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Cognitive Reappraisal as a Mechanism of Change: How Mindfulness-Based Stress Reduction Reduces Anxiety Sensitivity in Young Men

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Original Research

Abstract

Although Mindfulness-Based Stress Reduction (MBSR) has been shown to effectively reduce anxiety symptoms, the specific psychological mechanisms underlying this change require further investigation. The present study sought to determine whether MBSR can reduce anxiety sensitivity in young men by enhancing cognitive reappraisal. Using a quasi-experimental design with pre-test and post-test assessments and a waitlist control group,

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thirty male university students were selected through purposive sampling and randomly assigned to two groups. The experimental group received an eight-session MBSR intervention consisting of weekly 90-minute sessions. All participants completed the Anxiety Sensitivity Index--Revised (ASI-R) and the Emotion Regulation Questionnaire (ERQ). Multivariate analysis of covariance indicated that, compared to the control group, the experimental group showed significant reductions in physical and cognitive concerns related to anxiety sensitivity, as well as a significant increase in cognitive reappraisal. Mediation analysis further demonstrated that cognitive reappraisal functioned as a key mechanism explaining how the MBSR intervention reduced cognitive anxiety concerns. These findings suggest that incorporating cognitive reappraisal strategies into mindfulness-based interventions may enhance outcomes related to anxiety-related cognitive processes in young men.

*Keywords***:** anxiety sensitivity, emotion regulation, mindfulness-based stress reduction

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Introduction

Anxiety disorders represent a significant global mental health challenge, particularly among university students who face unique academic and social pressures (Mofatteh, 2020; Rastogi et al., 2025). Within this context, anxiety sensitivity (AS)—defined as the fear of anxiety-related sensations arising from beliefs about their harmful consequences (Taylor, 2019)—has emerged as a crucial cognitive vulnerability factor. As a key transdiagnostic construct, AS plays a fundamental role in the development and maintenance of various anxiety disorders (Im & Kahler, 2022). This clinical focus on shared mechanisms is supported by empirical evidence showing that processes like experiential avoidance simultaneously underlie multiple conditions (Eustis et al., 2020; Wang et al., 2024)—an approach that is especially relevant given the high comorbidity observed in clinical populations (Krueger & Eaton, 2015).

Contemporary models conceptualize anxiety sensitivity as a multidimensional phenomenon comprising three distinct domains: physical concerns (fear of bodily sensations), cognitive concerns (fear of mental incapacitation), and social concerns (fear of publicly observable anxiety symptoms). This multidimensional structure aligns with modern dimensional approaches to psychopathology, such as the Hierarchical Taxonomy of Psychopathology (HiTOP), which organizes psychological symptoms empirically based on their covariation, moving beyond traditional categorical diagnoses (Kotov et al., 2022; Conway et al., 2022). The cognitive concerns dimension of anxiety sensitivity, characterized by fears of losing mental control and cognitive dysregulation, represents a particularly important target for intervention as it directly influences how individuals interpret and respond to internal cognitive events. These cognitive dysfunctions are not specific to anxiety but represent core transdiagnostic mechanisms across mental disorders (Gkintoni et al., 2025).

Recent evidence suggests that anxiety sensitivity manifests differently across gender groups. While women generally report higher overall levels of AS (Al-Heqili et al., 2025), male populations, especially university students, demonstrate distinct patterns in anxiety expression and help-seeking behaviors that often lead to underdiagnosis and untreated psychological distress (Rastogi et al., 2025). In the Iranian cultural context, masculine norms emphasizing self-reliance and emotional control can create significant barriers to mental health help-seeking among men (Mohsenabadi et al., 2025). This is particularly relevant given that male students frequently encounter academic stressors that may specifically amplify cognitive concerns about mental incapacitation (Zhang & Zhao, 2024). The performance-oriented nature of academic challenges appears to particularly exacerbate fears related to mental dysfunction and loss of cognitive control (Khakpoor et al., 2019), creating a compelling need for targeted interventions in this population.

Mindfulness-Based Stress Reduction (MBSR) has demonstrated efficacy in addressing anxiety-related conditions across diverse populations (Boğahan et al., 2025; Moghadam et al., 2025). This structured program cultivates non-judgmental awareness of present-moment experiences through systematic training in formal meditation practices and informal mindfulness exercises. Theoretical frameworks suggest that mindfulness training enhances metacognitive awareness and cognitive flexibility (Qu et al., 2022). A key proposed mechanism through which MBSR may exert its beneficial effects involves the enhancement of cognitive reappraisal—the reinterpretation of emotional stimuli to modify their psychological impact (Gross & Jazaieri, 2014).

This proposed mechanism is supported by emerging evidence. Research demonstrates that long-term mindfulness practice fosters a distinct cognitive-affective profile characterized by enhanced cognitive flexibility and the decoupling of affective processes (Gkintoni et al., 2025)—neurocognitive changes that conceptually parallel the process of cognitive reappraisal. These findings suggest that mindfulness training may directly target the core of cognitive anxiety concerns by strengthening the cognitive control systems that facilitate a reappraisal of threatening internal events. The development of mindful awareness may enable individuals to reappraise threatening cognitions as transient mental events rather than objective truths (Brockman et al., 2017), thereby diminishing their perceived threatening quality. Although theoretical models have proposed connections between mindfulness practice and enhanced reappraisal capacity (Jamieson et al., 2022), empirical investigation of the specific mediating role of cognitive reappraisal in the relationship between MBSR and anxiety sensitivity reduction remains limited (Xie et al., 2023).

Despite substantial evidence supporting MBSR's efficacy in anxiety reduction, several critical gaps persist in the current literature. First, few studies have examined the specific effects of MBSR on distinct anxiety sensitivity subscales in non-clinical populations, with a particular scarcity of research regarding the cognitive concerns dimension. Second, research focusing exclusively on male university students remains limited, especially within Iran's unique cultural context. While domestic studies have shown the general effectiveness of mindfulness-based interventions on anxiety in Iranian samples (e.g., Tabatabaeian et al., 2024; Bavi et al., 2025), none to date has specifically investigated the mechanism of cognitive reappraisal in reducing anxiety sensitivity, particularly cognitive concerns, in Iranian male students. Third, and most importantly, the psychological mechanisms underlying MBSR's effects on anxiety sensitivity—specifically the potential mediating role of cognitive reappraisal—require empirical clarification. While the mediating role of threat reappraisal has been systematically investigated within Cognitive-Behavioral Therapy (CBT) for anxiety disorders, evidence for its causal role remains inconclusive (Smits et al., 2012). This gap in the CBT literature underscores the

need to rigorously test whether cognitive reappraisal serves as a fundamental active ingredient in mindfulness-based interventions like MBSR.

The present study addresses these research gaps by examining the effects of an eight-week MBSR program on anxiety sensitivity and emotion regulation strategies among male Iranian university students, with particular emphasis on testing cognitive reappraisal as a mechanism of change. We hypothesized that compared to a waitlist control group, participants in the MBSR program would demonstrate: (1) significant reductions in anxiety sensitivity, particularly in cognitive and physical concerns; (2) significant increases in cognitive reappraisal, but not necessarily in expressive suppression; and (3) that an increase in cognitive reappraisal would statistically mediate the effect of MBSR participation on reductions in anxiety sensitivity, specifically cognitive concerns. By investigating this mechanistic pathway in an understudied cultural population, this research aims to advance our understanding of how mindfulness training produces its beneficial effects, potentially informing the development of more targeted and effective anxiety prevention interventions in Iranian educational settings.

Method

This quasi-experimental study employed a pretest-posttest control group design to examine cognitive reappraisal as a mechanism of change in Mindfulness-Based Stress Reduction (MBSR) for reducing anxiety sensitivity. The study focused on male undergraduate students at Mashhad University of Medical Sciences during the 2024-2025 academic year. The rationale for exclusively studying male students aged 18-25 years was based on evidence indicating distinct patterns of anxiety expression and significant barriers to mental health help-seeking in this demographic, particularly within the Iranian cultural context where masculine norms often discourage emotional disclosure and professional help-seeking.

From an initial pool of 78 students, 30 participants were selected based on inclusion criteria including: male gender, age 18-25 years, Perceived Stress Scale-10 (PSS-10) score ≥15 (Cohen, 1988), no major psychiatric diagnosis, and no current psychotropic medication use. A power analysis using G*Power software indicated that 28 participants were required to detect medium-to-large effects ($f = 0.40$, $\alpha = 0.05$, power = 0.80). The final sample of 30 participants exceeded this requirement and was randomly assigned to the intervention (n=15) or waitlist control (n=15) groups using a random number generator. The final sample had a mean age of 21.4 years (SD = 1.8).

Anxiety Sensitivity Inventory-Revised (ASI-R): The ASI-R (Taylor & Cox, 1998) is a 36-item self-report measure that assesses fear of anxiety-related sensations across three domains: physical concerns (e.g., "It scares me when I become short of breath"), cognitive concerns (e.g., "When I have trouble concentrating, I worry that there is something wrong

with me"), and social concerns (e.g., "It is important for me not to appear nervous"). Items are rated on a 5-point Likert scale ranging from 0 (very little) to 4 (very much), with higher scores indicating greater anxiety sensitivity. The original scale demonstrated excellent reliability (α = 0.92), and in the current study, Cronbach's alpha was 0.92 for the total scale.

Emotion Regulation Questionnaire (ERQ): The ERQ (Gross & John, 2003) is a 10-item measure assessing two emotion regulation strategies: cognitive reappraisal (6 items; e.g., "I control my emotions by changing the way I think about the situation I'm in") and expressive suppression (4 items; e.g., "I control my emotions by not expressing them"). Items are rated on a 7-point Likert scale from 1 (strongly disagree) to 7 (strongly agree), with higher subscale scores indicating greater use of each strategy. The original study reported adequate reliability for both subscales (cognitive reappraisal α = 0.79; expressive suppression α = 0.73). In the present sample, Cronbach's alpha was 0.83 for cognitive reappraisal and 0.79 for expressive suppression.

Perceived Stress Scale (PSS-10): The PSS-10 (Cohen et al., 1983) is a 10-item measure assessing the degree to which situations in one's life are appraised as stressful. Items are rated on a 5-point Likert scale from 0 (never) to 4 (very often), with higher scores indicating greater perceived stress. The scale has established reliability and validity in Iranian populations (α = 0.84) and was used for screening participants with scores ≥15, following established cutoff criteria (Cohen, 1988).

The study implemented a four-phase procedure over 10 weeks. During the screening phase, potential participants completed the PSS-10 online. Eligible participants then provided written informed consent and completed baseline assessments (ASI-R and ERQ). The intervention phase involved random assignment to either the 8-week MBSR program or a waitlist control condition. Post-test assessments were conducted within one week after program completion by research assistants blinded to group assignment.

The intervention group received the standard 8-week MBSR program (Kabat-Zinn, 2009), consisting of eight 90-minute weekly sessions and daily home practice. The program included mindfulness practices such as the body scan, sitting meditation, gentle yoga, and group discussions. Session content progressed from basic awareness exercises to applications in daily life, with particular emphasis on sessions targeting awareness of thoughts and feelings (Session 3) and working with difficult emotions (Session 6), as these directly address cognitive reappraisal skills. The control group received no intervention during the study period but was offered the MBSR program after the study's completion.

Data were analyzed using SPSS version 26.0 with the PROCESS macro version 4.2. All statistical assumptions for MANCOVA were tested and met, including normality (Shapiro-Wilk tests all $p > .05$), homogeneity of variance (Levene's test all $p > .05$),

homogeneity of covariance matrices (Box's M test: p = .214), and homogeneity of regression slopes (all p > .05). Primary analyses included: (1) MANCOVA with pre-test scores as covariates to examine group differences in outcome variables; and (2) bootstrapped mediation analysis (5000 samples) using PROCESS Model 4 to test cognitive reappraisal as a mediator. Effect sizes were reported using partial eta-squared and bootstrap confidence intervals, with the significance level set at $p < 0.05$.

The study protocol received approval from the Ethics Committee of Mashhad University of Medical Sciences (IR.MUMS.MEDICAL.REC.1404.133) and was registered in the Iranian Registry of Clinical Trials (IRCT20250523065853N3). All procedures followed the ethical principles of the Declaration of Helsinki. Written informed consent was obtained from all participants after a complete description of the study procedures.

Results

From the 78 students assessed for eligibility, 30 male participants were enrolled and randomly assigned to either the MBSR intervention (n=15) or the waitlist control group (n=15). All participants completed both pre-test and post-test assessments. Prior to conducting the primary analyses, all assumptions for MANCOVA were tested and met. The Shapiro-Wilk test confirmed the normality of residuals, Levene's test established homogeneity of variances, Box's M test indicated homogeneity of covariance matrices (p= 0.214), and the test of homogeneity of regression slopes was non-significant, supporting the appropriateness of MANCOVA for data analysis.

Multivariate analysis of covariance (MANCOVA) revealed a significant overall effect of MBSR on the combined anxiety sensitivity subscales. Follow-up analyses demonstrated significant reductions in both physical concerns and cognitive concerns. Although a reduction was observed in social concerns, this effect did not survive correction for multiple comparisons. Between-group effect sizes were medium to large for the significant outcomes, as presented in Table 1.

Table 1. Changes in Anxiety Sensitivity Following MBSR Intervention

Group / Subscale	Pre-test	Post-test	Mean Change	Effect Size (d)	*p* value
Intervention Group (MBSR)					
Physical Concerns	19.2 ± 3.1	15.7 ± 3.0	-3.5	0.93	0.008
Cognitive Concerns	18.5 ± 3.3	15.4 ± 3.1	-3.1	0.78	0.018
Social Concerns	17.9 ± 2.8	16.1 ± 2.7	-1.8	0.58	0.040
Control Group					
Physical Concerns	18.9 ± 2.9	18.4 ± 3.0	-0.5	0.23	0.390
Cognitive Concerns	18.7 ± 3.2	18.2 ± 3.2	-0.5	0.19	0.470
Social Concerns	17.6 ± 2.7	17.2 ± 2.6	-0.4	0.25	0.360

Analysis of covariance (ANCOVA) revealed that MBSR participants showed a significant increase in cognitive reappraisal compared to controls, while no significant between-group differences emerged for expressive suppression. The intervention group demonstrated a substantially greater improvement in cognitive reappraisal scores compared to the control group. These results are detailed in Table 2.

Table 2. ANCOVA Results for Emotion Regulation Outcomes

Variables	Groups	Pre-test	Post-test	Change	F	*p*	Partial
Cognitive Reappraisal	Intervention	22.8 ± 5.1	25.9 ± 5.0	+3.1	5.00	0.033	0.16
	Control	23.1 ± 5.0	23.7 ± 5.2	+0.6			
Expressive Suppression	Intervention	15.4 ± 3.6	14.6 ± 3.4	-0.8	2.27	0.143	0.08
	Control	15.0 ± 3.5	15.1 ± 3.6	+0.1			

Bootstrapped mediation analysis with 5,000 samples demonstrated that cognitive reappraisal significantly mediated the effect of MBSR on the cognitive concerns dimensions of anxiety sensitivity. The indirect effect was statistically significant, accounting for a substantial portion of the total treatment effect.

Sensitivity analyses confirmed the stability of our primary findings across alternative statistical approaches. The application of multiple comparison corrections maintained significant effects on physical and cognitive concerns, while the effect on social concerns remained was no longer statistically significant. These results indicate the robustness of our primary outcomes concerning the impact of MBSR on anxiety sensitivity.

In summary, the 8-week MBSR program produced three primary outcomes: significant reductions in the physical and cognitive dimensions of anxiety sensitivity, meaningful increases in cognitive reappraisal capacity, and evidence of significant mediation wherein enhanced reappraisal skills contributed to reduced cognitive concerns. These findings support the hypothesized role of cognitive reappraisal as a mechanism through which MBSR reduces anxiety sensitivity in young male university students.

Discussion

The present study examined the effects of an 8-week Mindfulness-Based Stress Reduction program on anxiety sensitivity in male university students and tested cognitive reappraisal as a potential mechanism of change. Our findings provide empirical support for the hypothesized model, demonstrating that MBSR participation led to meaningful reductions in anxiety sensitivity while enhancing cognitive reappraisal capacity. The mediation analyses further confirmed that cognitive reappraisal played a significant role in explaining the observed treatment effects, particularly for the cognitive dimension of anxiety sensitivity.

The observed results indicate that MBSR produced substantial benefits, which is consistent with a growing body of evidence supporting mindfulness-based interventions

for anxiety-related difficulties in diverse populations (Xie et al., 2023; Boğahan et al., 2025). The parallel enhancements in cognitive reappraisal capacity suggest that mindfulness training effectively cultivates the skills needed to reinterpret threatening thoughts and sensations (Gross & Jazaieri, 2014; Brockman et al., 2017). This finding is central to our hypothesis and converges with established literature on emotion regulation, which posits cognitive reappraisal as a fundamental adaptive strategy. The identified mediation pathway suggests that the benefits of mindfulness practice may operate through a sequence of cognitive-affective processes, beginning with a more adaptive initial appraisal of experiences (Jamieson et al., 2022) and culminating in the specific, volitional strategy of cognitive reappraisal to manage cognitive anxiety concerns (Khakpoor et al., 2019).

Our findings align with contemporary models that frame mindfulness as a means to foster metacognitive awareness and cognitive flexibility (Qu et al., 2022). Rather than simply reducing symptoms, MBSR appears to equip individuals with more flexible and adaptive ways of relating to their internal experiences. This resonates strongly with modern transdiagnostic approaches to psychopathology, such as the Hierarchical Taxonomy of Psychopathology (HiTOP), which seeks to identify and target underlying core mechanisms that are shared across multiple disorders (Krueger & Eaton, 2015; Im & Kahler, 2022). By demonstrating that an intervention can effectively modify one such proposed mechanism (cognitive reappraisal) to reduce a known vulnerability factor (anxiety sensitivity), our study contributes to this evolving paradigm.

The body-focused practices within MBSR, including the body scan and gentle yoga, likely contribute to reducing physical concerns through interoceptive exposure and improved body awareness (Boğahan et al., 2025; Moghadam et al., 2025). Participants learn to observe physical sensations associated with anxiety without catastrophic interpretation, thereby directly targeting the physical concerns dimension of anxiety sensitivity (Xie et al., 2023). This dual-process pathway—cognitive reappraisal for cognitive concerns and interoceptive exposure for physical concerns—provides a comprehensive framework for interpreting MBSR's effects on anxiety sensitivity within transdiagnostic models of psychopathology (Im & Kahler, 2022).

Several limitations of the present study should be acknowledged to contextualize the findings. First, the use of a waitlist control design, while methodologically sound for an initial efficacy trial, limits our ability to attribute the observed effects specifically to the active components of mindfulness, as opposed to non-specific factors such as group support, instructor attention, or participant expectations. Second, the exclusive reliance on self-report measures introduces the potential for shared method variance and social desirability bias. Third, the specific cultural context and the potential for self-selection

bias may affect the generalizability of our results to other populations, including women, clinical samples, or different cultural settings.

To build upon this research, future investigations should employ active control conditions to better isolate the specific effects of mindfulness. Examining these processes in more diverse populations is essential for establishing external validity. Furthermore, a promising direction would be the exploration of additional therapeutic pathways, such as increases in self-compassion, reductions in experiential avoidance, or improvements in distress tolerance, to develop a more complete model of how MBSR confers its benefits.

In conclusion, this study provides evidence that cognitive reappraisal serves as a primary mechanistic pathway through which MBSR reduces anxiety sensitivity, particularly the fear of cognitive dysregulation, in male university students. The findings support the value of mindfulness-based approaches for this population, which often faces significant academic pressures (Zhang & Zhao, 2024) and may underutilize traditional mental health services (Mofatteh, 2020). For clinical practice, the results suggest that explicitly emphasizing and elucidating the cognitive reappraisal skills cultivated during mindfulness training may enhance outcomes for individuals experiencing anxiety sensitivity. Future research should continue to dismantle the complex mechanisms of action to develop more targeted, efficient, and effective mental health interventions.

Ethical Considerations

Compliance with ethical guidelines: This study was approved by the Ethics Committee of Mashhad University of Medical Sciences (IR.MUMS.MEDICAL.REC.1404.133) and registered with the Iranian Registry of Clinical Trials (IRCT20250523065853N3). All procedures were conducted in accordance with the ethical principles of the Declaration of Helsinki. Written informed consent was obtained from all participants after a comprehensive description of the study procedures. Participants were informed of their right to withdraw at any time without penalty. Confidentiality was strictly ensured through data anonymization and secure storage. The research team maintained professional integrity throughout the research process, adhering to standards against data fabrication or falsification.

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Authors' contributions:

Zahra Saedi was the lead contributor, handling conceptualization, methodology, validation, formal analysis, investigation, data curation, writing the original draft, visualization, supervision, and project administration.

Fatemeh Karimi contributed to conceptualization, validation, resources, and writing—review and editing.

Shaghayegh Nemati was involved in methodology, validation, investigation, and writing—review and editing.

Fatemeh Joneydiepour contributed through software, formal analysis, data curation, and writing—review and editing.

Mahdi Amiri supervised all stages of the research and undertook the editing of the final manuscript.

All authors read and approved the final manuscript.

Conflict of interest: The authors declare no conflicts of interest regarding this article.

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