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Predicting Positive and Negative Affect based on Cognitive Flexibility with the Mediating Role of Pain Catastrophizing in Patients with Musculoskeletal Pain

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ABSTRACT

Aims: The purpose of this study was to predict positive and negative affect based on cognitive flexibility with the mediating role of pain catastrophizing in patients with musculoskeletal disorders.

Method and Materials: This study employed a correlational approach using the structural equation method. The population of this study comprised all patients with musculoskeletal disorders in Tehran in 2025. For this purpose, 250 patients with musculoskeletal disorders were selected through convenience and voluntary sampling. Participants completed Watson et al.'s Positive and Negative Affect Questionnaire, Dennis and VanderWal's Cognitive Flexibility Questionnaire, and Sullivan et al.'s Pain Catastrophizing Questionnaire. Data analysis involved correlation and structural equation modeling, conducted using SPSS version 26.

Findings: Results of this study showed that the positive and negative mood affect has a good fit with the mediating role of pain catastrophizing in patients with musculoskeletal disorders. In other words, cognitive flexibility has positive and negative effects on the mediating role of pain catastrophizing in patients with musculoskeletal disorders (P≤ 0.001).

Conclusion: This study showed that the positive and negative mood prediction is based on cognitive flexibility, with the mediating role of pain catastrophizing in patients with musculoskeletal disorders. This structural model will benefit physicians and psychologists in health and clinical settings to which the these patients referred.

Keywords: Positive and Negative Affect, Cognitive Flexibility, Pain Catastrophizing, Musculoskeletal Pain

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Introduction

Pain is an unpleasant experience and a sign of danger that often causes severe or harmful stimuli and can cause a lot of psychological pressure on people. Pain features not only cause pain and discomfort but can also disrupt people's daily planning and affect their quality of life [1]. Musculoskeletal disorders refer to a set of conditions affecting the body's motor system. It includes bones, muscles, joints, ligaments, tendons, and nerves [2]. This type of pain is common and can vary from mild to chronic and debilitating conditions [3]. Indeed, musculoskeletal disorders not only cause physical discomfort but may also affect individual characteristics [4], psychological aspects [5], quality of life [6], and social life. Therefore, paying attention to this indicator and its appropriate management is essential so that people can continue their daily lives and enjoy their activities. The main aspects of emotional experience are emotions such as anxiety, depression, anger, and fear [7].

Research shows that negative affect is associated with increasing severity of pain and disability [8]. Positive affect includes happiness, interests, satisfaction, and hope. Positive affect acts as a psychological coping resource that can improve tolerance and coping with it [9].

People experience these relationships differently, and some may find that positive affect can help reduce the pain effect. Studies consistently indicate that pain intensity is associated with higher negative affect, such as grief, anxiety, and irritability. Positive affect caused a significant

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Increase in positive affect and a significant decrease in negative affect [10].

Cognitive flexibility and pain have an inverse relationship, meaning that with increasing cognitive flexibility, chronic pain decreases and vice versa. Cognitive flexibility refers to a person's ability to change their mental and behavioral patterns in response to a new situation [11]. Positive affect can help people move more easily between different tasks or categories, potentially reducing response conflict and fostering a more flexible approach to resolving conflicts. Cognitive flexibility is very important for coping with chronic pain. Chronic pain patients often need to regulate their daily activities, manage pain attacks, and adapt to constraints [12]. Cognitive flexibility refers to the ability of an individual to change the patterns of thought, to adapt to new situations, and to shift attention from one concept to another. In chronic pain patients, high cognitive flexibility helps the person inhibit negative thoughts related to pain and focus their attention on valuable activities and life despite the existence of pain. Low cognitive flexibility, known as rigidity, is often associated with dry and irreversible thinking patterns, which lead to rumination and scale pain. Cognitive flexibility is very important for coping with chronic pain. Chronic pain patients often need to regulate their daily activities, manage pain attacks, and adapt to constraints [13].

Many people may magnify their pain and find it a disaster that will not improve. Pain catastrophizing is conceptualized as a negative cognitive- emotional response to predicted or actual pain and is associated with many important outcomes associated with pain [14]. The origin of the term catastrophizing (in the clinical setting) refers to Albert Ellis, who believed that catastrophizing is described as a pessimistic forecast of future negative events [15]. Pain catastrophizing refers to a maladaptive cognitive- emotional response in dealing with pain, which includes three main components: magnification or exaggeration in the threat and severity of pain. Helplessness or feeling of inability to manage pain and its consequences, and rumination is a continuous and extreme focus on pain and negative thoughts associated with it [16]. On the other hand, a relationship between pain intensity and pain intensity in experimental and clinical studies, in response to a wide range of medical/ surgical interventions, and in any population with pain that has been studied is reported. Cultural studies show that the relationship between pain intensity and pain is a global problem [17].

Pain and perception have various dimensions. Its important dimensions are behavioral, cognitive, and affective. Mental imagery and metallization of pain can affect the severity and its reduction. There are limited studies in the literature that focus on cognitive elements in pain, such as cognitive flexibility and pain catastrophizing. On the other hand, the presence of positive and negative affect is a new and interdisciplinary variable. Such studies are not carried out either in or within the comprehensiveness that can cover these variables, and this is one of the reasons for this research. In addition, the existence of positive and negative affect and cognitive flexibility in individuals with chronic pain has been confirmed in previous research. Therefore, it suggests that cognitive flexibility can predict positive and negative affect with a mediating role of pain catastrophizing in patients with musculoskeletal pain, and does this model fit?

Method and Materials

The method of this study was practical and, in terms of the descriptive method, employed a correlational approach with the structural equation method. The population of this study comprised all patients with musculoskeletal disorders in Tehran in 2025. Therefore, based on Kline's model [18], 250 patients with musculoskeletal disorders were selected through convenience and voluntary sampling. In this model, the emphasis is always on the sample limitation, which should not exceed 200 people. Inclusion criteria were: being aged 25-65 years, having low back pain, headache, wrist pain, and neck pain for at least 6 months, being a resident of Tehran, and being willing to share their information. The exclusion criteria included: lack of desire to continue contributing at each stage of the study, attending psychosomatic therapy or a

new therapy started in the last two months, abusing drugs or alcohol, which disrupted mental function, and recent or planned surgery. For this purpose, the main researcher consulted the university education center. After necessary coordination with the Department of Education and obtaining permission, the education centers of hospitals or pain clinics (such as Alghadir Pain Hospital, Sadr Clinic, Milad Hospital, and Fakhre-e-Sadegh Pain Physiotherapy Center) were studied. After the necessary coordination, the relevant units were asked to send the questionnaire of the study to the individuals who were referred to and available via text messaging. The main researcher monitored the study. To collect the questionnaires on the PorseLine platform, the main researcher created a new questionnaire after entering it into the system, and, using various features of the question designer, the standard questionnaires were implemented electronically. Finally, by activating the diffusion option, a dedicated questionnaire was provided to the researcher to send to participants so that participants could respond online and at any time and place to the questions. All collected data were stored automatically in the researcher's account and prepared for later stages of statistical analysis In this study, research instruments were as follows:

Demographic Questionnaire: This questionnaire was designed to collect personal information of participants, including age, education, sex, place of residence, type of pain, cause of pain, and socioeconomic status.

Positive and Negative Affect Questionnaire: This questionnaire was constructed by Watson et al [19]. The questionnaire has 20 items to measure positive and negative affect. The answer to each question is graded on a five- point Likert scale (very low to very high). In Watson et al., the internal consistency coefficients were 0.88 for the negative affect subscale and 0.87 for the positive affect subscale. The test-retest validity after eight weeks indicated 0.68 for positive affect and 0.71 for negative affect. In Iran, confirmatory factor analysis was used to examine construct validity. According to the values obtained for the CFI = 0.92 and RMSEA = 0.05, it can be concluded that by deleting six items of positive and negative affect, the two-factor model has a good fit. Cronbach's alpha coefficients for positive affect (0.82) and negative affect (0.77) were reported [20]. In this study, the questionnaire's internal consistency was 0.87, as indicated by Cronbach's alpha.

Cognitive Flexibility Questionnaire: Cognitive flexibility questionnaire designed by Dennis and VanderWal [21]. This questionnaire consisted of 20 items. In Iran, three sub-scales were found for this questionnaire: Alternatives, control, and alternatives to human behaviors. Dennis and VanderWal have shown that the current questionnaire has good convergent and concurrent validity[21]. The concurrent validity of the questionnaire with Beck Depression was -0.39, and the cognitive flexibility scale of Martin and Robin was 0.75, which measured its validity. The reliability of the questionnaire by Cronbach's alpha for the total scale, perceived control-ability, and the perception of different options was 0.91, 0.84, and 0.91, respectively, and by the test-retest method was 0.81, 0.75, and 0.77, respectively. In Iran, Shareh et al. [22] reported a retest coefficient for the whole scale of 0.71 and a Cronbach's alpha coefficient of the whole scale of 0.90. In this study, the questionnaire's internal consistency was 0.83, as indicated by Cronbach's alpha.

- Pain Catastrophizing Questionnaire: This questionnaire was designed by Sullivan et al. [23]. It has 13 items, and the goal is to evaluate the thoughts and behaviors of the patients when dealing with pain (exaggeration, rumination/ despair). The scoring is based on five options (very low = 1 to very high = 5). This questionnaire has two dimensions: exaggeration [1-7] and mental rumination/despair [8 -13]. Higher overall scores represent higher pain intensity in the responder and vice versa. In the study of Sullivan et al., the reliability was obtained by retest and twisted conduction. In Germany, Cronbach's alpha coefficient for the exaggeration was 0.63, for the mental rumination was 0.89, and for despair was 0.83. In Iran, the face and content validity of the questionnaire were measured by experts and professors, and construct validity was assessed using factor analysis. To calculate its reliability, Cronbach's alpha was used, and its

reliability was calculated for all dimensions at 0.70. The reliability was obtained by the test-retest method [24]. In this study, the questionnaire's internal consistency was 0.83, as indicated by Cronbach's alpha.

Findings

Out of 250 patients (22 %), 89 patients (35.6%) had joint pain, 70 (28%) had tendon pain, ligament pain, and 36 (14.4 %) had bone pain. Moreover, 122 (48.8%) were female, and 128 (51%) were male. Table 1 shows the descriptive statistics of research variables. As observed, the mean statistics and standard deviation for each variable are computed. The standard deviation is a descriptive statistic that measures dispersion, showing the average deviation from the mean.

Table 1) Mean, standard deviation of research variables

Variables	Mean	standard deviation
Alternatives	36.68	17.376
Control	32.88	13.786
Alternatives to human behavior	7.96	3.753
Cognitive flexibility	77.52	22.710
Exaggeration	20.96	8.663
Rumination/ despair	15.24	7.579
Pain Catastrophizing	36.20	10.235
Positive affect	30.73	4.135
Negative affect	30.88	4.195

In Table 2, the results of the Pearson correlation test show that the relationship between cognitive flexibility and positive affect is positive and direct, whereas with negative affect it is negative and reverse, statistically significant at the 0.001 alpha level (P=0.001). In addition, there was a significant negative correlation between pain catastrophizing and positive affect (negative and reverse), and a significant positive correlation with negative affect (P=0.001).

Table 2) Correlation matrix between the main variables of research

Main variables	Cognitive flexibility	Pain catastrophizing	Positive affect	Negative affect
Cognitive flexibility	1			
Pain catastrophizing	-0.534**	1		
Positive affect	0.540**	-0.598**	1	
Negative affect	-0.660**	0.568**	0.538**	1

Significance level (*) was found to be significant (**).

In Table 3. The value of (X^2 is 9.818, and the degrees of freedom are 4(P≤ 0.001). The index of (X^2) on degrees of freedom is equal to 2.45. Furthermore, the RMSEA is 0.055, which is acceptable. The Goodness of Fitness Index (GFI), the amended GFI, and the comparative fitness index are equal to 0.985, 0.965, and 0.903. According to these results, the model of positive and negative affect based on cognitive flexibility, with the mediating role of pain catastrophizing, was examined in patients with musculoskeletal pain. According to Figure 1 and Table 3, the model of positive and negative affect based on cognitive flexibility, with pain catastrophizing as a mediator, performs well.

Table 3) The indices of fitness of the model of positive and negative affect based on cognitive flexibility, with the mediating role of pain catastrophizing

Indexes	(X^2)	DF	P	/df²χ	RMSEA	GFI	AGFI	CFI
Present Model	9.98	4	0.001	2.45	0.055	0.986	0.965	0.903
Acceptable amounts			≤ 3	0.05- 0,08	≥ 0.90			

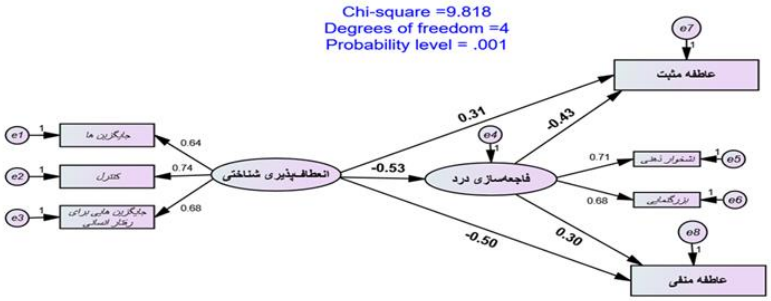

Fig 1) Structural model of positive and negative affect predicted by cognitive flexibility with the mediating role of pain catastrophizing in patients with musculoskeletal pain

Discussion

The purpose of this study was to predict positive and negative affect based on cognitive flexibility with the mediating role of pain catastrophizing in patients with musculoskeletal disorders. The results of this main hypothesis indicated that positive and negative affect, based on cognitive flexibility, fit well with the mediating role of pain catastrophizing in patients with musculoskeletal pain. As a result, the evidence is sufficient to accept the main hypothesis of the research. Based on the results obtained from this research hypothesis, it can be said that the results of this study are consistent with the study of Yuan et al. [25] that pain catastrophizing fully mediates the pathways from emotion regulation to pain experiences, with the study by Alcon et al. [26] that there is a significant relationship between pain catastrophizing and cognitive function in chronic musculoskeletal pain, with Gong et al.'s [27] study showing that pain resilience and pain catastrophizing mediate the relationship between pain intensity and pain-related activity patterns (avoidance and walking) in older adults with chronic musculoskeletal pain, Anagnostopoulos et al. [28] found that catastrophizing and pain intensity are jointly important mediators of the relationship between emotional intelligence and emotion regulation in cancer patients. What distinguishes this study from previous studies is its investigation of the role of emotions in addition to cognitive factors in the perception of pain in cancer patients.

To explain this hypothesis, positive and negative affect in patients with musculoskeletal pain can be predicted and analyzed based on cognitive flexibility, with pain catastrophizing mediating the effect. This model provides a three-part framework for predicting pain severity and disability in chronic musculoskeletal patients; predictor variables (affect and cognitive flexibility) in the form of positive affect, which is predictive [29]. Higher positive affect (joy, hope, contentment) is directly related to higher cognitive flexibility. A happier, more hopeful person is better able to change rigid thought patterns. The path of effect is as follows: high positive affect leads to reduced pain catastrophizing and reduced disability severity caused by pain and illness. In negative affect, higher negative affect (anxiety, depression, anger) is directly related to lower cognitive flexibility [30]. Emotional distress keeps the mind engaged in rumination and negative patterns. The path of effect is such that high negative affect leads to increased pain catastrophizing and increased severity of disability caused by pain and illness. The main role of cognitive flexibility is that it acts as a key cognitive modulator. High flexibility helps a person, even if they are in pain or have a negative mood, to shift their attention away from focusing on pain and return to valuable activities. This ability controls catastrophe.

It can be concluded that the positive and negative mood prediction is based on cognitive flexibility, with the mediating role of pain catastrophizing in patients with musculoskeletal disorders. There is a structural model, and the findings of this study will benefit physicians and psychologists in health and clinical settings. The findings of this study will benefit physicians and health and clinical

psychologists. Inability to control the effects of certain intervening variables, such as participants' identity characteristics and patients' social status. The online sampling method for chronic pain patients was seriously biased in our study. According to the results of the present study, it is recommended that counselors and therapists use self-management and pain education to improve the mental health of patients with musculoskeletal pain. Positive mood and cognitive flexibility training can reduce the intensity of negative reactions and pain catastrophizing that people experience when faced with chronic pain

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Authors' Contribution

The first author contributed to data collection, data analysis, and preparation of the initial draft of the manuscript. The second author supervised the study, contributed to the study design and interpretation of the findings, and critically revised the manuscript. Both authors read and approved the final manuscript.

Conflict of Interest

The authors declare that there is no conflict of interest regarding the publication of this article.

Ethical Permission

The study was approved by the Ethics Committee of Islamic Azad University, Central Tehran Branch (Ethics Code: IR.IAU.CTB.REC.1404.225). All participants provided informed consent before participation in the study**.**

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