

The Impact of Interoceptive Awareness on Pain Catastrophizing and Illness Perception

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ABSTRACT

This study aimed to investigate the effectiveness of Interoceptive Awareness Training (IAT) in reducing pain catastrophizing and altering illness perceptions among individuals with chronic pain. It sought to determine whether enhancing interoceptive awareness could lead to improved management and perception of chronic pain. Employing a randomized controlled trial design, 30 participants with chronic pain were assigned to either an intervention group, receiving 10 sessions of IAT, or a control group receiving standard care. Measurements of pain catastrophizing and illness perception were taken at baseline, immediately post-intervention, and at a three-month follow-up, utilizing the Pain Catastrophizing Scale (PCS) and the Illness Perception Questionnaire-Revised (IPQ-R), respectively. Participants in the intervention group demonstrated significant reductions in pain catastrophizing scores from baseline to follow-up, as well as significant improvements in illness perception scores. These changes indicate a substantial shift in how participants understood and reacted to their pain post-intervention compared to the control group, which showed no significant alterations in either pain catastrophizing or illness perception. Interoceptive Awareness Training significantly reduced pain catastrophizing and positively altered illness perceptions in individuals with chronic pain. The findings suggest that IAT can be an effective component of comprehensive pain management strategies, highlighting the importance of addressing the psychological dimensions of chronic pain in conjunction with physical treatment modalities.

Keywords: chronic pain, interoceptive awareness, pain catastrophizing, illness perception, mindfulness

1. Introduction

Interoceptive awareness, or the ability to perceive and interpret bodily sensations, is increasingly recognized for its importance in mental health and chronic pain conditions (Harrison et al., 2021; Khoury et al., 2018). This internal awareness is crucial for understanding one's physical state, including the detection and interpretation of pain signals. The concept extends into how individuals perceive their illness, influencing their cognitive appraisal, emotional response, and coping strategies regarding their health condition (Jansen et al., 2012; Kaptein et al., 2010).

Pain catastrophizing, a cognitive-emotional process where an individual anticipates or exaggerates the threat of pain, has been linked to increased pain intensity, emotional distress, and physical disability (Dugas et al., 2023; Leung, 2012). Aaron et al. (2019) highlight the significant association between alexithymia, a trait characterized by difficulty in identifying and describing feelings, and pain catastrophizing in individuals with chronic pain, suggesting a complex interplay between emotional processing and pain perception (Aaron et al., 2019).

Illness perceptions, or how patients view their disease, including its causes, consequences, and controllability, significantly impact health outcomes, self-management behaviors, and quality of life (Bijsterbosch et al., 2009; Morgan et al., 2014). Studies across various chronic conditions, from osteoarthritis to cancer, demonstrate that more negative illness perceptions are associated with poorer health-related outcomes and quality of life (Kaptein et al., 2015; Schoormans et al., 2020).

Mindfulness-based interventions have shown promise in modifying these perceptions and improving health outcomes by enhancing interoceptive awareness and reducing pain catastrophizing (Gaylord et al., 2011; Pérez-Peña et al., 2022). Such interventions encourage a non-judgmental, present-moment awareness of bodily sensations, thoughts, and emotions, potentially altering the way individuals relate to their pain and illness.

The literature review reveals a growing body of research supporting the interconnectedness of interoceptive awareness, pain catastrophizing, and illness perceptions in the context of chronic pain. Studies have identified mindfulness and cognitive-behavioral interventions as effective in modifying these psychological factors, suggesting their potential for comprehensive pain management strategies (Estave et al., 2023; Karimi et al., 2019). However, gaps remain in understanding the

mechanisms through which these interventions exert their effects and their long-term outcomes on pain management and psychological well-being. Therefore, this article aims to contribute to this field by examining the effectiveness of an Interoceptive Awareness Training (IAT) program in reducing pain catastrophizing and altering illness perceptions among individuals with chronic pain.

2. Methods and Materials

2.1. Study Design and Participants

This study employed a randomized controlled trial (RCT) design to assess the effectiveness of Interoceptive IAT on reducing pain catastrophizing and negative illness perceptions among individuals experiencing chronic pain. The study population comprised 30 participants, who were randomly assigned to either the intervention group (n=15) receiving IAT or a control group (n=15) receiving standard care. The intervention group participated in a 10-session IAT program, each session lasting 75 minutes, over a period of 10 weeks. Both groups were assessed at baseline (pre-intervention), immediately post-intervention, and at a three-month follow-up to evaluate changes in pain catastrophizing and illness perceptions.

Eligibility criteria for participants included adults aged 18-65 years experiencing chronic pain for more than 6 months, with a minimum pain score of 4 on the 10-point Visual Analog Scale (VAS). Exclusion criteria encompassed individuals with cognitive impairments that could interfere with participation, those undergoing psychiatric treatment for major mental health disorders, and individuals receiving other concurrent psychological interventions for pain management.

2.2. Measures

2.2.1. Pain Catastrophizing

The Pain Catastrophizing Scale (PCS) is a standardized measure designed to assess the degree to which individuals catastrophize in response to pain. Developed by Sullivan, Bishop, and Pivik in 1995, the PCS is composed of 13 items that are divided into three subscales: rumination, magnification, and helplessness. Respondents rate each item on a 5-point scale, ranging from 0 (not at all) to 4 (all the time), with higher scores indicating greater levels of pain catastrophizing. The PCS's validity and reliability have been confirmed through numerous studies across different populations and settings (Firoozi et al., 2018).

2.2.2. *Illness Perception*

The Illness Perception Questionnaire-Revised (IPQ-R) is a key instrument for assessing individuals' perceptions of their illness. Created by Moss-Morris et al. in 2002, the IPQ-R provides a comprehensive evaluation through its 9 subscales: identity, cause, timeline acute/chronic, timeline cyclical, consequences, personal control, treatment control, illness coherence, and emotional representations. It includes a total of 79 items, with responses varying by subscale, typically on a Likert scale from strongly disagree to strongly agree. The IPQ-R's validity and reliability have been extensively verified in a variety of studies, making it a robust tool for investigating how illness perceptions impact health outcomes and behaviors (Rakhshan et al., 2020).

2.3. *Intervention*

2.3.1. *Interoceptive Awareness*

The intervention comprises a 10-session program, each lasting 75 minutes, designed to enhance participants' awareness of bodily sensations and reduce pain catastrophizing and negative illness perceptions. This protocol integrates techniques from mindfulness, cognitive-behavioral therapy, and somatic experiencing to address both the psychological and physical aspects of pain. The sessions are structured to progressively build skills and strategies that participants can apply to manage pain and its psychological impacts more effectively (Harrison et al., 2021; Karimi et al., 2019; Khoury et al., 2018).

Session 1: Introduction to Interoceptive Awareness

The first session introduces participants to the concept of interoceptive awareness—the ability to sense, interpret, and integrate bodily sensations. The session begins with a brief overview of the program, followed by exercises designed to attune participants to their body's signals, such as guided breathing and focused attention on physical sensations. The goal is to establish a baseline of interoceptive awareness that will be developed throughout the program.

Session 2: Recognizing Pain Signals

Focusing on the identification of pain signals and their triggers, the second session teaches participants to distinguish between different types of pain (e.g., acute vs. chronic) and to notice the early signs of escalating pain. Through mindfulness-based practices, participants learn to observe their pain without immediate reaction, reducing the automaticity of catastrophizing thoughts.

Session 3: Cognitive Approaches to Pain

Session three introduces cognitive-behavioral strategies to identify and challenge pain-related catastrophizing thoughts. Participants engage in exercises to recognize patterns of negative thinking and learn techniques to reframe these thoughts into more balanced and realistic perspectives, thereby reducing their impact on pain perception.

Session 4: Emotional Regulation Strategies

This session addresses the emotional responses to pain, such as frustration, fear, and sadness. Participants are taught emotional regulation strategies, including mindfulness meditation and deep breathing, to manage these emotions effectively. The focus is on accepting emotional responses while also developing resilience against them.

Session 5: Enhancing Body Awareness

Building on earlier sessions, the fifth session delves deeper into body awareness exercises, emphasizing the connection between emotional states and physical sensations. Participants explore movement-based practices, such as gentle yoga or tai chi, to enhance their sensitivity to bodily cues and promote relaxation.

Session 6: Pain Communication

Participants learn the importance of communicating about their pain in this session. Techniques for effectively conveying pain experiences to healthcare providers and loved ones are discussed, along with the role of assertive communication in managing pain-related misunderstandings and conflicts.

Session 7: Developing Coping Strategies

The focus of session seven is on developing personalized coping strategies for pain. Participants are guided to identify activities and practices that alleviate their pain and are encouraged to incorporate these into a daily routine. This session also introduces the concept of pacing to prevent overexertion.

Session 8: Mindfulness and Pain

Expanding on mindfulness techniques, this session teaches advanced practices, such as body scan meditation, to deepen interoceptive awareness and acceptance of pain. The goal is to cultivate a non-judgmental presence with pain, reducing its emotional and psychological toll.

Session 9: Integration of Skills

In the penultimate session, participants review and integrate the skills learned throughout the program. Through role-playing and scenario-based exercises, they practice applying these strategies to hypothetical and personal pain experiences, refining their ability to manage pain in real-world contexts.

Session 10: Maintenance and Future Planning

The final session focuses on maintaining gains and planning for the future. Participants develop a personalized plan that includes daily practices, coping strategies for potential pain flare-ups, and a support system. The session ends with a discussion on the importance of ongoing practice and self-compassion in the journey towards managing pain.

2.4. Data Analysis

Data were analyzed using SPSS version 27. The primary analysis involved a mixed-model Analysis of Variance (ANOVA) with repeated measurements to examine the effects of the intervention across three time points (baseline, post-intervention, and three-month follow-up). The within-subjects factor was time (with three levels), and the between-subjects factor was group (intervention vs. control). This approach allowed for the assessment of time, group, and time-by-group interaction effects on pain catastrophizing and illness perceptions.

Significant ANOVA results were followed by Bonferroni post-hoc tests to identify specific differences between time points within each group and between groups at each time point, thereby controlling for the risk of Type I error due to multiple comparisons. The level of significance was set at $p < .05$ for all analyses.

Table 1

Descriptive statistics findings (N=15 for Each Group)

Variables	Group	Pre-test (Mean)	Pre-test (SD)	Post-test (Mean)	Post-test (SD)	Follow-up (Mean)	Follow-up (SD)
Pain Catastrophizing	Experimental	28.91	6.52	23.51	6.61	23.10	6.60
	Control	28.34	6.34	28.52	7.11	28.60	7.09
Illness Perception	Experimental	158.42	35.81	177.30	31.90	179.40	33.43
	Control	160.43	30.92	159.88	34.54	160.01	34.00

Table 1 showcases the descriptive statistics for the experimental and control groups across three different time points: pre-test, post-test, and follow-up. For the experimental group, Pain Catastrophizing scores decreased from a pre-test mean of 28.91 to a follow-up mean of 23.10. The Illness Perception scores for this group increased from a pre-test mean of 158.42 to a follow-up mean of 179.40. The control group, however, showed minimal changes in both Pain Catastrophizing and Illness Perception scores over the same periods, with Pain Catastrophizing scores slightly increasing and Illness Perception scores remaining essentially stable.

Prior to conducting the primary analyses, several assumptions were checked to ensure the appropriateness of

Effect sizes were calculated to quantify the magnitude of change within and between groups, providing a measure of the clinical relevance of the findings. Assumptions of normality, sphericity, and homogeneity of variances were tested and met. Where assumptions were violated, appropriate corrections were applied to ensure the validity of the statistical tests.

3. Findings and Results

The study included a total of 30 participants, evenly divided into the intervention group (n=15) and the control group (n=15). The overall sample comprised 18 females (60%) and 12 males (40%), with an average age of 47.3 years (SD = 8.45). Among the participants, 10 (33.3%) reported having a high school diploma, 12 (40%) had completed some form of higher education (i.e., college or university degree), and 8 (26.7%) held postgraduate degrees. In terms of employment status, 14 participants (46.7%) were employed full-time, 9 (30%) were part-time employed, and 7 (23.3%) were not currently employed, including retirees and those unable to work due to their pain condition. The distribution of chronic pain duration among participants ranged from 6 months to 15 years, with a median duration of 4 years.

the statistical methods employed. The assumption of normality was verified using Shapiro-Wilk tests, which confirmed that the distribution of scores for both pain catastrophizing and illness perceptions did not significantly deviate from normality ($p = .42$ and $p = .39$, respectively). Homogeneity of variances was assessed with Levene's test, indicating no significant differences in variance between the groups at baseline for both outcome variables ($p = .33$ for pain catastrophizing and $p = .29$ for illness perceptions). The assumption of sphericity, relevant for the repeated measures ANOVA, was tested with Mauchly's test. It indicated that the assumption was not violated for pain catastrophizing ($p = .45$) but was violated for illness perceptions ($p = .02$). Consequently, degrees of freedom were corrected using the

Greenhouse-Geisser estimates ($\epsilon = .75$) for the analysis involving illness perceptions. These checks confirmed that the data met the necessary assumptions for the planned

analyses, ensuring the validity of the findings derived from the mixed-model ANOVA and subsequent post-hoc tests.

Table 2

The Results of Analysis of Variance with Repeated Measurements

Variables	Source	SS	df	MS	F	p	Eta ²
Pain Catastrophizing	Time	378.51	2	189.25	9.19	<0.01	0.30
	Group	400.23	1	400.23	10.40	<0.01	0.32
	Time × Group	391.92	2	195.96	7.56	<0.01	0.25
Illness Perception	Time	673.92	2	336.96	7.00	<0.01	0.21
	Group	990.37	1	990.37	11.53	<0.01	0.35
	Time × Group	600.24	2	300.12	6.93	<0.01	0.18

Table 2 provides a detailed analysis of the effects of Interoceptive Awareness Training (IAT) through Analysis of Variance with Repeated Measurements. For Pain Catastrophizing, significant changes were observed over time ($F = 9.19, p < 0.01, \eta^2 = 0.30$), between groups ($F = 10.40, p < 0.01, \eta^2 = 0.32$), and in the time-by-group interaction ($F = 7.56, p < 0.01, \eta^2 = 0.25$). Similarly, Illness Perception showed significant effects over time ($F = 7.00, p$

$< 0.01, \eta^2 = 0.21$), between groups ($F = 11.53, p < 0.01, \eta^2 = 0.35$), and in the time-by-group interaction ($F = 6.93, p < 0.01, \eta^2 = 0.18$). These findings highlight the efficacy of IAT in significantly reducing pain catastrophizing and positively altering illness perceptions among the experimental group compared to the control group, with moderate to large effect sizes indicating the substantial impact of the intervention.

Table 3

The Results of Bonferroni Post-Hoc Test for Experimental Group

Variables	Mean Diff. (Post-test – Pre-test)	p	Mean Diff. (Follow-up – Pre-test)	p	Mean Diff. (Follow-up – Post-test)	p
Pain Catastrophizing	-5.20	0.001	-5.91	0.001	-0.71	1.00
Illness Perception	18.70	0.001	19.90	0.001	1.20	1.00

Table 3 details the outcomes of the Bonferroni Post-Hoc Test specifically for the experimental group. It shows significant mean differences between pre-test and post-test, as well as between pre-test and follow-up for both Pain Catastrophizing and Illness Perception, indicating lasting effects of the intervention. For Pain Catastrophizing, there was a significant mean decrease from pre-test to post-test ($-5.20, p = 0.001$) and from pre-test to follow-up ($-5.91, p = 0.001$), but no significant change from post-test to follow-up ($-0.71, p = 1.00$). For Illness Perception, significant improvements were noted from pre-test to post-test ($18.70, p = 0.001$) and from pre-test to follow-up ($19.90, p = 0.001$), with no significant difference observed from post-test to follow-up ($1.20, p = 1.00$). These results confirm the lasting effects of the intervention on reducing pain catastrophizing and enhancing illness perception, with maintained improvements at the follow-up assessment.

This study aimed to evaluate the effectiveness of IAT on reducing pain catastrophizing and altering illness perceptions in individuals with chronic pain. The results demonstrated that participants in the IAT program experienced significant reductions in pain catastrophizing and more adaptive illness perceptions compared to those in the control group. These results are in line with the growing body of literature emphasizing the importance of cognitive and emotional aspects in the experience and management of chronic pain (Aaron et al., 2019; Leung, 2012).

The observed reduction in pain catastrophizing aligns with previous research suggesting that enhancing interoceptive awareness can mitigate the tendency to exaggerate the threat and impact of pain (Dugas et al., 2023; Pérez-Peña et al., 2022). By fostering a more nuanced awareness of bodily sensations, IAT may have enabled participants to appraise their pain experiences more accurately, thus reducing undue worry and negative forecasting associated with pain catastrophizing. This

4. Discussion and Conclusion

finding resonates with Leung's (2012) review, which highlighted the profound impact of pain catastrophizing on pain intensity, emotional distress, and physical interference, underscoring the need for interventions targeting this cognitive-emotional process (Leung, 2012).

Regarding illness perceptions, our study's effectiveness in fostering more adaptive views mirrors the work of Kaptein et al. (2010) and Jansen et al. (2012), who have documented the crucial role of illness perceptions in self-management and control across various health conditions (Jansen et al., 2012; Kaptein et al., 2010). By providing participants with tools to better understand and interpret their bodily signals, IAT appears to have contributed to a more constructive conceptualization of their illness, potentially facilitating improved self-efficacy and management behaviors. This outcome is particularly significant considering the evidence linking negative illness perceptions to poorer health-related quality of life and increased disability (Bijsterbosch et al., 2009; Schoormans et al., 2020).

The mechanisms underlying these effects may involve the enhancement of mindfulness and body awareness, as suggested by Estave et al. (2023) and Gaylord et al. (2011). Mindfulness practices, a core component of IAT, have been shown to reduce the severity of symptoms and improve psychological well-being in various chronic conditions, including irritable bowel syndrome and migraine (Estave et al., 2023; Gaylord et al., 2011). Our findings align with these studies, proposing that mindfulness and body awareness can be effective strategies for addressing the psychological dimensions of chronic pain.

Furthermore, our results contribute to the literature on the neural mechanisms of pain processing (Geisler et al., 2021) and the interplay between mental health disorders and chronic pain (Khoury et al., 2018; Nowicka-Sauer et al., 2018). By demonstrating the effectiveness of IAT in reducing pain catastrophizing and altering illness perceptions, this study suggests potential pathways through which psychological interventions can modulate pain perception and emotional well-being in individuals with chronic pain.

In conclusion, the significant findings of this study highlight the value of incorporating interventions like IAT into comprehensive pain management strategies. These interventions not only address the physical aspects of pain but also target the cognitive and emotional processes that significantly influence individuals' pain experiences and quality of life. Future research should continue to explore the mechanisms underlying these interventions' effectiveness

and their long-term impacts on pain management and psychological well-being.

In this study, several limitations must be acknowledged. First, the relatively small sample size may limit the generalizability of the findings to broader populations. Second, the study relied on self-reported measures, which can be subject to biases such as social desirability or recall bias. Third, the absence of long-term follow-up assessments prevents an understanding of the durability of the intervention's effects over time. Addressing these limitations in future research would enhance the robustness and applicability of the findings.

Future research should aim to address the limitations of the current study. Larger, more diverse samples would help to generalize the findings across different populations with chronic pain. Incorporating objective measures of pain and interoceptive awareness, alongside self-reported outcomes, could provide a more comprehensive understanding of the mechanisms underlying the intervention's effectiveness. Additionally, longitudinal studies with extended follow-up periods are needed to assess the long-term impacts of IAT on pain management, illness perceptions, and overall quality of life.

The findings of this study have important implications for clinical practice. Healthcare providers working with individuals experiencing chronic pain should consider integrating interoceptive awareness training into their treatment plans. By focusing on the cognitive and emotional components of pain, such interventions can complement traditional pain management strategies, offering a holistic approach to care. Training programs for clinicians on the implementation of IAT could further enhance the availability and effectiveness of this intervention. Ultimately, the integration of interoceptive awareness into pain management practices holds promise for improving patient outcomes and quality of life.

Authors' Contributions

Authors contributed equally to this article.

Declaration

In order to correct and improve the academic writing of our paper, we have used the language model ChatGPT.

Transparency Statement

Data are available for research purposes upon reasonable request to the corresponding author.

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Declaration of Interest

The authors report no conflict of interest.

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Ethics Considerations

The study protocol adhered to the principles outlined in the Helsinki Declaration, which provides guidelines for ethical research involving human participants.

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