the scores for the individual items and ranges from 0 to 52. An increased score denotes a greater tendency towards pain catastrophizing, with a total exceeding 30 points deemed clinically significant. PCS consists of three subscales: helplessness, rumination, and magnification. It was shown that the helplessness subscale is a key predictor of disability and of the pain intensity itself [22, 23]. The subscale of rumination is associated with disability, whilst magnification is a predictor of the pain intensity [24]. Pain catastrophizing in younger individuals is related to emotional response to pain, and in older individuals, it is positively related to pain intensity [25]. Rumination consists of 4 items (range from 0-16 points), magnification consists of 3 items (range from 0-12 points), and helplessness consists of 6 items (range from 0-24 points) [20, 26]. The Croatian version of the PCS has suitable psychometric properties and is used in clinical practice [27]. The intensity of pain at rest and pain in movement were measured on VAS [19, 28]. Functional disability was determined using the RMDQ, encompassing 24 everyday activities, each scored dichotomously as present (one point) or absent (zero points). A higher total sum indicates greater disability [18]. RMDQ was derived from items in the Sickness Impact Profile (SIP) [29]. RMDQ encompasses esteemed psychometric properties, including reliability, validity, and responsiveness [30, 31].

Statistical analysis

Descriptive analyses were generated and reported in the appropriate metric for continuous and categorical variables. Before choosing statistical methods, the normality of the distributions was tested using the Kolmogorov-Smirnov test. All the variables included in the research showed an asymmetric distribution; therefore, non-parametric tests were applied. The relationship between the RMDQ total score and the PCS was analyzed using the Pearsons correlation test. Determining the statistical significance of the differences between the effects, the Mann-Whitney U test was employed. Descriptive data were presented as medians and quartiles. The level of statistical significance was set at $p < 0.05$. The PSPP v.3 program was used for data analysis.

3. RESULTS

Of total 129 patients 96 (74.42%) were women and 33 (25.58%) males. Median age was 49 years. The average duration of low back pain was 113.7 months. In Table 1, the employment status, professional credentials, marital status, sick leave from work during the episode of CLBP, and employment status of the participants are delineated.

Table 1 Sociodemographic characteristics of participants.

Category	Variable	N	(%)
Working status	Full-time work	114	88.4
	Part-time work	3	2.3
	Unemployed/working from home	8	6.2
	Pensioner	4	3.1
Professional credentials	Unqualified staff	11	8.5
	High school education	93	72.1
	College Education	13	10.1
	Higher vocational education	11	8.5
	Postgraduate university	1	0.8
Marital status	Married/Common-law	110	85.3
	Widower/widow	4	3.1
	Unmarried	10	7.8
	Divorced	5	3.9
Type of work	Office sitting work	35	27.1
	Easier physical work	50	38.8
	Heavy physical work	34	26.4
	Not applicable	10	7.8
Used sick leave	Yes	64	49.61
	No	63	48.84
	Not applicable	2	1.55

The values of the components of pain catastrophizing in three-time assessments are shown in Figure 1. Overall, helplessness was reduced by four points, rumination by three, and magnification by two points in the third assessment compared to the initial one. The total pain catastrophizing was reduced by seven points.

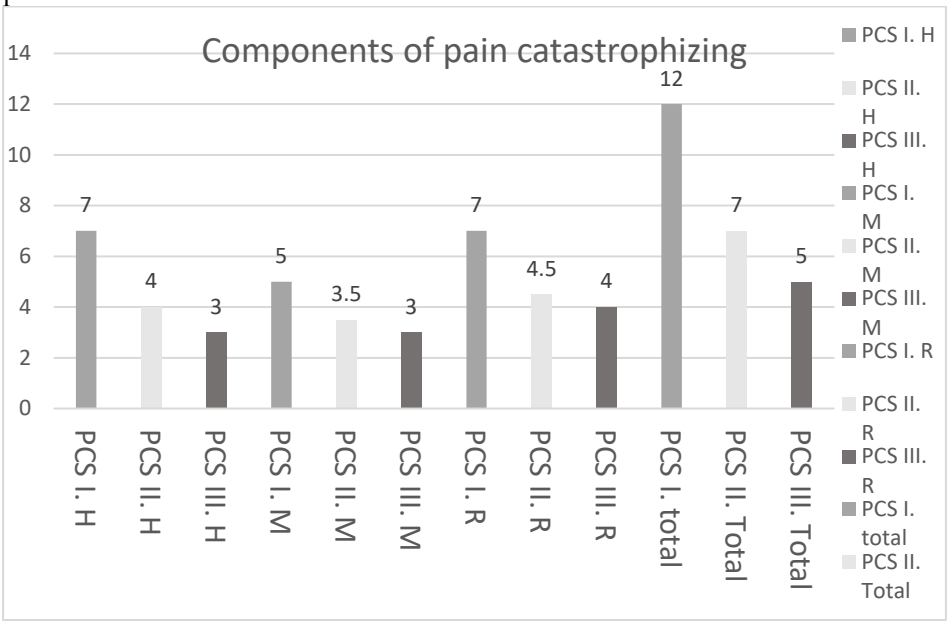

Figure 1. Components of pain catastrophizing in three points of assessment.

Legend: PCSH I. - III. - Pain catastrophizing scale Helplessness, visits I-III; PCSM I. - III. - Pain catastrophizing scale Magnification, visits I-III; PCSR I. - III. - Pain catastrophizing scale Rumination,visits I-III.
PCS total I. – III. - Pain catastrophizing scale total.

A significant association of pain in movement and pain at rest was found in three components of catastrophizing pain in the second and third visit ($p < 0.01$). While in the first visit, pain in movement was associated with helplessness ($p < 0.01$) and rumination ($p < 0.05$), it was not associated with magnification ($p > 0.05$), as well as pain at rest with helplessness and rumination ($p > 0.05$) (Table 2).

Table 2 Association between pain intensity at rest and in movement with subscales of pain catastrophizing in three points of assessment.

Pain in points of assessment	Helplessness	Magnification	Rumination
I Pain in movement	0.292**	0.155	0.179*
I Pain at rest	0.129	0.230**	0.122
II Pain in movement	0.630**	0.459**	0.511**
II Pain at rest	0.519**	0.481**	0.428**
III Pain in movement	0.521**	0.425**	0.483**
III Pain at rest	0.483**	0.465**	0.488**

*Legend: I – first visit, II - second visit, III - third visit, *p < 0.05; **p < 0.01*

Also, the results showed that increasing the score on the RMDQ will also increase the scores on the components of catastrophization ($p < 0.01$) (Table 3).

Table 3 Association between disability and subscales of catastrophization at three points of assessment.

Roland Morris Disability Questionnaire (RMD	Helplessness	Magnification	Rumination
I. visit	0.429**	0.382**	0.400**
II. visit	0.579**	0.503**	0.586**
III. visit	0.526**	0.419**	0.567**

**$p < 0.01$

Regarding taking sick leave due to CLBP, during the study participants who did not take sick leave had statistically significantly lower results on the observed scales in all visits ($p < 0.05$) except for the first visit for the RMDQ (Table 4).

Table 4 Association between the use of sick leave, RMDQ and components of PCS in three points of assessment.

	Sick leave - Median (IS)				
Variable	Yes	No	U	p	R
I Helplessness	8 (5,25-13)	6 (3-8)	1405.000	0.003	0.26
I Magnification	5 (4-7)	4 (2-6)	1460.500	0.007	0.24
I Rumination	8,50 (5-12)	6 (4-9)	1608.500	0.049	0.17
II Helplessness	6 (3-10)	3 (1-5)	1362.500	0.002	0.28
II Magnification	4 (3-6)	3 (2-4)	1278.500	0.000	0.32
II Rumination	6 (3-9)	4 (2-6)	1483.500	0.010	0.23
III Helplessness	4 (1,25-7)	2 (1-4)	1371.500	0.002	0.27
III Magnification	4 (3-6)	3 (2-4)	1272.000	0.000	0.32
III Rumination	5 (2,25-7)	3 (1-5)	1334.000	0.001	0.29
I RMDQ	10 (8-13)	9 (7-13)	1686.000	0.110	/
II RMDQ	7 (4-9)	5 (4-6)	1404.500	0.003	0.26
III RMDQ	5 (3-7)	3 (2-5)	1581.500	0.034	0.19

Legend: I - first visit, II - second visit, III - third visit, U - value Mann-Whitney test, p - significance, r - size effect, IS - interquartile scattering

The results of the assessment of the subscale of catastrophic pain in subjects with up to 25 years of service compared to those with 26 or more years of service were not different ($p > 0.05$) (Table 5).

Table 5 Association between components of PCS with years of service at three points of assessment.

Pain Catastrophizing Scale Components	Years of service / Median (IS)		U	p	R
	≤ 25	≥26			
I Helplessness	7 (4-11)	7 (3-12)	2050.500	0.900	/
I Magnification	4 (2-7)	5 (3-6)	1859.500	0.302	/
I Rumination	7 (4-12)	7 (5-10)	2054.000	0.913	/
II Helplessness	3,5 (1-8)	5 (2-8)	1880.500	0.352	/
II Magnification	3 (2-6)	4 (2-5)	2041.000	0.864	/
II Rumination	4 (2-8.25)	5 (3-8)	1900.00	0.402	/
III Helplessness	2 (1-6)	3 (1-6)	1697.500	0.603	/
III Magnification	3 (2-5.25)	3 (3-5)	2054.500	0.914	/
III Rumination	3 (1-6,25)	4 (2-6)	1879.500	0.349	/

Legend: I - first visit, II - second visit, III - third visit; U - the result of the Mann-Whitney test; p – significance; r - effect size; IS - interquartile scattering

4. DISCUSSION

In our sample of patients with CLBP four weeks of exercise treatment showed a positive impact in terms of reduced catastrophization, pain intensity, and disability. The obtained results indicate that in the assessment of pain catastrophizing, the highest score was assessed in the subscale of helplessness, followed by rumination, and the lowest score in magnification. The total PCS was correlated with disability, in line with the results of Sulivan et al. [21]. Participants who did not use sick leave demonstrated lower pain intensity. Regarding years of service, there was no difference in the assessment of pain intensity in participants who had less than or equal to 25 years compared to those with more than 25 years of service. Secondly, a decline in the catastrophization components continued to be observed at the point of the third visit. This may suggest that physical activity can improve the body's capacity and that patients may view this as a decrease in their sense of helplessness. Thirdly, there was a notable decrease in rumination, with the least improvement in magnification. Because the participants rated magnification the lowest, we can presume that it lost significance here due to great improvement and rumination. Participants in this study were not individuals whose diagnosis of depression was verified by a specialized physician. It is also conceivable that one of the reasons for the favorable outcomes is a reduction in catastrophizing. Additionally, these patients were in the moderate pain category, which could account for the beneficial effect on pain relief. The results of the Meints et al. study suggested that catastrophization may play a role in sensitizing pain in patients with CLBP [32]. Mutubuki et al. showed that the catastrophization of pain and CLBP had a negative correlation with pain intensity and functional disability [33], while Li et al. confirmed a significant positive relationship between the level of pain and the level of pain catastrophizing [34] which is in line with our results. Moreover, in their study, Naugle et al. concluded that greater catastrophization of pain was associated with a smaller effect than result of exercise in healthy subjects [35].

Catastrophizing pain is more pronounced the longer the pain lasts [36]. So, cognitive factors might have less influence on the levels of pain and disability reported by patients undergoing physiotherapy [37]. Ellingsen et al. applied functional magnetic resonance imaging (fMRI) and digital pain drawings, stating that regardless of the type of sensation, the subjects reported the prevalence of pain, and a correlation was found between the prevalence of pain and the catastrophization of pain [38]. Gorczyca et al. demonstrated a clear correlation between catastrophization and the personal experience of pain [39]. Our findings also support the idea that increasing the pain threshold additionally increases the scores on all subscales of the catastrophization state. Timely management of pain can increase neuroplasticity in the brain, fMRI studies reveal increased activity in neural networks [40]. In the study by Mankovsky and al. demonstrated that as functional disability diminished the pain catastrophizing components declined. This is important because patients with current pain catastrophizing show a poor response to medical intervention, in association with various forms of dysfunction, including increased rates of depression and feelings of helplessness in trying to cope with pain, and an increase of various negative effects of pain [41]. Rumination is related to reduced pain tolerance, while magnification is linked to physical health and functionality [42]. In comparison to these studies, we found a moderate relationship between magnification and disability. In their systematic review, Wertly et al. found that a lower level of pain catastrophizing was associated with better outcomes. They concluded that, in the majority of studies, certain degrees of pain catastrophizing and disability have a mediating effect on treatment [2]. Our results are indirectly supporting fMRI-based systematic evaluation which revealed structural alterations in the brains of individuals with severe pain catastrophizing [43]. We are aware, confirmed by the systematic review with meta-analysis by Miyamoto et al., that exercise in very useful in the treatment of CLBP [44]. Our results brings out the additional notion that the decrease in helplessness results from improved functional outcomes and pain relief from therapeutic exercise-induced activity.

The strength of this study is the homogeneity of the studied population, the age of the subjects, from 40 to 60 years of age, when problems with low back pain are frequent. The obtained results contribute to a better scientific understanding of the relationship between pain intensity and pain catastrophizing in patients with CLBP and confirm the usefulness and important role of conducting therapeutic exercises in the treatment of these patients, as well as their effectiveness in reducing pain and pain catastrophizing. Medications couldn't be changed, so our study eliminated the potential confounding effect of medication use that might have influenced the outcomes.

The limitation of our study was that it was a study lasting 12 weeks with a small sample size and limited by geographic area. So, the data's generalizability may be underestimated or overestimated. Even if we satisfied all statistical requirements, the sample size might not be typical of the Croatian community, due to a lack of diversity in the sample population, which limits the generalizability and comprehensive prognostic evidence of our study findings. Considering the duration of 10 sessions in total, it might not be adequate to capture long-term effects of exercise on pain catastrophizing and disability, especially when considering chronic conditions. Although our study recognises PCS as a valuable tool as a part of a comprehensive assessment of patients with CLBP, there might be some reservations that some cultural factors could have influenced how participants interpret and respond to PCS items.

In conclusion, in our study on a sample of employed patients with CLBP, we demonstrated that by reducing the level of pain intensity and disability we also accomplished a reduction in catastrophization, resulting in a considerable effect, signaling the potential effectiveness of the exercise treatment. Also, correlations have been shown between higher PCS scores and the degree of both emotional and physical distress. This

study demonstrates that patients with CLBP may see a decrease in the pain catastrophizing value if they follow a prescribed exercise program. Additionally, therapeutic exercise may have a beneficial effect in lowering pain and disability. So, knowledge of the overall level of pain catastrophizing of individuals, and especially of individual components, can facilitate the way of application and resolution through the intervention of conducting physiotherapy exercises that will possibly be the most effective in promoting pain reduction and functional recovery. From a clinical perspective, the PCS may be useful in identifying individuals with CLBP who are much more sensitive to pain and exhibit particular pain responses. Further research is advised to validate the results of this study.

Supplementary Materials: The following supporting information can be obtained on request.

Author Contributions: Conceptualization, M.B.Š., S.G., J.M.K. and G.H.; methodology, M.B.Š., S.G., J.M.K. and G.H.; software, M.B.Š. and S.G.; validation, M.B.Š., S.G., J.M.K. and G.H.; formal analysis, M.B.Š., S.G., J.M.K. and G.H.; investigation, M.B.Š., S.G., J.M.K. and G.H.; writing-original draft preparation, M.B.Š. and S.G.; writing-review and editing, M.B.Š., S.G., J.M.K. and G.H.; visualization, M.B.Š. and G.H.; supervision, S.G. and J.M.K. All authors have read and agreed to the published version of the manuscript.

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Institutional Review Board Statement: In conformity with the ethical standards, participation in the study was voluntary, and participants were informed about the testing procedure. All participants in the study consented, in written form, to data processing and the scientific use of data. The study was approved by Zagreb County Health Center, Samobor, Croatia Board of the Ethics Committee (Class: 510-14/18-01/1046, Ur. Number: 238-106-18-1046-4) and is in accordance with the Helsinki Declaration..

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study. Written informed consent was obtained from the patients to publish this paper.

Data Availability Statement: Supplementary data available at request.

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