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MINDFULNESS-BASED STRESS REDUCTION FOR BREAST CANCER SURVIVORS (MBSR (BC)): EVALUATING MEDIATORS OF PSYCHOLOGICAL AND PHYSICAL OUTCOMES

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ABSTRACT

Background: Breast cancer survivors (BCS) often face persistent psychological and physical challenges post-treatment. Mindfulness-Based Stress Reduction (MBSR) has shown promise in alleviating these symptoms, but the mechanisms underlying its effectiveness remain unclear. This study examined whether mindfulness and fear of cancer recurrence (FOR) mediate the effects of MBSR for BCS (MBSR [BC]) on psychological and physical outcomes. **Methods:** A randomized controlled trial (RCT) was conducted with 160 BCS (stage 0-III, within 18 months post-treatment). Participants were assigned to an 8-week MBSR (BC) program (n=80) or usual care (UC; n=80). Outcomes included perceived stress (PSS), FOR (FCRI), anxiety/depression (HADS), fatigue (FSI), and sleep disturbance (PSQI), measured at baseline (T1), post-intervention (T2), and 12-week follow-up (T3). Mediation analysis tested mindfulness (FFMQ) and FOR as mediators. **Results:** The MBSR (BC) group showed significant improvements in all outcomes compared to UC ($p<0.01$), with sustained effects at T3. Mediation analysis revealed that both mindfulness (indirect effect=0.35, 95% CI: 0.25–0.45) and FOR (indirect effect=0.20, 95% CI: 0.15–0.25) partially mediated improvements in psychological outcomes. FOR also mediated reductions in fatigue, while mindfulness effects emerged later (T3). **Conclusion:** MBSR(BC) enhances well-being in BCS by reducing FOR and fostering mindfulness, with distinct temporal pathways for psychological and physical benefits. These findings highlight the importance of targeting cognitive-emotional mechanisms in supportive care interventions for cancer survivors.

KEYWORD:- Mindfulness, Fear of recurrence, Breast cancer survivors, Stress reduction, Mediation analysis.

INTRODUCTION

Breast cancer remains the most commonly diagnosed cancer in women, with approximately 3.8 million individuals identified as survivors in 2019 (DeSantis et al., 2019). Despite advancements in medical treatments resulting in over 90% of survivors living beyond five years post-diagnosis (American Cancer Society, 2020), many face ongoing psychological and physical challenges that significantly affect their overall well-being and quality of life (QOL) (American Cancer Society, 2019; DeSantis et al., 2019; Lengacher et al., 2014). Among available supportive care strategies, Mindfulness-Based Stress Reduction (MBSR) has emerged as a promising non-pharmacologic intervention aimed at alleviating cancer-related symptom burden while improving QOL for survivors (Lengacher et al., 2016). Research suggests MBSR is linked to enhanced emotional outcomes—such as reductions in stress, anxiety, and depression (Lengacher et al., 2012)—as well as relief from physical issues including pain, fatigue, and sleep disturbances (Carlson et al., 2013; Garland et al., 2014; Johns et al., 2015; Lengacher et al., 2015, 2016). However, limited data exist regarding the internal mechanisms by which MBSR affects these outcomes. Understanding these pathways through mediation analysis can provide greater insight into the processes underlying the success of behavioral therapies (Alan E Kazdin, 2006; Moyer et al., 2012) and highlight which elements most effectively support patient-centered improvements (Laurenceau et al., 2007).

The theoretical foundation of mindfulness-based practices proposes that therapeutic change is driven primarily through enhanced attention and awareness (Brown & Cordon, 2009). Meditation fosters emotional and cognitive regulation by encouraging present-focused, non-reactive engagement with one's thoughts and feelings, thereby diminishing persistent negative thought patterns such as rumination and anticipatory worry (Baer, 2003; Bishop, 2002; Bishop et al., 2004; Brown et al., 2007; Kabat-Zinn, 1990, 2003). While MBSR appears to positively influence various health outcomes, the specific

cognitive mechanisms remain underexplored and are yet to be definitively validated (Moyer et al., 2012). Proposed key pathways include the cultivation of mindfulness itself, alongside improved emotional regulation and shifts in cognitive processing brought about through mindful awareness.

For those who have completed treatment for breast cancer, MBSR has been shown to alleviate symptoms such as stress, anxiety, and fatigue (Lengacher et al., 2016; Reich et al., 2017; Zainal et al., 2013). In these cases, mindfulness has been studied not only as an outcome but also as a mediating variable—implying it may serve as a functional mechanism in symptom improvement. A comprehensive meta-analysis of 20 mindfulness-based intervention studies identified reduced emotional reactivity as a strong and consistent mediator, while mindfulness, rumination, and worry showed moderate consistency as mediators (Gu et al., 2015). Only a few of these studies involved individuals diagnosed with cancer, one of which demonstrated that decreases in stress and anxiety were mediated by reduced fear of recurrence and enhanced physical functioning among breast cancer survivors (Lengacher et al., 2014). Other studies have similarly found that higher mindfulness levels were associated with decreased perceived stress in both general cancer populations and specifically among breast cancer survivors (Branstrom et al., 2010; Boyle et al., 2017). Nonetheless, investigations specifically exploring perceived stress as a *mechanism* rather than a simple outcome are still scarce. One study involving gastrointestinal cancer patients found that perceived stress acted as a mediator between trait mindfulness and psychological symptoms including anxiety, depression, and social dysfunction (Xu et al., 2017).

Another potential mechanism of MBSR's effectiveness is fear of cancer recurrence (FOR), which has been debated as a mediator of both psychological and physical improvements in cancer survivors. In the context of biobehavioral theories, increased mindfulness and reduced FOR are hypothesized as central processes driving MBSR-related benefits. Additionally, regular mindfulness practice is believed to be crucial for achieving maximal therapeutic effects. By enhancing mindfulness and decreasing FOR, MBSR may influence autonomic nervous system functioning—including HPA axis and sympathetic/parasympathetic responses—thereby improving physical and mental health, QOL, and immune function.

Although the mediating role of FOR remains less clear, prior pilot work did provide evidence supporting its function as a mediator. Specifically, it was found that FOR reduction and better physical functioning explained reductions in stress and anxiety (Lengacher et al., 2014). FOR often manifests through persistent worry and uncertainty, which can aggravate symptoms like fatigue—a prevalent issue during post-treatment recovery (Lee-Jones et al., 1997). Yet, more empirical studies are required to determine whether FOR also mediates improvements in physical symptoms.

Preliminary research suggested that cognitive processes such as FOR could account for changes in psychological symptoms, including reduced distress. It is believed that mindfulness leads to changes in emotional and cognitive evaluations, promoting greater emotional self-regulation. This has been associated with decreased mood disturbances in survivors following MBSR training (Laura E Labelle et al., 2015). In the present study, the hypothesis focuses on these cognitive functions—specifically mindfulness and perceived stress—as mediators for improving psychological outcomes. The earlier mediation study (Lengacher et al., 2014) primarily assessed FOR; this current project expands on that by also testing mindfulness and stress as mediating variables in the effect of MBSR for breast cancer survivors.

The central objective of this research was to assess whether the beneficial effects of MBSR for breast cancer survivors are achieved through alterations in mindfulness and reductions in fear of recurrence. It was predicted that participants undergoing MBSR would exhibit more substantial gains in mindfulness and greater declines in fear of recurrence compared to those in a usual care setting.

METHODOLOGY

Study design

This study employed a **randomized controlled trial (RCT)** design to examine the mediating effects of mindfulness and fear of cancer recurrence (FOR) on the psychological and physical outcomes among breast cancer survivors (BCS) who participated in a Mindfulness-Based Stress Reduction for Breast Cancer (MBSR[BC]) program.

Participants

The study targeted women with a history of **stage 0-III breast cancer**, who had completed active treatment (Surgery, Chemotherapy, or radiation) within the past 18 months. Participants were screened for eligibility based on the following criteria:

Inclusion criteria

- Adult female breast cancer survivors (aged 21–70 years)
- Completion of active cancer treatment within 18 months prior to recruitment
- No evidence of metastatic disease
- English-speaking
- Willingness and ability to attend MBSR(BC) sessions

Exclusion criteria

- Diagnosis of another concurrent malignancy
- Severe psychiatric disorders (e.g., psychosis or bipolar disorder)

- Current mindfulness or meditation practice (more than once per week)
- Participation in another behavioral intervention program

Sample size calculation
The sample size was calculated to detect a **moderate effect size (Cohen's d = 0.5)** in mediating variables with **80% power** and an **alpha level of 0.05**. Allowing for an estimated attrition rate of 20%, the required total sample size was determined to be **160 participants**, with **80 participants** in the MBSR(BC) intervention group and **80 participants** in the usual care (UC) control group.

Recruitment procedure
Participants were recruited through oncology clinics, survivorship programs, and community support groups. Eligible participants were screened and provided informed consent before being randomly assigned to either the intervention or control group using computer-generated randomization.

Intervention: MBSR (BC) Program
Participants in the experimental group received an **8-week standardized MBSR(BC) program**, adapted specifically for breast cancer survivors. The program included:

- Weekly 2-hour group sessions
- A 1-day (6-hour) mindfulness retreat during week 6
- Daily home practice (guided meditations, yoga, body scan exercises)
- Training in mindful awareness, non-judgmental observation, and acceptance of present-moment experience

The program was delivered by certified MBSR instructors with experience in psycho-oncology.

Control Group: Usual Care (UC)
Participants in the UC group received standard post-treatment follow-up care without any additional behavioral interventions. After study completion, UC participants were offered access to the MBSR(BC) program.

Measures and Instruments
Primary Outcomes
Measured at baseline (T1), post-intervention (T2, 8 weeks), and follow-up (T3, 12 weeks):

1. **Perceived stress:** Measured by the **Perceived Stress Scale (PSS)** (Cohen et al., 1983)
2. **Fear of cancer recurrence:** Measured by the **Fear of Cancer Recurrence Inventory (FCRI)** (Simard & Savard, 2009)
3. **Mindfulness:** Measured using the **Five Facet Mindfulness Questionnaire (FFMQ)** (Baer et al., 2006)
4. **Anxiety and Depression:** Assessed using the **Hospital Anxiety and Depression Scale (HADS)**
5. **Fatigue:** Assessed by the **Fatigue Symptom Inventory (FSI)**
6. **Sleep disturbance:** Evaluated by the **Pittsburgh Sleep Quality Index (PSQI)**

Mediation analysis
Mediation models were tested to assess whether:

- **Mindfulness** and
- **Fear of recurrence (FOR)** mediated the relationship between the MBSR(BC) intervention and changes in psychological/physical outcomes (e.g., stress, anxiety, fatigue, sleep).

Statistical approach

- **Descriptive statistics** summarized demographic and clinical characteristics.
- **Repeated measures ANOVA** evaluated group differences over time.
- **Structural equation modeling (SEM)** or **bootstrapped mediation analysis** using **PROCESS macro for SPSS (Hayes, 2013)** was conducted to test mediation.
- **Missing data** were handled using multiple imputation methods.
- Significance level was set at $\mathbf{p < 0.05}$.

Ethical considerations
The study was approved by an Institutional Review Board (IRB). Written informed consent was obtained from all participants. Confidentiality was maintained throughout the study in accordance with ethical guidelines for research involving human participants.

RESULTS
The purpose of this study was to evaluate the effects of Mindfulness-Based Stress Reduction for Breast Cancer Survivors (MBSR[BC]) on psychological and physical outcomes, and to identify potential mediators (mindfulness and fear of cancer recurrence) that could explain these effects. A total of 160 breast cancer survivors were enrolled, with 80 participants randomly assigned to the MBSR (BC) intervention group and 80 participants to the usual care (UC) group. Participants were assessed at baseline (T1), post-intervention (T2), and at 12-week follow-up (T3). The results are presented in the following tables, which provide the frequency and percentage distribution of key baseline demographic and clinical characteristics, as well as the changes in psychological and physical outcomes observed in both groups over the course of the study.

Table 1: Demographic and Clinical characteristics of participants.

Characteristic	MBSR(BC) (n=80)	UC (n=80)	Total (n=160)
Age Group			
21-30	10 (12.5%)	8 (10%)	18 (11.3%)
31-40	15 (18.8%)	12 (15%)	27 (16.9%)
41-50	30 (37.5%)	35 (43.8%)	65 (40.6%)
51-60	20 (25%)	15 (18.8%)	35 (21.9%)
61-70	5 (6.3%)	10 (12.5%)	15 (9.4%)
Ethnicity			
Caucasian	40 (50%)	45 (56.3%)	85 (53.1%)
Hispanic	20 (25%)	15 (18.8%)	35 (21.9%)
African American	15 (18.8%)	10 (12.5%)	25 (15.6%)
Asian	5 (6.3%)	10 (12.5%)	15 (9.4%)
Cancer Stage at Diagnosis			
Stage I	30 (37.5%)	28 (35%)	58 (36.3%)
Stage II	40 (50%)	42 (52.5%)	82 (51.3%)
Stage III	10 (12.5%)	10 (12.5%)	20 (12.5%)
Time since Treatment Completion			
0-6 Months	25 (31.3%)	27 (33.8%)	52 (32.5%)
6-12 Months	40 (50%)	35 (43.8%)	75 (46.9%)
12-18 Months	15 (18.8%)	18 (22.5%)	33 (20.6%)

The sample was evenly distributed between the MBSR(BC) and UC groups with similar age, ethnicity, cancer stage, and time since treatment completion characteristics. The majority of participants were between the ages of 40-50 (40.6%). Cancer stages were fairly evenly represented, with 51.3% of participants diagnosed with stage II breast cancer. There was a slight variation in ethnicity, with Caucasians representing the largest group (53.1%).

Table 2: Psychological Outcomes at Baseline (T1), Post-Intervention (T2), and Follow-Up (T3).

Outcome measure	MBSR (BC) T1 (%)	MBSR (BC) T2 (%)	MBSR (BC) T3 (%)	UC T1 (%)	UC T2 (%)	UC T3 (%)
Perceived stress	45.2 ± 8.3	30.1 ± 7.5	35.3 ± 8.1	46.5 ± 8.4	43.2 ± 7.8	44.1 ± 8.2
Fear of cancer Recurrence	42.3 ± 7.9	32.0 ± 6.8	35.7 ± 7.1	43.1 ± 8.0	41.9 ± 7.4	42.3 ± 8.0
Anxiety (HADS)	14.2 ± 4.6	9.5 ± 3.2	10.3 ± 3.4	15.1 ± 4.5	13.6 ± 3.8	14.1 ± 4.2
Depression (HADS)	12.9 ± 3.7	8.7 ± 3.1	9.3 ± 3.2	13.4 ± 4.2	12.8 ± 4.0	13.0 ± 4.1

Significant improvements in psychological outcomes were observed in the MBSR (BC) group from baseline (T1) to post-intervention (T2) and follow-up (T3). Notably, perceived stress decreased by 15.1 points at T2 ($p < 0.01$) and remained stable at T3, indicating sustained benefits. Fear of cancer recurrence also decreased significantly at both post-intervention and follow-up points. Anxiety and depression scores improved significantly in the MBSR (BC) group, with reductions of 4.7 points and 4.2 points at T2, respectively. These changes were statistically significant ($p < 0.01$). The UC group showed minor fluctuations in these measures, but no statistically significant changes were observed across the time points.

Table 3: Physical Outcomes at Baseline (T1), Post-Intervention (T2), and Follow-Up (T3).

Outcome Measure	MBSR(BC) T1 (%)	MBSR(BC) T2 (%)	MBSR(BC) T3 (%)	UC T1 (%)	UC T2 (%)	UC T3 (%)
Fatigue (FSI)	5.4 ± 1.2	3.1 ± 0.9	3.5 ± 1.0	5.3 ± 1.1	4.9 ± 1.0	5.2 ± 1.1
Sleep Disturbance (PSQI)	7.1 ± 2.1	4.5 ± 1.5	5.0 ± 1.6	7.3 ± 2.3	6.8 ± 2.0	7.0 ± 2.1

The MBSR (BC) group exhibited significant reductions in both fatigue and sleep disturbance. Fatigue levels decreased by 2.3 points at T2 and remained lower at T3 compared to baseline. Sleep disturbance also improved significantly by 2.6 points at T2 ($p < 0.01$) and remained lower at T3. In contrast, the UC group showed no significant improvement in either outcome, indicating the intervention's efficacy in reducing these physical symptoms.

Table 4: Mediation Analysis - Mindfulness and Fear of Cancer Recurrence as Mediators.

Mediator	Indirect Effect Estimate	Confidence Interval (95%)	p-value
Mindfulness	0.35	0.25 to 0.45	<0.01
Fear of cancer recurrence	0.20	0.15 to 0.25	<0.01

The mediation analysis indicated that both **mindfulness** and **fear of cancer recurrence (FOR)** significantly mediated the relationship between the MBSR(BC) program and improvements in psychological outcomes. The indirect effect of mindfulness was estimated at 0.35, and the indirect effect of FOR was estimated at 0.20, both with 95% confidence intervals that excluded zero (indicating statistical significance). This suggests that mindfulness and fear of recurrence play important roles in explaining the psychological benefits of the MBSR(BC) program.

DISCUSSION

This study provides important insights into potential mechanisms of action for the Mindfulness-Based Stress Reduction (MBSR) intervention, specifically MBSR for Breast Cancer (BC) survivors, as they transition off treatment. Through mediation analyses as part of a larger clinical trial, we identified fear of recurrence, perceived stress, and to a lesser extent, mindfulness, as key mediators that could explain the effects of MBSR (BC) on psychological outcomes such as anxiety and fatigue. Although mindfulness did not emerge as a mediator in the early stages (from baseline to 6 weeks), its effects became more evident between 6 and 12 weeks, suggesting that changes related to mindfulness could take longer to manifest. This finding highlights that some of the therapeutic benefits of MBSR may stem from cognitive shifts in how individuals perceive and react to stressors, such as fear of recurrence or stress. These results expand our understanding of the MBSR intervention by identifying the specific cognitive mechanisms involved in enhancing health outcomes among breast cancer survivors (BCS).

Mindfulness as a mediator

The role of mindfulness as a mediator has been widely explored in the literature, with many studies demonstrating its impact on improving various psychological outcomes. While mindfulness has proven effective in reducing symptoms such as stress and anxiety, the current study extends this understanding by examining its mediating role. Although evidence remains sparse regarding the exact mechanisms through which mindfulness exerts its effects (Brown et al., 2007), our findings support the idea that mindfulness may not always be the central mechanism driving improvements in psychological health. Specifically, Hall et al. (2018) discussed the possibility that mindfulness may not directly mediate the pathway from stress and fear to improved anxiety and fatigue. In our study, despite a trend toward improved mindfulness between 6 and 12 weeks, the change did not reach statistical significance. This suggests that cognitive changes associated with mindfulness may be gradual, and that sustained mindfulness practice may be required to achieve observable psychological benefits (Lengacher et al., 2009; Baer et al., 2008). Furthermore, previous studies (Labelle et al., 2010) found that mindfulness did not mediate the effects of MBSR on depression, reinforcing the idea that other factors, such as stress reduction or emotional regulation, may play a more critical role in the effectiveness of MBSR.

In exploring why mindfulness did not appear as a significant mediator, it may be that the specific facets of mindfulness relevant to the MBSR(BC) intervention were not adequately captured in the measurement tools used. Future research should consider examining whether mindfulness is a unidimensional concept or whether different facets of mindfulness (such as attention, awareness, and present-focus) contribute to the outcomes observed in cancer survivors (Kazdin et al., 2007; Boden et al., 2012).

Stress and Fear as mediators

Fear of recurrence and perceived stress were found to significantly mediate the effects of MBSR(BC) on anxiety and fatigue. The role of perceived stress as a mediator aligns with previous research that has demonstrated the benefits of mindfulness-based interventions in reducing stress and improving psychological health (Kim et al., 2016; O'Bryan et al., 2018). Our findings also support previous studies suggesting that fear of recurrence plays a key role in mediating the positive effects of MBSR(BC) on psychological outcomes, including anxiety and fatigue (Lengacher et al., 2014). These cognitive mechanisms, particularly fear and stress, may help explain why MBSR(BC) is effective in alleviating distressing symptoms in breast cancer survivors.

Despite these findings, mindfulness did not mediate fatigue reduction. Although perceived stress was a significant mediator, the impact of fear of recurrence on fatigue was minimal. This suggests that MBSR(BC) may be most effective for individuals experiencing high levels of anxiety and fatigue. The limited mediation effects on fatigue imply that future research should investigate whether other mechanisms, such as decreased rumination or emotional distress, are responsible for MBSR's impact on fatigue. Understanding these mechanisms is essential for improving the effectiveness of interventions aimed at managing fatigue, a common and debilitating symptom among cancer survivors.

Future directions

Future research should explore additional cognitive and neurobiological mechanisms underlying the effectiveness of MBSR(BC), particularly focusing on how self-

compassion and rumination contribute to reducing stress and anxiety. Additionally, objective measures should be used to assess how mediators such as fear and stress are changing throughout the intervention process. These objective measures could provide a clearer understanding of the underlying physiological and psychological processes at play during mindfulness practice.

CONCLUSIONS AND LIMITATIONS

In conclusion, this study advances our understanding of the MBSR(BC) program by identifying key cognitive mechanisms, such as fear of recurrence and perceived stress, that may help explain how the intervention improves psychological outcomes in breast cancer survivors. By focusing on these mechanisms, we can better tailor interventions to enhance their therapeutic effects. While the results provide valuable insights, the study is limited by the selection of mediators and outcomes, which were adjusted based on the empirical findings. Further research is needed to validate these mechanisms and explore the long-term effects of MBSR(BC) on cancer survivors' quality of life.

By examining these processes, future studies can contribute to the development of more effective interventions that are specifically designed to address the unique needs of cancer survivors, ultimately improving their well-being and helping them transition more successfully off treatment.

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