Systematic Review

Received: 2025-03-11
Accepted: 2025-06-23

BCCR
2025, No 2, Vol 17 :000-000
www.bccrjournal.com

Effect of mindfulness based interventions for sleep quality and stress reduction in breast cancer patients: A systematic review

Arman Ryahin[1], Kaveh Ebadi[2] , Farhad Azadmehr[3*]

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1. Department of Community Health Nursing, Faculty of Nursing And Midwifery, Kurdistan University of Medical Science, Sanandaj, Iran
2. Department of Medical-Surgical Nursing, Faculty of Nursing And Midwifery, Kurdistan University of Medical Science, Sanandaj, Iran
3. Department of Medical-Surgical Nursing, Clinical Care Research Center, Research Institute for Health Development, Kurdistan university of Medical Science, Sanandaj-Iran

*Corresponding author
Farhad Azadmehr
Department of Medical-Surgical Nursing, Clinical Care Research Center, Research Institute for Health Development, Kurdistan university of Medical Science, Sanandaj-Iran

e-mail: azadmehrfarhad@gmail.com

Telephone Number: + 989145267108

ORCID: 4522-6909-0002-0000

ABSTRACT

troduction: Breast cancer is the most common invasive cancer among women worldwide. While advancements in early diagnosis and treatment have improved survival rates, many breast cancer patients experience persistent sleep disturbances, anxiety, and stress, which negatively impact their quality of life. Pharmacological treatments for sleep disorders pose risks such as dependency and side effects, making non-pharmacological interventions like mindfulness-based interventions (MBIs) increasingly relevant. This systematic review evaluates the effectiveness of MBIs, particularly Mindfulness-Based Stress Reduction (MBSR) and Mindfulness-Based Cognitive Therapy (MBCT), in improving sleep quality and reducing psychological distress in breast cancer patients.

Methods: Following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines, a comprehensive search was conducted across databases including PubMed, Web of Science (WOS), Scopus, Cochrane Library, SID, Irandoc, and Noormags. Studies published up to November 5, 2024, were screened using Medical Subject Headings (MeSH) terms and Boolean operators. Eligible studies included randomized controlled trials (RCTs) and quasi-experimental studies investigating MBIs' effects on sleep and psychological health in breast cancer patients. Data extraction and quality assessment were performed using the Joanna Briggs Institute (JBI) checklist.

Results: Out of 207 initially identified studies, eight met the inclusion criteria. MBIs significantly improved sleep quality by reducing insomnia severity, sleep latency, and nighttime awakenings while enhancing sleep efficiency. Additionally, MBIs led to substantial reductions in anxiety and depression scores. Some studies reported improvements in emotional resilience and psychological well-being. However, variations in intervention duration, follow-up periods, and study designs influenced result consistency.

Discussion: The findings indicate that MBIs effectively enhance sleep quality and reduce psychological distress in breast cancer patients. Compared to pharmacological treatments, MBIs provide a safer, non-invasive alternative. The benefits are attributed to mindfulness-induced stress reduction and emotional regulation. Despite promising outcomes, variations in methodologies and limited long-term evaluations warrant further research.

Conclusion: MBIs are a valuable complementary approach to conventional breast cancer care, addressing sleep and psychological challenges. Further large-scale, high-quality RCTs are needed to confirm long-term efficacy and establish standardized protocols.

Keywords:Mindfulness, mindfulness-based stress reduction, sleep quality, breast cancer, insomnia, stress management, psychological well-being

INTRODUCTION:

Breast cancer is one of the most significant medical challenges in today's world and the most common invasive cancer diagnosed among women. Although its prevalence has increased over the past fifteen years, advancements in screening, early diagnosis, and various treatments have resulted in a higher survival rate among those affected by the disease (1-3). While certain risk factors, such as genetic mutations, reproductive history, weight gain, and alcohol consumption, are well-established, they account for only a small proportion of breast cancer cases (3). A report on the global cancer burden estimated the incidence and mortality rates of cancer in 2022 and revealed that breast cancer was the second most diagnosed cancer (11.6%) among all cancer type (4-6).

Recent global cancer statistics indicate that female breast cancer is now the most commonly diagnosed cancer in women and a leading cause of cancer-related death worldwide (4–6). Incidence rates are generally highest in high-income regions, whereas mortality rates remain disproportionately elevated in many low- and middle-income countries because of later-stage diagnosis and limited access to comprehensive treatment (7–10). These disparities highlight the continued burden of breast cancer and the need for effective supportive care strategies in diverse health-care systems (9, 10).

Patients with breast cancer are treated with surgery, radiation therapy, adjuvant chemotherapy, or hormone therapy, depending on the disease stage. However, menopause or estrogen deprivation therapy in breast cancer treatment can negatively impact their sexual functioning (11, 12). Statistics show that breast cancer survivors often undergo extended follow-up care to reduce the risk of recurrence or secondary cancer. Improved breast cancer management suggests that the 5-year survival rate for affected women has increased from 18% to 36% (7, 8, 10, 12).

The physical and mental health outlook for breast cancer patients, however, remains less optimistic. Between 14% and 93% of breast cancer patients experience sleep problems, and approximately 23% to 46% suffer from insomnia. These issues often stem from emotional distress and various psychological and physical symptoms that impact their quality of life. Such problems persist not only during diagnosis and treatment but also in the long term (17-13) . For instance, a study conducted in the United Kingdom reported that 58% of cancer patients experienced fatigue in recent months. A long-term follow-up study involving 6,592 breast cancer survivors found that 5 to 16 years post-recovery, fatigue and insomnia were among the most prevalent issues reported .(18)Recent studies have shown that sleep disturbances in women with breast cancer significantly affect numerous quality-of-life measures .Patients with this condition are more vulnerable to sleep disorders, which negatively impact their daily functioning ,cause greater physical pain ,and lead to poorer mental health and lower quality of life for up to 10 years(18 ,16) .

While pharmacological treatments can reduce sleep latency and increase total sleep time, they are limited by issues such as drug dependency, tolerance, and side effects. Over the past decade, a new generation of cognitive-behavioral therapies, known as third-wave therapies, has emerged to address insomnia symptoms. These include mindfulness-based interventions (MBIs), cognitive-behavioral therapy for insomnia (CBT-I), and stress management interventions (MBSR) (2-1) .

Mindfulness-based interventions (MBIs) typically involve 1- to 2-month educational programs consisting of weekly mindfulness exercises and lectures. While various MBIs exist with differing lecture materials and supplementary content, they share a common set of practices, including formal meditation exercises (e.g., seated meditations, walking meditations, body scans) and informal practices (e.g., cultivating mindfulness during daily activities such as eating, breathing, and walking). Traditionally, MBIs are delivered in person within community-based settings (13). The primary goal of mindfulness-based interventions in clinical practice is to observe one's thoughts as mere mental events rather than absolute truths, thereby preventing absorption in positive or negative content. The ultimate hope is that mindfulness practice will foster more adaptive responses to stressors encountered in daily life (19).

To the best of our knowledge, no comprehensive study has yet been conducted on the impact of mindfulness-based interventions on sleep quality in breast cancer patients. Given the widespread occurrence of sleep-related issues among these patients and the necessity of addressing these issues to improve their quality of life, the present study is a systematic review examining the effectiveness of mindfulness-based interventions in improving sleep quality and stess reduction in breast cancer patients.

Material and methods

The systematic review was conducted according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) checklist (20).

Study Design:

This review included interventional studies such as randomized controlled trials (RCTs), clinical trials, and quasi-experimental studies. Grey literature, reviews, descriptive studies, and observational/analytical studies were excluded from the review. This systematic review was registered in the PROSPERO database under the registration number CRD42025642417, ensuring transparency and adherence to pre-defined research protocols.

Search Strategy and Database Selection

To conduct this systematic review, a comprehensive search was performed across multiple online databases, including PubMed, Web of Science (WOS), Scopus, Cochrane Library, SID, Irandoc, and Noormags covering all available studies from database inception up to November 5, 2024.To ensure a thorough and detailed search, Medical Subject Headings (MeSH) terms were applied for systematic keyword selection.

Keywords used as per MeSH

Mindfulness, mindfulness-based interventions, mindfulness-based stress reduction (MBSR), cognitive behavioral therapy for insomnia (CBT-I), meditation, sleep quality, sleep disorders, insomnia, sleep disturbance, breast cancer, breast neoplasms, cancer survivors, oncology patients. The following search terms formed the search strategy, which was used in various combinations:

("Mindfulness" OR "Mindfulness-Based Interventions" OR "Mindfulness-Based Stress Reduction" OR "MBSR" OR "Cognitive Behavioral Therapy for Insomnia" OR "CBT-I" OR "Meditation") AND ("Sleep Quality" OR "Sleep Disorders" OR "Insomnia" OR "Sleep Disturbance") AND ("Breast Cancer" OR "Breast Neoplasms" OR "Cancer Survivors" OR "Oncology Patients")

This structured search strategy ensures comprehensive coverage of relevant studies addressing the effect of mindfulness-based interventions on sleep quality in breast cancer patients.

Inclusion and Exclusion Criteria

The review included studies published in both Persian and English, ensuring inclusivity and relevance to the topic. Studies were included based on specific keywords related to mindfulness, sleep quality, breast cancer, and related psychological factors. Studies focusing on populations other than women diagnosed with breast cancer or that did not meet the criteria for mindfulness-based interventions (MBIs) were excluded.

Population and Intervention

This review included studies focusing on women diagnosed with breast cancer, regardless of cancer stage, treatment phase (active treatment or survivorship), or age group. The inclusion criteria encompassed any mindfulness-based intervention (MBI), including but not limited to mindfulness-based stress reduction (MBSR), mindfulness-based cognitive therapy (MBCT), cognitive behavioral therapy for insomnia (CBT-I), meditation practices, and other mindfulness-related techniques aimed at improving sleep quality.

Outcomes of Interest

All outcomes related to sleep quality and associated psychological and physical health measures were included in the review. Specific outcomes examined across included studies were sleep latency, total sleep duration, sleep disturbances, insomnia severity, fatigue, psychological well-being, mental health (e.g., anxiety, depression, stress), quality of life, and emotional resilience among breast cancer patients.

Measurement tools

Across the included studies, several validated self-report questionnaires were used to assess psychological and sleep-related outcomes. The Patient Health Questionnaire-9 (PHQ-9) consists of 9 items scored from 0 to 3, yielding a total score from 0 to 27, with higher scores indicating more severe depressive symptoms. The Generalized Anxiety Disorder-7 (GAD-7) includes 7 items rated on a 0–3 scale, producing a total score between 0 and 21, where higher scores reflect greater anxiety severity. The Depression Anxiety Stress Scales (DASS-21) is a 21-item instrument with three subscales for depression, anxiety, and stress, each scored from 0 to 42, with higher scores indicating more severe symptoms. Sleep quality was primarily evaluated using the Pittsburgh Sleep Quality Index (PSQI), a 19-item questionnaire that generates a global score ranging from 0 to 21; higher scores represent poorer sleep quality. Insomnia severity was assessed with the Insomnia Severity Index (ISI), which includes 7 items scored from 0 to 4, resulting in a total score of 0 to 28, with higher scores indicating more severe insomnia.

Mindfulness-related processes were measured using the Five Facet Mindfulness Questionnaire (FFMQ; 39 items, total score 39–195, higher scores indicating greater mindfulness) and the Cognitive and Affective

Mindfulness Scale-Revised (CAMS-R; 12 items, total score 12–48, higher scores reflecting higher levels of mindfulness). Fatigue outcomes were captured with the Fatigue Symptom Inventory (FSI; 14 items, higher scores indicating greater fatigue) and the Brief Fatigue Inventory (BFI; 9 items rated 0–10, higher scores representing more severe fatigue).

Sexual function was assessed with the Female Sexual Function Index (FSFI; 19 items, total score 2–36, with higher scores reflecting better sexual function) and climacteric symptoms with the Greene Climacteric Scale (GCS; 21 items, total score 0–63, higher scores indicating greater severity of menopausal and climacteric complaints). Emotional distress and cancer-related concerns were evaluated using the Hospital Anxiety and Depression Scale (HADS; 14 items, total score 0–42, higher scores indicating greater anxiety and depressive symptoms) and the Concerns About Recurrence Scale (CARS; higher scores indicating greater fear of cancer recurrence).

Anxiety in general and cancer-related contexts was also measured using the State-Trait Anxiety Inventory (STAI; 20 items, total score 20–80, higher scores indicating more severe anxiety). Post-traumatic growth was examined using the Post-Traumatic Growth Inventory (PTGI; 21 items, total score 0–105, higher scores representing higher perceived growth). Cancer-related fatigue was assessed with the Cancer Fatigue Scale (CFS-D; 15 items, total score 0–60, with higher scores indicating more severe fatigue).

Study Selection Process

Two independent reviewers carried out the study selection process. All retrieved records were imported into EndNote v.20, where duplicate entries were automatically identified and removed, followed by manual verification by the reviewers. Title and abstract screening, followed by full-text assessment, were independently performed using pre-defined inclusion and exclusion criteria. Any disagreements at either stage were resolved through discussion, and when consensus could not be immediately reached, a third senior reviewer was consulted to adjudicate.

Methodological Quality Assessment

A critical appraisal checklist developed by the Joanna Briggs Institute (JBI) was used to assess the quality of randomized control trials (RCTs) and quasi-experimental studies (21). The quality was assessed based on 13 items for RCTs and 9 items for quasi-experimental studies, considering their internal validity, similarity of participants, and reliability of outcomes. Based on a three-point reading range, two researchers independently evaluated the quality of the studies included in the systematic review: “yes” (score 1), “no” (score 0), and “not applicable/not clear” (score 0) (22, 23). Among the studies assessed by JBI checklists, the levels are defined as good (≥8), fair (6,7) and poor (≤5) (21, 22). Although the quality levels based on the JBI checklist have been mentioned, it is important to reiterate that all studies included in this review were classified as ‘good’ (≥8) according to the JBI quality assessment criteria.

The methodological quality of randomized controlled trials (RCTs) included in this review was also assessed using the Risk of Bias (ROB) tool, which is recommended in the Cochrane Handbook for Systematic Reviews of Interventions(23)Thomas J, Chandler J, Cumpston M, Li T, Page MJ, Welch VA</style></author></authors></contributors><titles><title>Cochrane Handbook for Systematic Reviews of Interventions version 6.5 (updated August 2024. This tool evaluates the risk of bias across several domains, including selection bias, performance bias, detection bias, attrition bias, reporting bias, and other potential sources of bias. Each domain is rated as ‘low risk,’ ‘high risk,’ or ‘unclear risk,’ and studies are considered to have a low risk of bias if all domains are rated as ‘low risk’(23)Thomas J, Chandler J, Cumpston M, Li T, Page MJ, Welch VA</style></author></authors></contributors><titles><title>Cochrane Handbook for Systematic Reviews of Interventions version 6.5 (updated August 2024.

Data Extraction and Quality Assessment:

The first author collected the data using standardized data extraction forms, and the second reviewer verified its accuracy. The standardized data extraction form included fields for study identification (first author, year, country), design, sample size, participant characteristics, details of the mindfulness-based intervention (type, format, frequency, duration, and follow-up), comparator conditions, outcome measures and instruments, main results for sleep and psychological outcomes, and quality appraisal scores. The process of article screening is illustrated in Figure 1. In addition to data extraction, the methodological quality of the included studies was independently assessed by two reviewers using the Joanna Briggs Institute (JBI) checklist for randomized controlled trials and quasi-experimental studies, as well as the Risk of Bias (ROB2) tool recommended by the Cochrane Handbook for randomized controlled trials. Any disagreements between reviewers were

resolved through discussion and consensus. The quality assessment results were used to interpret the findings and evaluate the robustness of the evidence.

Results

Study Selection Process

Initially, a total of 207 articles were identified through a comprehensive search of databases using the specified key terms. After removing 81 duplicate articles, 120 studies remained for further evaluation. The titles and abstracts of these studies were screened, resulting in the exclusion of 80 articles. This left 40 articles for full-text review. After thoroughly assessing the full-texts, only 8 studies met the inclusion criteria for the final analysis.. The selected studies were organized into table 1 for better visualization and summary. This table includes information such as the author (year), location, study characteristics (up to November 5, 2024), patient characteristics, tools used, follow-up period, and main conclusions.

Study Characteristics

The final 8 studies reviewed focused on the impact of mindfulness-based interventions (MBIs) for breast cancer patients. Of these, 5 studies evaluated the effects of mindfulness-based stress reduction (MBSR) programs, 2 studies examined mindfulness-based cognitive therapy (MBCT), and 1 study investigated a combined intervention involving mindfulness and acupressure. The studies varied in their design, intervention duration, and follow-up periods, but all shared a focus on improving sleep quality, anxiety, depression, and overall psychological well-being in breast cancer patients. The detailed characteristics and outcomes of these studies are summarized in table 1.

Risk of Bias Assessment

After evaluating the methodological quality of the included studies, the Risk of Bias (ROB) was assessed using the ROB2 tool, as recommended by the Cochrane Handbook. This tool considers five primary domains, including bias arising from the randomization process, bias due to deviations from intended interventions, bias due to missing outcome data, bias in measurement of the outcome, and bias in selection of the reported result. The detailed assessment for each included study is presented in table 2.

The Effect of MBSR On Anxiety and Depression of Patients with Breast Cancer

Three studies investigated the effect of MBSR on anxiety of patients with breast cancer (4, 11, 15). Kang et al. (2021) in their study found that there was a significant improvement in anxiety and depression scores of the intervention group compared to the control group after an 8-week MBSR practice ($P<0.05$) (4). Also, the results of the study conducted by Chang et al. (2022) showed that the MBSR group's anxiety scores were significantly higher compared to the control group in the post-intervention periods ($P<0.05$) (11). Moreover, another study by Lengacher et al. (2021) showed that from baseline to 12 weeks later there was a significant reduction in the anxiety score of the intervention group compared to the control group ($P<0.05$) (15).

The Effect of MBSR On Sleep Quality of Patients with Breast Cancer

The effect of MBSR on the sleep quality of patients with breast cancer was investigated in 5 studies (1, 7, 13, 14, 24). The results of the study conducted by Zhao et al. (2020) showed that in the MBCT-I group, the insomnia severity decreased significantly compared to the WLC group in the post-intervention (T2), 3-month follow-up (T3) and 6-month follow-up (T4) periods ($P<0.001$) (13). Furthermore, Zamani et al. (2022) in their study found that there was a significant difference between the average score of sleep quality between the two experimental and control groups in the post-intervention period compared to the pre-intervention period ($F=42.34$, $P=0.001$) ($P<0.05$) (1). In addition, another study by Ahmadi Yegane et al. (2023) indicated that the mean sleep quality scores decreased immediately and 2 months after the intervention compared to the baseline in the intervention group, while it increased in the control group ($P<0.001$). Also, the results of this study demonstrated that the mean sleep quality scores decreased in the intervention group from baseline to immediately after the intervention, as well as from baseline to 2 months later ($P>0.001$). In contrast, the control group patients experienced increased sleep quality scores ($P>0.001$) (7). Furthermore, Liu et al. (2022) in their study compared the effect of MBSR and acupressure on sleep quality in breast cancer patients with insomnia and revealed that there was no significant difference across the sleep quality and its parameters between acupressure and combined intervention ($p\geq0.05$) (14). Finally, Kröz et al. (2023) in their study found that patients treated in the multimodal therapy and combination therapy group improved compared to baseline and achieved exploratively better sleep quality and shorter sleep latency and in multimodal therapy even fewer sleep disturbances compared to aerobic training

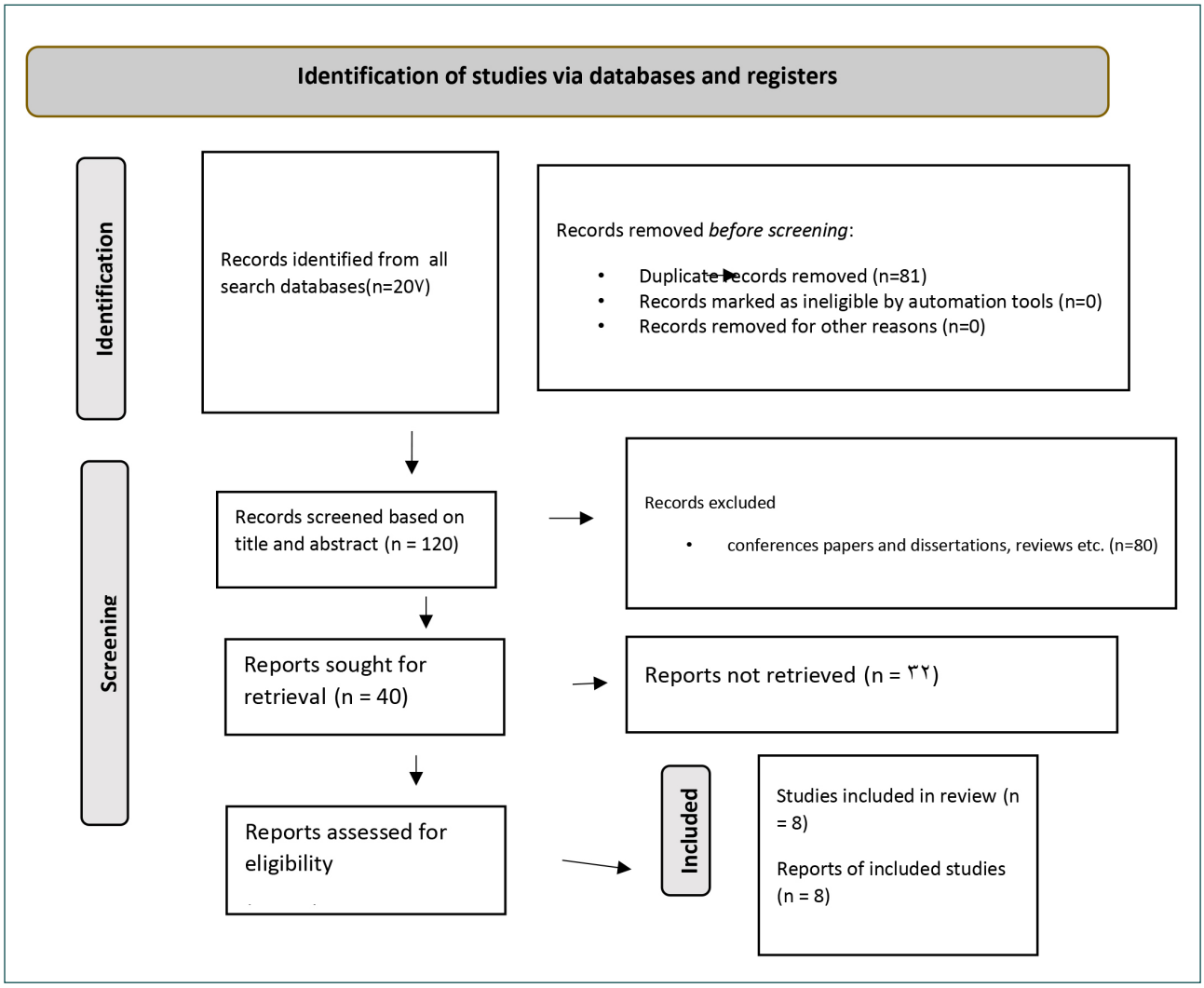

Figure 1: The study screening process is clarified for systematic reviews and meta-analyses flow chart

(P<0.05). Furthermore, patients in the combination therapy group improved compared to baseline regarding sleep duration, sleep efficiency, and disturbances, and together with multimodal therapy regarding daytime sleepiness without achieving superiority to aerobic training (P<0.05) (24).

Discussion

This study aimed to systematically investigate the effects of mindfulness-based interventions, particularly MBSR and MBCT, on anxiety, depression, and sleep quality in patients with breast cancer. The findings of this review suggest that mindfulness-based interventions may help reduce anxiety and depression in patients with breast cancer. There are a few studies which are in line with the current study. The results of the study conducted by Stefan et al. (2017) showed that MBIs can efficacy reduce anxiety and depression severity in a broad range of treatment-seeking individuals (25), which were similar to the results of this study. Also, the study by Li et al. (2019) revealed that MBSR is more effective than the wait-list-control group in reducing depression in older adults with clinically significant symptoms immediately following the intervention. However, there is no clear evidence that the intervention reduced the perception of stress and anxiety, or that positive effects are maintained over the longer term (26), which were consistent with the results of our study. In addition, another study by Bhattacharya et al. (2023) demonstrated the efficacy of MBIs for reducing anxiety and depression in a broad

range of clinical populations (27), which was in line with the present study's results. Moreover, Zhang et al. (2015) in their meta-analyses revealed that mindfulness-based therapy significantly improved measures of anxiety and depression (28). Although several of the included studies reported follow-up periods ranging from 6 months to up to 4 years, the number of trials with extended follow-up remains limited and their findings are heterogeneous. Therefore, while preliminary evidence suggests that mindfulness-based interventions may confer benefits beyond the immediate post-intervention period, the long-term sustainability of these effects on sleep quality and psychological outcomes in breast cancer patients still requires confirmation in future longitudinal studies. which were in agreement with the present study findings. When comparing different mindfulness-based protocols used in the included trials, it appears that standard MBSR programs and MBCT-based interventions both contribute to meaningful improvements in sleep quality and emotional distress among breast cancer patients. Studies using MBSR, including internet-based formats and brief group programs, generally reported reductions in anxiety, depression, and sleep disturbances, whereas MBCT and MBCT-I protocols showed particular benefits for insomnia severity and post-traumatic growth. Preliminary evidence also indicates that combined approaches, such as MBSR with acupressure or integration into multimodal rehabilitation programs, may yield comparable or additive effects on sleep quality and fatigue, although these multimodal interventions have been less frequently studied and require further evaluation. In terms of delivery format, the mindfulness-based interventions in this review were provided through in-person group sessions, internet-based platforms, and mobile messaging applications such as WhatsApp. Across these different formats, improvements in sleep quality and psychological outcomes were generally observed, suggesting that flexible, technology-assisted delivery may enhance access for patients who face logistical, physical, or treatment-related barriers to attending traditional face-to-face sessions. However, adherence to home practice, engagement with online content, and the amount of instructor contact were not consistently reported, and further research is needed to clarify how delivery mode influences treatment effectiveness and patient satisfaction.Also, the results of this study showed that MBSR interventions can significantly improve the sleep quality of patients with breast cancer. There are a few studies that were in agreement with the results of this study. Chen et al. (2020) in their meta-analysis indicated that there was a significant improvement in sleep quality of the MBSR group compared to the control group (29), which was in line with this study's results. Furthermore, the results of Suh et al.'s study found that MBSR significantly improved sleep quality compared to usual (30), which was consistent with the current study's results. Also, another study by Kim et al. (2022) revealed that in the subgroup analysis, MBSR did not improve objective or subjective sleep quality in chronic insomnia and cancers. However, MBSR versus waitlist control might have been effective in improving subjective sleep quality (31), which was similar to our study's results. Additionally, Winbush et al. in their study showed that MBSR significantly improved measures of sleep quality or duration, which were in line with this study's results (32). In addition to the consistency of our findings with prior studies, the methodological quality of the included randomized controlled trials and quasi-experimental studies was rigorously evaluated using the Joanna Briggs Institute (JBI) checklist and the Cochrane Risk of Bias (ROB2) tool, as presented in Table 2. The majority of studies were classified as having good quality and low risk of bias, which enhances the reliability of the observed beneficial effects of mindfulness-based interventions on anxiety, depression, and sleep quality among breast cancer patients. However, notable heterogeneity existed across studies in terms of intervention modalities, duration, sample sizes, and outcome measures, as detailed in Table 1. Such variability may contribute to differences in effect sizes and the magnitude of reported outcomes. Additionally, limitations such as relatively small sample sizes and short follow-up periods in some studies warrant cautious interpretation of the results. Future research should prioritize larger-scale randomized trials with standardized interventions and extended follow-up to confirm and expand upon these findings, thereby facilitating more robust clinical recommendations.

From a practical standpoint ,several factors may influence the implementation of mindfulness-based interventions in routine breast cancer care .Patient accessibility can be limited by travel distance ,treatment schedules ,fatigue, and comorbid conditions ,which may reduce their ability to attend regular group sessions .Adherence to home practice is another key issue ,as sustained benefits from MBIs are likely to depend on ongoing engagement with mindfulness exercises ,yet adherence data were not consistently reported in the included studies .In

Table 1. characteristics of the included studies in this systematic review

First Author/ Year	Location	Study Characteristics1. Design 2. Sample Size (I/C) 3. Intervention 4. Duration of study 5. Duration of intervention 6. Duration of follow-up	M/F Ratio (%)	Age (Mean)	Type of Disease	Control Group	Tool and Questionnaire Characteristics	Specific Statistical Tests	Key Results	JBI Score
Kang et al(4)., 2021	China	1. Semi-Experimental 2. 48 (29/19) 3. iMBSR[1] 4. 2 Months 5. 8 Weeks 6. N/A	All female	45	Breast cancer	No intervention	1. PHQ-9[2] (9 items, 0-27) 2. GAD-7[3] (7 items, 0-21) 3. PSQI (19 items, 0-21)	One-way ANOVA, Kruskal-Wallis	Significant reduction in depression, anxiety, and sleep disturbances ($p < 0.001$). Dose-response relationship observed.	Good
Chang et al(11)., 2022	Taiwan	1. RCT 2. 51 (26/25) 3. MBSR[4] 4. 6 Weeks 5. 6 Weeks 6. N/A	All female	47.7	Breast cancer	Routine care	1. FSFI[5] (19 items, 2-36) 2. DASS[6] (21 items, 0-126) 3. GCS[7] (21 items, 0-63)	Mann-Whitney U, Chi-square	Improved sexual function and mental health ($p < 0.001$).	Good
Lengacher et al(15)., 2021	USA	1. RCT 2. 322 (167/155) 3. MBSR 4. 12 Weeks 5. 6 Weeks 6. 6 and 12 Weeks	All female	56	Breast cancer	Routine care	1. STAI[8] (20 items, 20-80) 2. FSI[9] (14 items, 0-140) 3. PSS[10] (14 items, 0-56) 4. FFMQ[11] (39 items, 39-195) 5. CAMS[12] (12 items, 12-48)	ANCOVA, Mediation Analysis	Significant reduction in anxiety, stress, and fatigue ($p < 0.05$).	Good
Zhao et al(13)., 2020	China	1. RCT 2. 136 (68/68) 3. MBCT-I[13] 4. 13 Months 5. 40 Minutes 6. 6 Months	All female	52.7	Breast cancer	No intervention	1. ISI[14] (7 items, 0-28) 2. FFMQ[15] (39 items, 39-195)	Independent sample t-test	Significant improvements in insomnia severity and mindfulness ($p < 0.001$).	Good
M. Kröz et al(18)., 2023	Germany	1. RCT 2. 79 (66/13) 3. MT[16], CT[17], AT[18] 4. 2012-2017 5. 10 Months 6. 4 Years	All female	56.5-59.9	Breast cancer	Aerobic Training (AT)	1. CFS-D[19] (15 items, 0-60) 2. PSQI (19 items, 0-21)	Baseline covariate	Significant improvements in sleep quality and fatigue ($p < 0.05$). No significant difference in fatigue reduction ($p > 0.05$).	Moderate

Ahmadi Yegane et al(7)., 2024	Iran	1. RCT 2. 62 (31/31) 3. MBSR (via WhatsApp) 4. 3 Months 5. 4 Weeks 6. 2 Months after intervention	All female	45.7	Breast cancer	Standard cancer treatment only	1. PSQI (19 items, 0-21)	Fisher-Chi square	Improved sleep quality ($p < 0.001$).	Good
Liu et al(14)., 2022	China	1. RCT 2. 147 (113/34) 3. MBSR 4. N/A 5. 10 Months 6. 4 Years	F: 98.64% M: 1.36%	51.4	Breast cancer	Routine care	1. PSQI (19 items, 0-21) 2. HADS[1] (14 items, 0-21) 3. BFI[2] (9 items, 0-10)	Repeated-measures ANOVA	Significant differences in PSQI, sleep parameters, and anxiety ($p < 0.05$). No significant difference in sleep latency ($p = 0.235$).	Good
M. Kröz et al(18)., 2023	Germany	1. RCT 2. 79 (66/13) 3. MT[3], CT[4], AT[5] 4. 2012-2017 5. 10 Months 6. 4 Years	All female	56.5-59.9	Breast cancer	Aerobic Training (AT)	1. CFS-D[6] (15 items, 0-60) 2. PSQI (19 items, 0-21)	Baseline covariate	Significant improvements in sleep quality and fatigue ($p < 0.05$). No significant difference in fatigue reduction ($p > 0.05$).	Moderate

1 Internet-based Mindfulness-Based Stress Reduction
2 Patient Health Questionnaire-9
3 Generalized Anxiety Disorder-7
4 Mindfulness-Based Stress Reduction
5 Female Sexual Function Index
6 Depression Anxiety Stress Scales
7 Greene Climacteric Scale
8 State-Trait Anxiety Inventory
9 Fatigue Symptom Inventory
10 Perceived Stress Scale
11 Five Facet Mindfulness Questionnaire
12 Cognitive and Affective Mindfulness Scale-Revised
13 mindfulness-based cognitive therapy on insomnia
14 Insomnia Severity Index
15 Five Facet Mindfulness Questionnaire
16 Mindfulness-Based Cognitive Therapy
17 Post-Traumatic Growth Inventory
18 Pittsburgh Sleep Quality Index
19 Hospital Anxiety and Depression Scale
20 Brief Fatigue Inventory
21 Multimodal therapy
22 Combination therapy
23 Aerobic training
24 Cancer Fatigue Scale

Table 2. Abbreviations and main characteristics of outcome measures used in the included studies

Abbreviation	Full name	Brief description (items, score range, direction)
PHQ-9	Patient Health Questionnaire-9	9 items, total score 0–27; higher scores indicate more severe depressive symptoms.article-revised-3.docx
GAD-7	Generalized Anxiety Disorder-7	7 items, total score 0–21; higher scores indicate more severe anxiety.article-revised-3.docx
DASS-21	Depression Anxiety Stress Scales-21	21 items, three subscales for depression, anxiety, and stress (each 0–42); higher scores indicate more severe symptoms.article-revised-3.docx
PSQI	Pittsburgh Sleep Quality Index	19 items, global score 0–21; higher scores indicate poorer sleep quality.article-revised-3.docx
ISI	Insomnia Severity Index	7 items, total score 0–28; higher scores indicate more severe insomnia.article-revised-3.docx
FFMQ	Five Facet Mindfulness Questionnaire	39 items, total score 39–195; higher scores indicate greater mindfulness.article-revised-3.docx
CAMS-R	Cognitive and Affective Mindfulness Scale-Revised	12 items, total score 12–48; higher scores indicate higher mindfulness.article-revised-3.docx
FSFI	Female Sexual Function Index	19 items, total score 2–36; higher scores indicate better sexual function.article-revised-3.docx
GCS	Greene Climacteric Scale	21 items, total score 0–63; higher scores indicate more severe climacteric symptoms.article-revised-3.docx
HADS	Hospital Anxiety and Depression Scale	14 items, total score 0–42; higher scores indicate more severe anxiety and depressive symptoms.article-revised-3.docx
FSI	Fatigue Symptom Inventory	14 items; higher scores indicate greater fatigue.article-revised-3.docx
BFI	Brief Fatigue Inventory	9 items, each scored 0–10; higher scores indicate more severe fatigue.article-revised-3.docx
CFS-D	Cancer Fatigue Scale	15 items, total score 0–60; higher scores indicate more severe cancer-related fatigue.article-revised-3.docx
CARS	Concerns About Recurrence Scale	Assesses fear of cancer recurrence; higher scores indicate greater concern.article-revised-3.docx
STAI	State-Trait Anxiety Inventory	20 items, total score 20–80; higher scores indicate more severe anxiety.article-revised-3.docx
PTGI	Post-Traumatic Growth Inventory	21 items, total score 0–105; higher scores indicate greater post-traumatic growth.article-revised-3.docx

addition ,effective delivery of MBSR and MBCT requires adequately trained instructors ,structured curricula ,and institutional support ,which may increase program costs and limit availability in resource-constrained settings. Cultural differences ,including beliefs about meditation, stigma surrounding psychological interventions, and family or social norms ,may also shape patients' willingness to participate and their response to mindfulness-based programs ,underscoring the need for cultural adaptation when implementing these interventions in diverse populations.

This systematic review suggests that mindfulness-based interventions may have a meaningful impact on psychological well-being and sleep quality in breast cancer patients. The findings indicate that MBIs, particularly Mindfulness-Based Stress Reduction (MBSR) and Mindfulness-Based Cognitive Therapy (MBCT), may help reduce anxiety, depression, and insomnia and may enhance mental resilience and overall quality of life. The studies reviewed indicate that non-pharmacological interventions like mindfulness-based therapies can be a valuable complementary approach

Table 3. Risk of Bias (ROB2) Assessment of the included randomized controlled trials

Study	Bias arising from the randomization process	Bias due to deviations from intended interventions	Bias due to missing outcome data	Bias in measurement of the outcome	Bias in selection of the reported result	Overall Risk of Bias
Kang et al(4)., 2021	Low risk	Some concerns	Low risk	Low risk	Low risk	Low risk
Chang et al(11)., 2022	Low risk	Some concerns	Low risk	Some concerns	Low risk	Some concerns
Lengacher et al(15)., 2021	Low risk	Some concerns	Low risk	Low risk	Low risk	Low risk
Zhao et al(13)., 2020	Low risk	Some concerns	Low risk	Low risk	Low risk	Low risk
Zamani et al(1)., 2022	Some concerns	Some concerns	Some concerns	High risk	Some concerns	High risk
Ahmadi Yegane et al(7)., 2024	Low risk	Some concerns	Low risk	Low risk	Low risk	Low risk
Liu et al(14).,2022	Low risk	Some concerns	Low risk	Low risk	Low risk	Low risk
M. Kröz et al(18)., 2023	Some concerns	Some concerns	Low risk	Some concerns	Some concerns	Some concerns

for managing the psychological distress associated with breast cancer.

However, while the results are promising, more large-scale, high-quality randomized controlled trials (RCTs) are needed to further validate the effectiveness of these interventions and explore their long-term benefits.

Abbreviations

MBIs: Mindfulness-Based Interventions
MBSR: Mindfulness-Based Stress Reduction
MBCT: Mindfulness-Based Cognitive Therapy
CBT-I: Cognitive Behavioral Therapy for Insomnia
PRISMA: Preferred Reporting Items for Systematic Reviews and Meta-Analyses
JBI: Joanna Briggs Institute
ROB: Risk of Bias
RCT: Randomized Controlled Trial
PSQI: Pittsburgh Sleep Quality Index
PHQ-9: Patient Health Questionnaire-9
GAD-7: Generalized Anxiety Disorder-7
STAI: State-Trait Anxiety Inventory
FSI: Fatigue Severity Index
PSS: Perceived Stress Scale
FFMQ: Five Facet Mindfulness Questionnaire
CAMS: Cognitive and Affective Mindfulness Scale
ISI: Insomnia Severity Index
PTGI: Post Traumatic Growth Inventory
WLC: Waitlist Control
FSFI: Female Sexual Function Index
DASS: Depression Anxiety Stress Scale
GCS: Greene Climacteric Scale
HADS: Hospital Anxiety and Depression Scale
BFI: Brief Fatigue Inventory
CARS: Concerns About Recurrence Scale
MT: Multimodal Therapy
CT: Combination Therapy
AT: Aerobic Training

Declarations

Ethics approval and consent to participate

Not applicable because systematic review studies do not receive any information directly from participants.

Consent for publication

Not Applicable.

Competing interests

The authors declare no competing interests

Funding

No external funding.

Data availability
No datasets were generated or analysed during the current study.

Compeing interests
There are no conflicts of interest.

Authors' contributions
Arman Ryahin drafted the Introduction and made substantial contributions to the Methods, Results, and Data Analysis sections. Kaveh Ebadi contributed to additional sections of the Methods and Results, and played a key role in the Data Analysis and overall manuscript refinement. Samin Bakhshalizade Rashti, as the corresponding author, contributed to the design of the study, supervised the data analysis, and made significant contributions to the review and editing of the final manuscript. All authors collaboratively reviewed and approved the final version of the manuscript for submission.

Availability of data and materials
We appreciate the journal's recommendation regarding data sharing. In response, we have revised the "Availability of Data and Materials" section in our manuscript. The updated statement now reads:

"The datasets generated and/or analyzed during the current study are available from the corresponding author upon reasonable request."

This approach ensures transparency and facilitates reproducibility while addressing any potential confidentiality concerns. We believe this solution is in line with the journal's guidelines and offers interested readers the opportunity to access the data as needed.

Limitations
This systematic review has some limitations. In addition to the lack of a quantitative meta-analysis due to study heterogeneity and the limited number of comparable RCTs, another limitation was the lack of access to data from some databases or the full texts of certain articles. Additionally, the restriction of the review to studies published in English and Persian may have introduced language bias and led to the omission of relevant trials reported in other languages. Given the persistence of the disease, future studies are recommended to conduct comprehensive meta-analyses in this field.

Acknowledgment
The author is extremely grateful to the referenced authors for their invaluable research, which allowed us to compile the conclusions presented in this review.

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