



Cognitive Processing Styles and Mindfulness on Pain Intensity Prediction in People with Primary Headache

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Abstract

Background: Primary headaches are the most common cause of absence from work and school and one of the most common reasons for referring to the neurologists.

Objectives: The present study was designed to investigate the relationship of cognitive processing style and mindfulness with pain intensity and the ultimate aim was to provide the role of pain-related cognitive processes and mindfulness in the prediction of headache intensity.

Methods: The study was conducted descriptively by using the correlation method. The statistical population of this study was composed of 85 patients (56 females and 29 males) with one type of primary headache, which were selected through purposive sampling after the diagnosis of a headache by a neurologist at Imam Hossein Hospital in Tehran province. To measure the variables of the study, the numeric pain rating scale (NRS) and the pain-related cognitive processes questionnaire (PCPQ) were used. All data were analyzed using descriptive statistics (frequency and percentages). Bivariate correlation matrix and hierarchical stepwise linear regression statistics were used.

Results: The results showed that there was a significant and negative association between pain intensity (NRS) and mindfulness ($P < 0.01$) and all pain-related cognitive processes, except pain focus ($P < 0.01$). The results of stepwise linear regression indicated that mindfulness only explains 39% of total score changes in pain intensity ($P < 0.05$ and $\Delta F(1 \text{ and } 83) = 53.63$, $\Delta R = 0.385$). Adding cognitive processing styles to the model led to an 18% increase of the explained variance (R^2 change = 0.179). In total, the present research model justifies 54% of the severity of headache variance ($P < 0.01$, $\Delta R = 0.54$).

Conclusions: The results suggest that pain-related cognitive processes and mindfulness are effective on pain intensity prediction. In other words, this result can explain the role of mindfulness and adaptive cognitive processing in primary headache pain management.

Keywords: Headache Pain, Pain-Related Cognitive Processing, Mindfulness

1. Background

Headache pain is a comprehensive problem resulting in immense annual health costs for patients and their families (1). Depending on its intensity, it is followed by different disabilities in patients. Headaches are the most common nervous system disorders. Headache epidemiology indicates that out of every 20 adults, at least one person is affected by headaches, daily (2). There is some scientific evidence demonstrating that converting acute to chronic pain implicates a set of chemical and functional changes in pain perception pathways of the brain (3). Furthermore, there are many matched neurological areas that participate in the neural networks associated with these changes

and cognitive mechanisms (4). Numerous studies have shown that cognitive mechanisms can regulate sensory processes (5). Studies using MRI technology have provided objective evidence for these claims and have proven that sensitive and important pain pathways arise from brain areas deeply linked with cognitive and emotional activities (e.g., the anterior cingulate cortex, thalamus and limbic system). For the first time, Melzack emphasized that this neuromatrix had the ability to control or increase the sensory flow of painful stimuli (6, 7). Several researches have shown that cognitive factors play a prominent role in negative emotions sustainability, maladaptive behavioral reactions, and chronic pain complications (8). Cognitive

content and cognitive processing are often the first issues targeted by cognitive-behavioral treatment (CBT), which is known as first-line treatment of chronic pain over the past decades (9).

To devise a comprehensive model of chronic pain management, an innovative psychological approach re-defined the traditional cognitive approach, according to mindfulness-based principles (10). In the aforementioned model, among factors influencing the variance of pain severity, mindfulness and pain-related cognitive processes can be mentioned (11). The best definition of mindfulness has been proposed by Kabat-Zinn, as follows: "Awareness that emerges by way of paying attention on purpose, in the present moment, and non-judgmentally to the unfolding of experience moment by moment" (12). Based on some research, in individuals with chronic pain, mindfulness is a metacognitive component, which is a significant factor of pain intensity variance (13).

In the third generation, psychotherapy mindfulness brain state is increasingly used in the treatment of chronic pain (14). Another cognitive factor behind chronic pain is cognitive processing. Cognitive processing is referred to as a process including a way of thinking, whereas cognitive content refers to things that we are thinking about (15). Day et al. divided pain-related cognitive processes to four conceptually distinct subsets, including attentional focus or processes during the experience of pain (16). These four categories include; pain diversion, pain distancing, pain focus, and pain openness.

The pain focus processing style contains the method of thinking regarding absorption or attention immersed in pain and more-or-less involuntary attention or rumination to the pain. The pain openness processing contains adaptive attentional processes that indicate an open, non-reactive monitoring and non-judgmental monitoring of the pain sensations. Distraction processing includes attempts to divert attention from the pain. Pain distancing involves attending to the pain sensations, but with a reinterpretation to make it separate or distant from oneself (dissociate) or reinterpreting the pain to be something more positive (reappraisal) (17).

2. Objectives

Based on the aforesaid contents, the aim of the present study was to investigate the relationship of cognitive processing style and mindfulness with pain intensity and the ultimate aim was to provide the role of pain-related cognitive processes and mindfulness in the prediction of headache intensity in a sample of patients with primary headache.

3. Methods

The study was conducted descriptively and was approved by the Ethics Committee of Alborz Islamic Azad University of Medical Sciences.

3.1. Population

The study population was patients with chronic headache, referring to hospitals and clinics of Tehran city, Iran. A sample of 132 patients were selected for the study using a judgment selection method by a neurologist; 38 patients were deleted considering the following inclusion and exclusion criteria. Among those who had the inclusion criteria, four individuals rejected participation, five failed to complete the assessment, and the final sample was reduced to 85 patients, who completed the present research questionnaires for statistical analysis. The goal of the study was explained to these patients, informed consent was obtained, and researchers were committed to protecting the privacy of respondents. Overall, 34% of the subjects were men and 66% were women. The average age in the sample was 37 years.

Study inclusion criteria were: age of 19 years or older; at least three pain days per month (for more than three months) due to a primary headache pain type (i.e., tension-type headache, migraine, trigeminal autonomic cephalalgias, or other) as defined by the international classification of headache disorders, third edition (beta version) (18).

Study exclusion criteria included: history of epilepsy or head and neck neuralgia; cognitive impairment, screened by the mini-mental state examination (MMSE); any history of addiction or headaches caused by intracranial mass or caused by another condition; current participation in other psychological treatments for any pain condition; and affective disorder, schizophrenia, seizure disorder not enough controlled by prescribed medicine.

3.2. Assessments

The mindful attention awareness was assessed using the MAAS scale. According to Schroevers et al. (19), reports, internal consistency of the MAAS was reliable and Cronbach's alpha was 0.82 as well as excellent test-retest reliability that was reported over a one-month time period ($r = 0.81$).

Pain severity was assessed using the numeric rating scale (NRS). This scale assessed pain severity on a 0 (no pain) to 10 (the worst pain imaginable) numeric rating scale (20). Based on this scale, participants evaluated their average pain perception over the past week. The NRS was recommended by IMMPACT and Cronbach's alpha for the NRS was reported as 0.89 (21).

The pain-related cognitive processing was assessed using the pain-related cognitive processes questionnaire (PCPQ). The PCPQ has been developed by Day et al. (16). This questionnaire has 53 questions that measure four composite scales (pain diversion, pain focus, pain distancing, and pain openness) on pain cognitive processing style. Participant's use of a 5-point Likert scale to indicate the degree to which they respond to pain in different ways: Pain diversion, pain distancing, pain focus, and pain openness. The four composite scales were found to have adequate to desirable internal consistency, high values of test-retest reliability and convergent validity (16). Cronbach's alpha was for pain diversion (0.92), pain focus (0.91), pain distancing (0.90), and pain openness (0.78). In this study total number for content validity was 0.79 and Cronbach's alpha was for pain diversion (0.89), pain focus (0.99), pain distancing (0.77), and pain openness (0.87) (16).

3.4. Statistical Analysis

Data were analyzed using SPSS V. 16 software, the normality of data was assessed by Kolmogorov-Smirnov test. In descriptive data analysis, frequency, percentages, mean and standard deviation scores (SDS) were calculated. Pearson correlation analysis and hierarchical linear regression were used in order to distinguish the relationships of the research variables.

4. Results

A total of 85 patients were enrolled in this descriptive study. 65.9% of the subjects were women and 34. % were men with a mean age of 37.24 years. Overall, 45.9% single and 54.1% married individuals with two levels of education, including 37.6% non-academic and 62.4% academic graduate, participated in the study (Table 1).

4.1. Results of Pearson Correlation Analysis

The results of Pearson correlation showed that there was a statistically significant negative relationship between headache pain intensity and mindfulness ($P < 0.01$ and $r = -0.63$), pain diversion ($P < 0.05$ and $r = -0.29$), pain distancing ($P < 0.05$ and $r = -0.25$), pain openness ($P < 0.01$ and $r = -0.55$) and between mindfulness and pain focus ($P < 0.01$ and $r = -0.25$).

Also, there were statistically significant positive relationships between mindfulness and pain openness ($P < 0.01$ and $r = 0.44$), pain diversion and pain openness ($P < 0.05$ and $r = 0.30$) as well as between headache pain intensity and pain focus ($P < 0.01$ and $r = 0.39$) (Table 2).

Table 1. Sociodemographic, Clinical, Pain-Related

Variables	Values ^a , N = 85
Age, y	
Mean \pm SD	37.24 \pm 10.32
Sex	
Male	29 (34.1)
Female	56 (65.9)
Marital status	
Married	46 (54.1)
Unmarried (single, divorced)	39 (45.9)
Educational level	
Academic	53 (62.4)
Non-academic	32 (37.6)
Employment status	
Part or whole employed	34 (40.0)
Retired	11 (12.9)
Homemaker	10 (11.8)
Unemployed due to sickness	6 (7.1)
Clinical characteristics	
Type of headache diagnosis	
Migraine (with or without aura)	32 (37.6)
Tension-types headache	32 (37.6)
Cluster headache	13 (15.3)
Episodic paroxysmal hemicranias	2 (2.4)
Short-lasting unilateral neuralgia form headache attacks	6 (7.1)
Time since first onset of headache, y	
Mean \pm SD	17.33 \pm 4.19

^a Values are expressed as No. (%) unless otherwise indicated.

4.2. Regression Results

Hierarchical linear regression was used in order to determine predictive relations and contribution amount of two variable groups in explaining headache pain intensity. Based on Table 3 and by using the linear regression method, a significant model emerged for mindful awareness: $F(1, 83) = 53.63$, $P < 0.001$. The model explained 38% of the variance (adjusted $R^2 = 0.385$).

Adding cognitive processing styles to model 2, led to an 18% increase of the explained variance (R^2 change = 0.179). In the ultimate model, 0.544 percent of variance explained these two variables ($\Delta R = 0.544$).

Table 4 gives information about the predictor variables entered in the model. Pain intensity can be predicted using the variables of mindful awareness and pain-related cognitive processing components, except pain distancing. In

Table 2. Means, Error Standards and Correlations for Research Variables

	NRS	MAAS	Pain Diversion	Pain Distancing	Pain Focus	Pain Openness
Pain intensity	1.000					
Mindfulness	-0.627**	1.000				
Pain diversion	-0.293**	0.091	1.000			
Pain distancing	-0.252*	0.178	0.117	1.000		
Pain focus	0.398**	-0.251 [†]	-0.021	-0.137	1.000	
Pain openness	-0.558**	0.443**	0.308**	0.160	-0.181	1.000
Mean	5.72	32.91	23.52	18.16	21.17	17.31
SD	1.3	8.04	5.41	4.8	5.43	5.61

Table 3. Model Summary

Model	R	R ²	ΔR	R ² Change	Change Statistics			
					F Change	df1	df2	P Value F Change
1	0.627	0.393	0.385	0.393	53.638	1	83	< 0.001
2	0.756	0.572	0.544	0.179	8.249	4	79	< 0.001

step 2 mindful awareness had relatively higher predictive power than the other variables. The model shows the importance of mindful awareness for pain intensity and discloses the influence of attentional processing on pain. Pain intensity can be predicted using all types of pain-related cognitive processing, except pain distancing. In this case, pain focus has a positive predictive relationship yet pain diversion and pain openness have a negative predictive relationship.

These results indicate that, pain-related cognitive processing in the general collection (pain diversion, pain focus, pain distancing, and pain openness) after control of mindfulness, explains 18 percent of total score changes (R^2 change = 0.179) in patients' pain intensity with primary headache ($P < 0.001$ and $\Delta F(4 \text{ and } 79) = 8.24$, $\Delta R = 0.544$); However, separately in step 2, pain openness ($\beta = -0.267$, $P < 0.001$) and pain focus ($\beta = 0.229$, $P < 0.001$) were partly good predictors of pain intensity.

5. Discussion

Pain is associated with disability (22) and naturally draws one's attention and can disrupt cognitive processing and overcome cognitive content by confiscating the attention of an individual, who experiences pain (23). However, individuals with acute or chronic pain can utilize cognitive coping strategies that refocus attention to alter the experience and its related emotions. Therefore, psychologists emphasize the role of cognitive processing in reducing pain perception and prevention of pain-related disability (24). In addition, in clinical application, mindfulness

meditation can reduce the intensity and frequency of a primary headache with no associated side effects (14).

This study aimed at investigating the role of mindfulness and pain-related cognitive processing, i.e. pain diversion, pain focus, pain distancing, and pain openness, in anticipation of pain perception. The results of the present study indicate that these two variables are predictors of headache intensity. The results also proved that there was a statistically significant and negative relationship between headache pain intensity and mindfulness and the patients, who experienced higher level of mindfulness, concept the pain less than others. In addition, there was a statistically significant and negative relationship between headache pain intensity and pain-related cognitive processing, such as pain diversion, pain distancing, and pain openness except for pain focus.

In conclusion, the results of the current study suggests the role of mindfulness in pain management and points to the important role of mindful awareness in pain control. For example, Day et al. in 2014 (11), Bakhshani et al. in 2015 (25), and Wells et al. in 2014 (26) demonstrated that mindfulness is associated with lower experience of pain as well as the perception of pain intensity. Some other evidence in the literature indicates that mindful awareness is related to pain perception. For example, the findings of Omid and Zargar in 2014 proved that higher levels of mindfulness is associated with lower pain (27).

It seems that low levels of mindfulness plays a major part in observing with judgment and led to defense, resistance to pain and movement towards pain interference with daily activity and more attention to pain. Higher lev-

Table 4. The Unstandardized and Standardized Regression Coefficients for the Variables Entered into the Model of Pain Intensity

Model	Unstandardized Coefficients		Standardized Coefficients	t	P Value
	B	S.E.	Beta		
Step 1					
(Stability)	9.072	0.470		19.314	< 0.001
MAAS	-0.102	0.014	-0.627	-7.324	< 0.001
Step 2					
(Stability)	9.195	0.802		11.460	< 0.001
MAAS	-0.068	0.014	-0.421	-4.995	< 0.001
Pain diversion	-0.038	0.019	-0.158	-2.026	< 0.001
Pain distancing	-0.023	0.020	-0.084	-1.112	> 0.001
Pain focus	0.055	0.018	0.229	2.986	< 0.001
Pain openness	-0.062	0.020	-0.267	-3.087	< 0.001

els of mindfulness are contributing factors in less attention to pain complaints. On the other hand, increasing of mindfulness did not explain how pain plays down.

Theoretically, intervention-based mindfulness for chronic pain particularly by targeting person's relationship to his or her emotions, behaviors and cognitions generates improvement in pain outcomes (27).

Other writers have expressed similar opinions on the subject and they expressed that, changes in cognitive content and cognitive process have an influence on reducing pain (11). Results on pain focus and pain distancing in the current study were in accordance with some researches (28, 29); Seminowicz and Davis study in 2006 suggested that pain perception may be reduced with people's expose to cognitive task processing (28).

Thus, pain-related brain activity can be reduced with cognitive engagement, yet this reduction is modest. Also, findings of Seminowicz et al. showed that cortical brain areas associated with pain can be modulated by cognitive coping strategies taken by patients with chronic pain, affecting pain reduction (29).

In the current study, data indicated that there was a strong and a negative relationship between pain focus on cognitive processing and pain severity. Pain focus strategy works in contrast with pain distraction and similar to our findings, distraction as a coping strategy in chronic pain management is supported by evidence from brain imaging studies (29, 30).

As mentioned earlier, cognitions and emotions are effective in pain perception (31) and, persistently heightened cognitive focus towards negative pain outcome has been proposed as an important factor in the maintenance of chronic pain (32, 33). Parallels can be drawn between the current study and the results of Amini-Fasakhoodi; they

concluded that openness to experience leading to catastrophizing caused a reduction in the fear of movement and pain intensity (34). Furthermore, according to Magyar et al., decreased Openness to pain experience is associated with higher migraine-type headaches (35).

Previous researchers also discovered cognitive processing is associated with pain severity and patients, who focus less on pain and coping with problems with more openness perceived less pain. Thus, the results of this study have potential benefits by comparison with similar studies (14) and it can be argued that patients with an appropriate and adaptive attentional focus during the processing of painful experiences may concept less pain than others.

Therefore, the present study has enriched the understanding of the mechanisms underlying cognitive pain processing and may help explain the influence of cognitive and psychosocial treatment on pain perception. It is recommended to consider and compare cognitive content versus cognitive processing in future researches for more accurate prediction of pain intensity so that it would be easier to control the condition.

The limitations of this study include the lack of a large sample size. Lack of considering other possible factors contributing to pain prediction can also be mentioned.

5.1. Conclusions

The main conclusion to be drawn from the current study is that psychosocial factors, such as cognitive processing and mindful awareness, are involved in headache pain. The results suggest that pain-related cognitive processes and mindfulness are effective on pain intensity prediction. In another words, this result can explain the role of mindfulness and adaptive cognitive processing in primary headache pain management.

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Footnote

Ethical Considerations: The study has been conducted descriptively and was approved by the Ethics Committee of Alborz Islamic Azad University of Medical Sciences. Ethics Committee reference number: IR.IAU.K.REC.1397.26

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