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Review Article

Effects of Mindfulness Interventions on Anxiety, Depression, and Quality of Life in Patients Undergoing Chemotherapy for Breast Cancer: A Systematic Review and Meta-Analysis

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Background: This study aims to specifically review the efficacy of mindfulness-based interventions (MBIs) for breast cancer patients undergoing chemotherapy.
Methods: Five databases (PubMed, Embase, Cochrane, Web of Science, and CINAHL) were searched to collect relevant randomized controlled trials (RCTs). A total of 1869 articles were initially retrieved, of which 8 met the inclusion criteria. The search cutoff date was May 1, 2024. Included studies met prespecified inclusion and exclusion criteria. Data analysis was performed using RevMan 5.4 and STATA/SE 15.0 software.
Results: This study included 8 studies. The findings revealed statistically significant improvements in anxiety, depression levels, and quality of life among patients undergoing MBIs compared to those receiving standard care, with a statistically significant difference [SMD = −0.72, 95% CI (−1.07, −0.37), $p = 0.040$], [SMD = −0.72, 95% CI (−1.07, −0.38), $p = 0.026$], and [SMD = 0.51, 95% CI (0.22, 0.81), $p = 0.037$], respectively.
Conclusions: MBIs have been shown to significantly enhance the psychological well-being and quality of life in breast cancer patients undergoing chemotherapy. Despite certain limitations, MBIs hold substantial promise for clinical use as a complementary therapy and warrant further investigation through larger-scale RCTs. Moreover, future studies should examine the reactions of breast cancer patients from various cultural backgrounds to MBIs, with the goal of refining intervention strategies to better serve a diverse population.

Keywords: breast cancer; chemotherapy; meta-analysis; mindfulness; quality of life

1. Background

Breast cancer, one of the most prevalent cancers among women worldwide, significantly impacts their mental health and overall quality of life (QoL) [1]. In 2020, breast cancer became the most diagnosed malignant tumor, surpassing lung cancer for the first time in history [2]. Classified as the leading cause of cancer death among women by the World Health Organization, breast cancer imposes a substantial burden on individuals and healthcare systems [3]. Innovative treatments and effective disease management are crucial to meet the complex needs of breast cancer patients, especially those undergoing chemotherapy [4].

Presenting a serious public health challenge [5], breast cancer results in approximately 1.8 million new cases diagnosed annually, with incidence and mortality rates continuously rising globally [6]. The WHO report notes that breast cancer incidence is rapidly increasing not only in developed countries but also in developing nations [1]. In more developed regions, the overall 5-year survival rate for breast cancer is higher than 80%; in contrast, the 5-year survival rate in India is reported to be below 70%, and in

South Africa below 50% [7]. According to 2023 projections, the United States is expected to have 300,590 new cases of invasive breast cancer and 43,700 deaths, accounting for about 30% of all cancers in women [8]. By 2040, the burden of breast cancer is expected to increase to over 3 million new cases and 1 million deaths annually due to population growth and aging alone [6]. Despite improvements in survival rates due to advancements in medical technology, the psychological stress and decline in QoL experienced by patients during treatment remain significant issues [9].

Treatment for breast cancer includes surgery, chemotherapy, radiotherapy (RT), endocrine therapy, targeted therapy, and immunotherapy, requiring the collaboration of multiple subspecialties, with each method targeting different stages and characteristics of the disease [10, 11]. However, despite the effectiveness of these treatments in prolonging patients' survival, they are often accompanied by various side effects such as nausea, hair loss, fatigue, and a range of mental health issues, which severely impact patients' QoL [12]. Additionally, psychological problems such as anxiety, depression, and fear of cancer recurrence (FCR) are particularly common among breast cancer patients. These issues can arise during chemotherapy and may persist for many years after cancer treatment [13]. Despite the existence of a variety of supportive interventions (e.g., counselling, exercise, peer support, etc.), there is still a gap in understanding the specific benefits of positive thinking interventions for patients undergoing chemotherapy during the course of their treatment, which prompted us to conduct this focused review. In recent years, mindfulness-based interventions (MBIs) have emerged as a promising psychosocial intervention in cancer treatment, demonstrating potential benefits in enhancing the mental health and quality of life of breast cancer patients [14, 15]. MBIs are interventions that help individuals increase their focus and awareness of the present moment through systematic mindfulness training, thereby improving mental health and overall QoL [16, 17]. Utilizing a series of structured techniques such as mindfulness meditation, yoga postures, group interactive discussions, and daily life practices, MBIs systematically train patients to enhance their awareness of present experiences. This training not only guides patients to practice mindfulness and presence in their daily lives but also encourages them to approach personal experiences with a nonjudgmental and accepting attitude, thereby cultivating compassion for themselves and others [18, 19]. By teaching patients to be mindful of the present, accept unchangeable realities, and develop compassion, these interventions help patients manage the psychological burden brought on by the disease [20]. MBIs can effectively address various biopsychosocial conditions, including depression, anxiety, stress, insomnia, addiction, psychosis, pain, hypertension, weight control, cancer-related symptoms, and prosocial behavior [21].

Recent meta-analyses and systematic reviews have elucidated various interventions aimed at improving psychological outcomes for breast cancer patients. MBIs, including methods such as mindfulness-based stress reduction (MBSR) and mindfulness-based cognitive therapy (MBCT), have increasingly been recognized for their potential to alleviate psychological distress in breast cancer patients [21].

Current literature suggests that MBSR can significantly enhance the QoL for breast cancer patients, reducing symptoms of anxiety and depression [22]. However, the review also highlights the heterogeneity of the study results, indicating that different MBIs vary in their implementation methods and in how well they meet the specific needs of breast cancer patients. Although existing meta-analyses provide valuable insights, they often include studies with broad criteria regarding cancer type or treatment stage, potentially diluting the specific impact of MBIs on breast cancer patients undergoing chemotherapy [23]. Additionally, these reviews sometimes overlook the effects of MBIs on psychological well-being and QoL during and after chemotherapy, leaving gaps in understanding the sustained benefits of mindfulness practices. Although various psychological interventions—such as cognitive-behavioral therapy (CBT), counseling, and supportive-expressive therapy—have been widely used and evidenced in cancer care, especially for addressing anxiety, depression, and fear of recurrence, MBIs represent a distinct therapeutic approach; unlike CBT, which emphasizes cognitive restructuring and problem-solving strategies, MBIs cultivate nonjudgmental awareness and acceptance of the present moment, aiming to reduce reactivity to distressing thoughts and bodily sensations [24–26]. This fundamental difference may offer additional or alternative benefits to patients experiencing the acute stressors of chemotherapy.

Several systematic reviews have confirmed the efficacy of CBT in improving psychological well-being among breast cancer patients [27]. However, the unique mechanisms and experiential qualities of MBIs remain less extensively studied, particularly in the context of active chemotherapy. To date, most meta-analyses have either focused broadly on psychological interventions regardless of type or included mixed cancer populations, which limits the ability to isolate MBI-specific effects during chemotherapy. Therefore, a focused synthesis of MBI effects on anxiety, depression, and QoL in breast cancer patients receiving chemotherapy is warranted to clarify their potential clinical value relative to existing interventions.

This meta-analysis aims to specifically review the efficacy of MBIs for breast cancer patients undergoing chemotherapy. By narrowing the scope of the research, it seeks to provide clearer insights and support clinical decision-making. What is more, it will critically evaluate existing evidence to better understand the potential of MBIs in managing the psychological aspects of breast cancer treatment, addressing research gaps and contributing to more comprehensive care approaches.

2. Methods

This study was carried out based on the Cochrane Handbook for the Systematic Review of Interventions (for details, see at http://training.cochrane.org/handbook) and the Preferred Reporting Items for Systematic Reviews and Meta-Analyses Statement (PRISMA) [28]. The research protocol was

published on PROSPERO (ID: CRD 42024552050). This study does not require ethical approval or patient consent.

2.1. Search Strategy. Two researchers independently searched PubMed, Cochrane Library, Embase, Web of Science, and CINAHL databases from their inception to May 1, 2024. The literature search employed a combination of controlled vocabulary (subject terms) and free-text terms, tailored to each database's specific requirements. Search terms included "Breast Neoplasm," "Chemotherapy," "mindfulness," and others, using Boolean operators "and" and "or" to refine the search (see supporting file 1: search strategy for details).

2.2. Inclusion Criteria

2.2.1. Study Type. The study type was randomized controlled trials (RCTs).

2.2.2. Study Participants. Study participants were female breast cancer patients aged ≥ 18 years undergoing chemotherapy or in the postchemotherapy phase.

2.2.3. Intervention. Experimental group receiving MBIs; control group receiving standard care or waitlist control.

2.2.4. Outcome Measures. Primary outcomes were anxiety and depression.

Secondary outcome was QoL.

2.3. Exclusion Criteria. Exclusion criteria were defined as follows:

1. Systematic reviews, meta-analyses, case reports, conference papers, animal studies, letters.
2. Studies without full-text accessibility.
3. Studies involving children or adolescents.

2.4. Literature Screening and Data Extraction. Two researchers were responsible for the literature search, and Endnote software Version X9 (Bld 12,062) was employed to manage the literature. After using software to automatically delete 524 duplicate articles, 1345 articles remained; then, 1302 articles were excluded by screening titles or abstracts; finally, 43 studies that met the criteria were preliminarily selected and the full texts were downloaded. Based on the full-text review, 9 "no full text," 4 "poster," 5 "non-RCT," 1 "observational studies," 4 "system overview," and 12 "wrong outcome" articles were excluded. Finally, eight original studies that met the requirements of this systematic review were included.

Literature information was extracted, cross-verified, and standardized for measurement units. If there was any discrepancy, a third researcher was consulted to assist in the final decision. The extracted information mainly included title, first author, year of publication, country, type of study, sample size, age, intervention method, intervention time, and outcome indicators.

To avoid duplicated data, the data extracted from the eligible studies were entered into a data collection spreadsheet. Based on the samples in the eligible study, this spreadsheet was pilot-tested to confirm that the inclusion and exclusion criteria were aligned with the research topic. If the outcome indicators within multiple periods were reported, we gathered the data within the shortest period.

2.5. Assessment of Study Quality. Two researchers independently assessed the risk of bias in the eligible studies using a bias assessment tool recommended in the Cochrane Handbook for Systematic Reviews of Interventions Version 6.3, Chapter 8: Assessing risk of bias in a randomized trial, the Cochrane risk-of-bias tool for randomized trials (RoB 2), and the results were cross-validated.

The assessment included the following seven aspects, categorized into three levels: low risk, unclear risk, and high risk: ① Generation of random sequence; ② Allocation concealment; ③ Blinding of participants, personnel, and outcome assessors; ④ Blinding of outcome assessment; ⑤ Completeness of outcome data; ⑥ Selective reporting of study results; ⑦ Other biases. Two reviewers independently assessed these aspects and checked for consistency. Discrepancies in assessment were resolved through discussion or consultation with a third reviewer to achieve consensus.

2.6. Statistical Analysis. Statistical analysis of the literature was conducted using STATA/SE 15 software. For studies that were combinable and relatively homogeneous in design, intervention, and outcomes, meta-analysis was performed to summarize the data statistically. Continuous data such as QoL, anxiety levels, and depression severity were recorded in mean and standard deviation format. In cases where there were differences in measurement methods or units between groups leading to potentially large numerical disparities, standardized mean differences (SMDs) were used as the effect size measure. Mean differences (MD) were utilized when measurement methods between groups were similar, both with 95% confidence intervals.

Statistical heterogeneity among included studies was assessed using the I^2 statistic, where I^2 values of 0%, 25%, 50%, and 75% represent no, low, moderate, and high heterogeneity, respectively. When $I^2 < 50\%$, we used a fixed-effects model for meta-analyses, which suggests low heterogeneity and the possibility of common underlying effect sizes; when $I^2 \geq 50\%$, we used a random-effects model to account for greater variability between studies, which is consistent with the Cochrane Handbook. All data were expressed with 95% confidence intervals, and all results were considered statistically significant at $p < 0.05$.

Given the high heterogeneity observed across the three outcomes, we attempted to explore potential sources. For the QoL outcome, differences in follow-up duration (1.5 vs. 2 months) were noted and tested via meta-regression alongside publication year; neither showed significant influence ($p = 0.637$). As each outcome included only five

studies, identifying the sources of heterogeneity remains challenging. Further analysis will be conducted as more primary studies become available (Supporting file 2: Figures S6 and S7).

3. Results

3.1. Literature Search Flow. A total of 1869 articles were initially identified through database searches: 816 from PubMed, 108 from Web of Science, 290 from Embase, 578 from Cochrane Library, and 77 from CINAHL. After screening and applying inclusion criteria, 8 articles [29–36] were included in the study. The detailed flowchart of the literature search process and results was presented in Figure 1.

3.2. Basic Characteristics of Included Studies. A total of 8 studies [29–36] were included in the final analysis, all of which were RCTs published between inception and 2024. The total sample size comprised 676 patients, with 342 patients in the intervention groups and 334 patients in the control groups. Among these studies, 5 reported anxiety as a primary outcome measure: 3 used the HADS scale [37], 1 used the BAI scale [38], and 1 used the BDI-II scale [39]. Secondary outcome measures included QoL indicators: FACT-B, FACT-G, and IFILC. Detailed basic characteristics of the included studies were summarized in Table 1.

3.3. Quality Assessment. Risk of bias assessment for the final eight included studies [29–36] was conducted using the Cochrane Collaboration's tool. Risk of bias graphs for individual studies (Figure 2(a)) and a summary of methodological quality assessment (Figure 2(b)) were generated using RevMan 5.4 software. All included studies were RCTs. Among the 8 studies, 2 were considered to be of good quality, with low risk of bias in random sequence generation, blinding, allocation concealment, completeness of outcome data, and selective reporting. Overall risk assessment across all studies was deemed low due to clear participant selection based on random sequence generation in all studies. One study was rated as high risk due to lack of allocation concealment. Selective reporting of trial results was assessed as low risk across all studies, and completeness of outcome data was rated low risk in all studies despite some loss to follow-up. Three studies did not report blinding of outcome assessors.

3.4. Meta-Analysis Results of Included Studies

3.4.1. Meta-Analysis Results for Anxiety. Five studies [29–31, 33, 35] reported on the impact of MBIs on anxiety among breast cancer patients undergoing chemotherapy. A total of 343 participants were included, with 170 in the intervention group and 173 in the control group. Among these, 3 studies utilized the HADS-Anxiety scale, 1 study used the SAS scale, and 1 study used the BAI scale. Heterogeneity testing showed significant variability ($I^2 = 60\%$), warranting analysis using a random-effects model. The results indicated a significant improvement in anxiety levels among patients receiving MBI compared to those receiving standard care, with a statistically significant difference [SMD = −0.72, 95% CI (−1.07, −0.37), $p = 0.040$] (Figure 3).

3.4.2. Meta-Analysis Results for Depression. Among the studies included in this analysis, five reported [29–31, 33, 35] on the impact of MBIs on depression in breast cancer patients undergoing chemotherapy. A total of 417 participants were included, with 203 in the intervention group and 214 in the control group. Among these, 3 studies utilized the HADS-Depression scale, 1 study used the BDI-II scale, and 1 study used the SDS scale. Heterogeneity testing showed significant variability ($I^2 = 63.7\%$), prompting the use of a random-effects model for analysis. The results indicated a significant improvement in depression levels among patients receiving MBIs compared to those receiving standard care, with a statistically significant difference [SMD = −0.72, 95% CI (−1.07, −0.38), $p = 0.026$] (Figure 4).

3.4.3. Meta-Analysis Results for QoL Outcome. Five studies [29–31, 33, 35] reported on the impact of MBIs on QoL in breast cancer patients undergoing chemotherapy. A total of 481 participants were included, with 235 in the intervention group and 246 in the control group. Among these, 3 studies utilized the FACT scale, 3 studies used the FACT-B scale, and 2 studies used the FACT-G scale. Heterogeneity testing showed significant variability ($I^2 = 60.8\%$), prompting the use of a random-effects model for analysis. The results indicated a significant improvement in QoL among patients who received MBIs compared to those receiving standard care, with a statistically significant difference [SMD = 0.51, 95% CI (0.22, 0.81), $p = 0.037$] (Figure 5).

3.5. Publication Bias and Sensitivity Analysis. Publication bias analysis was conducted for each included outcome measure using a funnel plot to visually assess bias. Egger's test was employed to analyze the funnel plot, with a p value > 0.05 indicating no publication bias. Egger's test results showed p values of 0.525 for depression, 0.380 for anxiety, and 0.357 for quality of life, all indicating no significant publication bias among the studies. To assess the sensitivity of the meta-analysis results, each study was individually excluded from the meta-analysis. None of the studies had a disproportionate influence on the meta-analysis results, indicating stability and reliability of the findings (supporting file 2: Figures S1–S3).

4. Discussion

Breast cancer patients undergoing chemotherapy often experience numerous complications, including fatigue, nausea, pain, and cognitive impairments, significantly impacting their QoL, mental health, and overall well-being, leading to decreased QoL as well as anxiety and depression [40]. Integrating MBIs early in the chemotherapy process for breast cancer patients holds promise as a strategy to enhance QoL

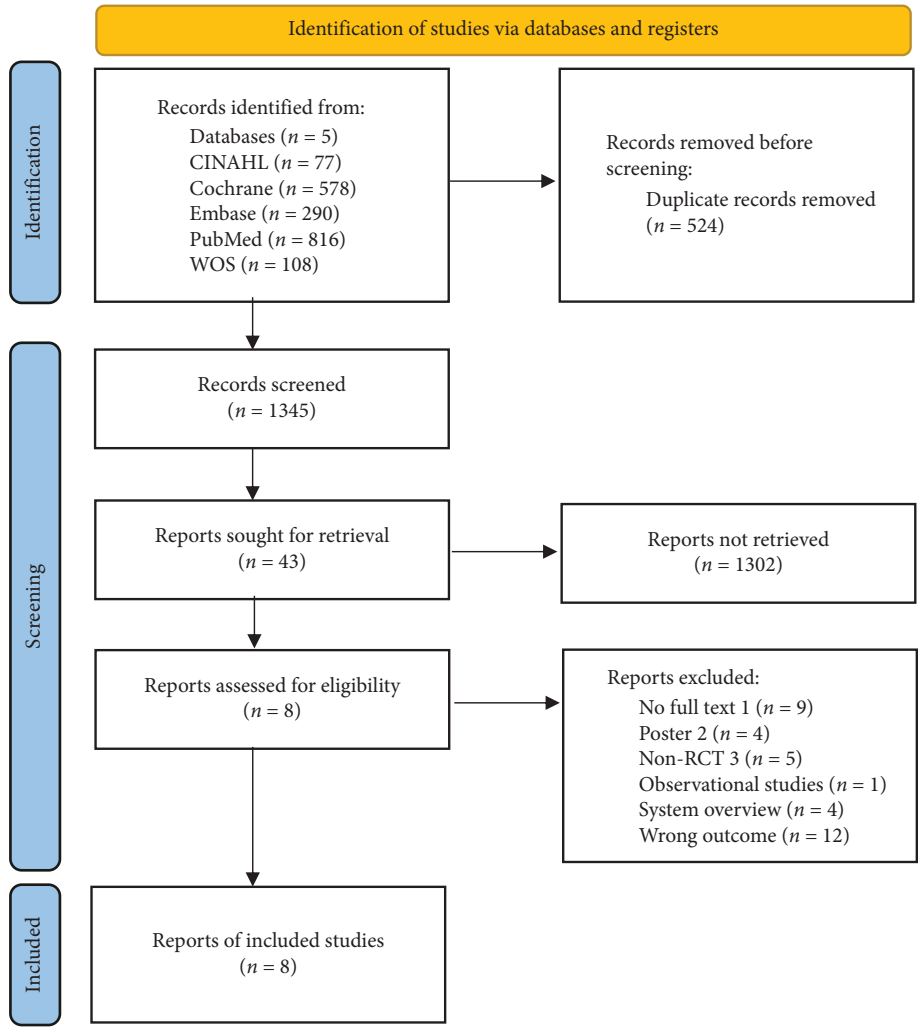

Figure 1: PRISMA flow diagram. Consider, if feasible to do so, reporting the number of records identified from each database or register searched (rather than the total number across all databases/registers). If automation tools were used, indicate how many records were excluded by a human and how many were excluded by automation tools. *Source:* Page MJ, et al. BMJ 2021; 372: n71. doi: 10.1136/bmj.n71. This work is licensed under CC BY 4.0. To view a copy of this license, visit https://creativecommons.org/licenses/by/4.0/.

by promoting better emotional regulation, reducing stress levels, and improving psychological health outcomes during chemotherapy. Implementing mindfulness interventions early in the chemotherapy process is crucial as it not only addresses immediate psychological distress but also provides long-term benefits by helping patients develop coping strategies to improve their overall psychological health and QoL.

Breast cancer patients undergoing chemotherapy or in the postchemotherapy phase frequently endure a wide range of adverse effects, such as fatigue, nausea, pain, and cognitive impairments. These complications have profound and multifaceted impacts, not only diminishing physical well-being but also significantly affecting mental health and overall QoL. The cumulative burden of these symptoms often leads to heightened levels of psychological distress, including anxiety and depression, further exacerbating the deterioration of QoL [31]. Integrating MBIs early in the chemotherapy process offers a promising approach to addressing these complex challenges. MBIs have the potential to enhance QoL by improving emotional regulation, reducing stress, and fostering resilience during treatment. By promoting present-moment awareness and acceptance, MBIs can help patients manage the psychological and emotional toll associated with chemotherapy. Moreover, early implementation of these interventions is essential, as it not only alleviates immediate emotional distress but also equips patients with long-term coping mechanisms. These strategies allow patients to navigate the psychological burdens of both treatment and survivorship more effectively, contributing to sustained improvements in their overall psychological health and QoL. Incorporating MBIs into the standard care regimen for breast cancer patients undergoing chemotherapy can thus provide a holistic approach to treatment. Beyond managing physical symptoms, these interventions target the underlying emotional and psychological factors that significantly contribute to the patient's overall well-being. Early MBI integration ensures that

Table 1: Characteristics of included studies.

First author	Years	Type	Country	Type of intervention		Number of cases		Sex (male/female)	Age		Follow-up time	Outcome indicator
				EP	CP	EP	CP		EP	CP		
Motahareh Mirmahmoodi	2020	RCT	Iran	MBSR	Routine care	27	24	F	44.14 11.19	45.64 10.11	2 M/8 W	Anxiety; depression; stress
Pingting Zhu	2023	RCT	China	MBSR	Routine care	50	51	F	47.96 ± 8.51 18–30: 1 (1.47) 31–40: 11 (16.18) 41–50: 19 (27.94) 51–60: 26 (38.24) > 60: 11 (16.18)	49.78 ± 7.48 18–30: 2 (2.94) 31–40: 9 (13.24) 41–50: 16 (23.53) 51–60: 22 (32.35) > 60: 19 (27.94)	8 W	QoL; anxiety; depression; cognitive emotion regulation strategies
Weimin Liu	2022	RCT	China	Mindfulness yoga + conventional care	Routine care	68	68	F			5 M	Anxiety; depression; fatigue; pain; health-related quality of life
Pingting Zhu	2022	RCT	China	MBSR	Routine care	50	51	F	47.96 ± 8.51	49.78 ± 7.48	2 M	Posttraumatic growth inventory The functional assessment of cancer therapy-breast Cancer (QoL) The perceived social support scale
Qixi Liu	2022	RCT	China	MBSR	Routine care	38	34	F	48.58 ± 8.48	51.41 ± 10.10	0 4 8 W	Sleep quality; fatigue; anxiety; depression
Zehra Gok Metin	2019	RCT	Turkey	MM Mindfulness meditation	Routine care	32	29	F	48.21 ± 10.23	52.86 ± 11.70	0/3/3.5 M	QoL
Xiaomin Chu	2020	RCT	China	MBCT	Routine care	42	42	F	54.6 ± 5.7	54.9 ± 6.3	2 M 3 M	QoL; anxiety; depression
Oner Cengiz	2023	RCT	German	MBT	Routine care	35	35	F	42.22 ± 6.86	41.64 ± 6.04	2 M	Spiritual well-being; QoL

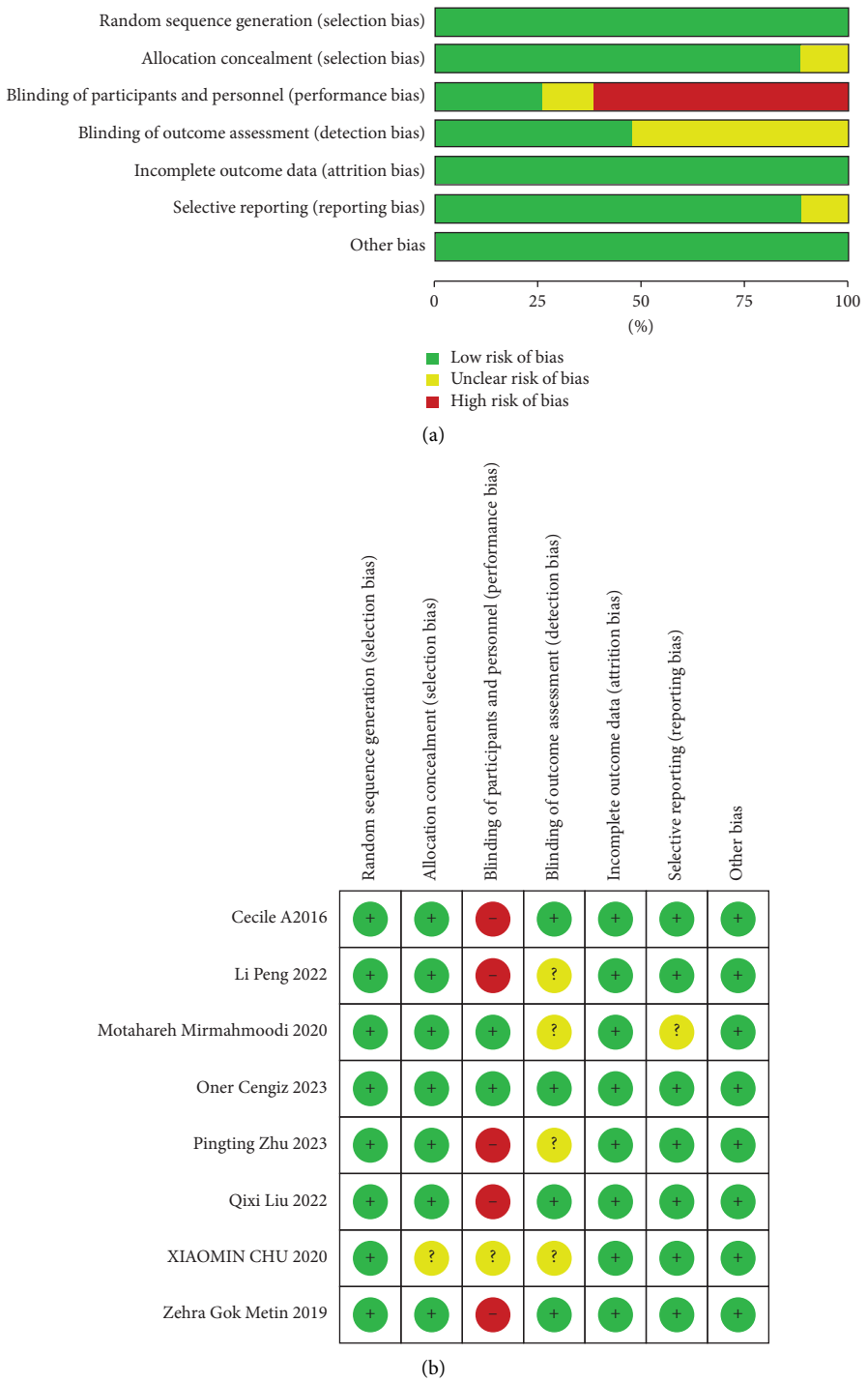

Figure 2: Risk of bias graph for individual studies. (a) Risk of bias graph. Proportion of included studies at different levels of risk of bias across seven bias domains. The *x*-axis represents the percentage of studies (0%–100%) for each domain. The *y*-axis lists the assessed bias domains, including: random sequence generation, allocation concealment, blinding of participants/personnel, blinding of outcome assessment, incomplete outcome data, selective reporting, and other bias. Green indicates low risk of bias, yellow indicates unclear risk, and red indicates high risk. (b) Risk of bias summary. Rows represent the eight included studies, and columns correspond to the seven bias domains: random sequence generation, allocation concealment, blinding of participants/personnel, blinding of outcome assessment, incomplete outcome data, selective reporting, and other bias. Each cell indicates the risk of bias judgment for the corresponding domain in a given study, using green for low risk, yellow for unclear risk, and red for high risk.

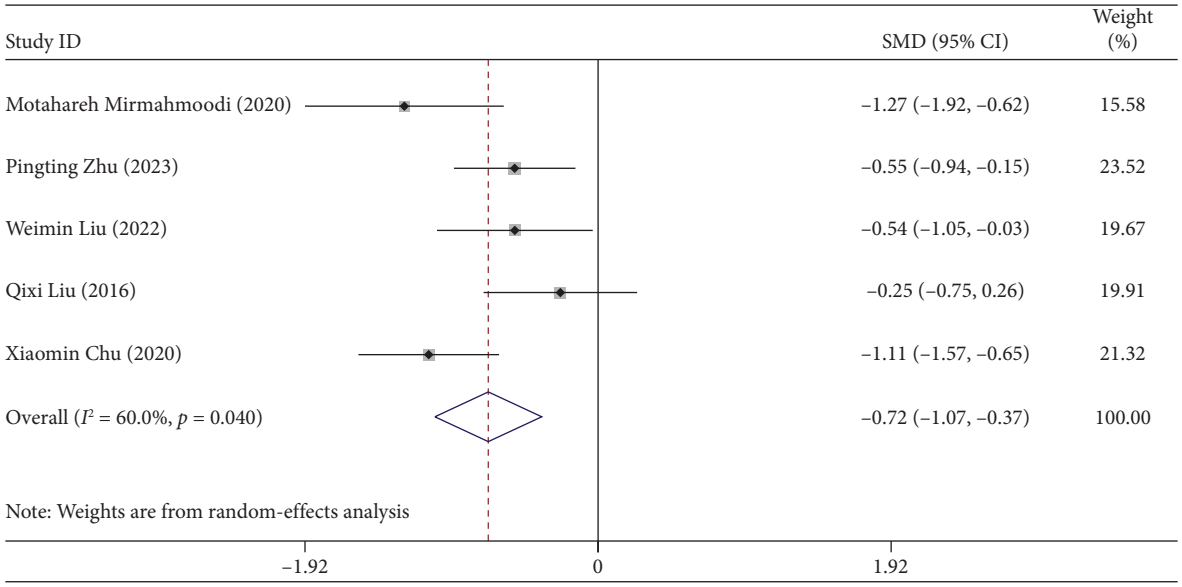

Figure 3: Anxiety forest plot. Forest plot of standardized mean differences (SMDs) and 95% confidence intervals (CIs) for anxiety outcomes across six included studies, sorted by publication year or author. The *x*-axis represents the SMD, and the *y*-axis lists individual studies. Each square denotes the point estimate of the effect size for a study, with the horizontal line indicating its 95% CI. The size of each square reflects the relative weight of the study in the meta-analysis (indicated as a percentage). The diamond at the bottom represents the overall pooled SMD and its 95% CI.

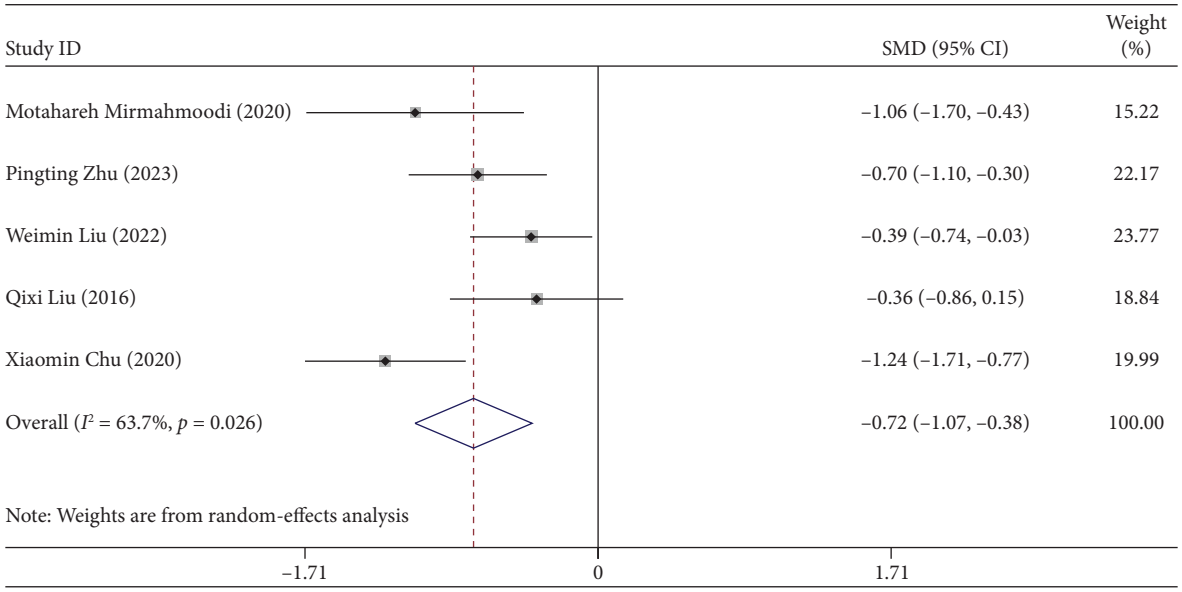

Figure 4: Depression forest plot. Forest plot of standardized mean differences (SMDs) and 95% confidence intervals (CIs) for depression outcomes across five included studies, sorted by publication year or author. The *x*-axis represents the SMD, and the *y*-axis lists individual studies. Each square denotes the point estimate of the effect size for a study, with the horizontal line indicating its 95% CI. The size of each square reflects the relative weight of the study in the meta-analysis (indicated as a percentage). The diamond at the bottom represents the overall pooled SMD and its 95% CI.

patients are better prepared to handle the ongoing demands of treatment while fostering greater resilience and psychological stability throughout their cancer journey.

This study mainly includes three mindfulness interventions: MBSR, MBCT, and MBT, among which MBSR includes mindfulness yoga and mindfulness meditation. Our analysis results indicate that MBIs significantly improve the psychological well-being of breast cancer participants and greatly enhance their QoL. These interventions exert a crucial role in alleviating psychological burdens and enhancing overall treatment experiences for these patients. Included studies demonstrate significant improvements in anxiety,

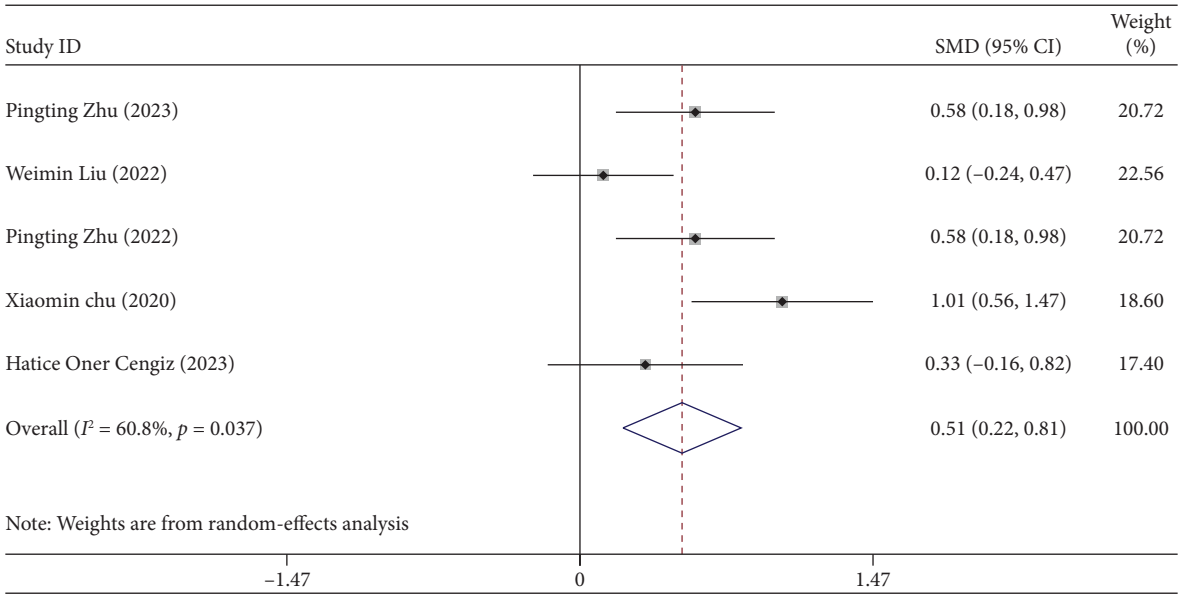

Figure 5: Quality of life (QoL) forest plot. Forest plot of standardized mean differences (SMDs) and 95% confidence intervals (CIs) for QoL outcomes across five included studies, sorted by publication year or author. The x-axis represents the SMD, and the y-axis lists individual studies. Each square denotes the point estimate of the effect size for a study, with the horizontal line indicating its 95% CI. The size of each square reflects the relative weight of the study in the meta-analysis (indicated as a percentage). The diamond at the bottom represents the overall pooled SMD and its 95% CI.

depression, and QoL among participants following mindfulness interventions. This finding aligns with previous literature on the positive impact of MBIs on cancer patients [23, 41].

Huiyuan Wu and Qiuxiang Zhang's research further supports this viewpoint. Their systematic review and meta-analysis demonstrated that MBSR was superior to standard or conventional care in alleviating psychological stress, anxiety, and depression among breast cancer patients [41, 42]. These study findings indicated that MBSR, as an effective psychological intervention, should be widely promoted in breast cancer treatment to improve patients' psychological well-being and QoL. To explore time-based trends, I plotted (supporting file 2: Figures S4–S6), which shows scatter plots of effect sizes (SMDs) for anxiety, depression, and QoL versus year of publication. No clear time trends were observed in any of the outcomes.

Compared to the meta-analysis by Reangsing et al. [23], this study's strength lies in analyzing anxiety and QoL as outcome measures. Furthermore, we focus specifically on breast cancer patients undergoing chemotherapy, a specific group that has received less attention in previous research. Our findings are consistent with the results of Reangsing et al. [23], who reported a moderate effect of MBIs on depression in breast cancer patients. However, unlike their review, we focused only on patients receiving chemotherapy, which may explain why we reported a slightly higher effect size for the anxiety outcome. However, unlike their review, we focused only on patients receiving chemotherapy, which may explain why we reported a slightly higher effect size for the anxiety outcome. By specifically targeting this stage, we can provide a more precise assessment of intervention effects, which has direct implications for clinical application of MBIs.

4.1. Strengths and Limitations. One of the strengths of this study is its focus on specific interventions tailored to particular populations for meta-analysis, which makes the results more precise. However, despite the promising findings, this study has several limitations. The included studies show heterogeneity and use different measurement indicators. To better understand the observed heterogeneity, we conducted exploratory meta-regression analyses using publication year and intervention type as potential moderators. For anxiety and depression outcomes, none of these moderators significantly explained variability in effect sizes (all p values > 0.6), although models indicated some explanatory power (R^2 ranged from 0.35 for anxiety to 0.72 for depression). Due to the small number of included studies ($n = 5$), these results should be interpreted cautiously. The QoL outcome had insufficient data ($n = 6$) for valid interpretation due to overfitting and thus provided no meaningful conclusions from the meta-regression analysis. These findings underscore the need for more homogeneous and larger-scale trials in future research.

Another important limitation is related to statistical power. In meta-analysis, traditional prospective power analyses are typically not performed, as meta-analysis aims to summarize existing published results rather than test a new hypothesis with a predefined sample size. However, we acknowledge that the small number of included studies and their relatively small sample sizes may increase the risk of Type II errors (false negatives), potentially leading to underestimation of true effects. Thus, our findings—especially nonsignificant ones—should be interpreted cautiously. Future studies with larger sample sizes are required to confirm our conclusions and to enhance the robustness of evidence regarding mindfulness interventions in this patient population.

Another limitation concerns the practical implementation and adherence to MBIs among patients undergoing chemotherapy. Although serious adverse events were not reported in the included studies, several trials indicated issues with intervention feasibility and participant retention. For instance, one trial [36] reported that 3 out of 35 participants in the MBI group withdrew due to poor adaptability or unwillingness to continue during treatment. Another study [31] documented a dropout rate of 10.3% in the intervention group, which was partly attributed to scheduling conflicts and lack of motivation for face-to-face sessions. These findings suggest that while MBIs are generally well tolerated, their real-world implementation during chemotherapy may be challenged by fatigue, time constraints, and reduced psychological engagement. These challenges underline the importance of designing more flexible, accessible, and personalized intervention strategies, such as short daily sessions or digital delivery formats, to enhance adherence and clinical applicability.

Of the eight studies reviewed, six mentioned QoL, with five using the FACT scale for assessment [30–32, 35, 36, 43]. In the included studies, the programs ranged from an 8-week MBSR course to shorter daily mindfulness exercises, which may be one reason for the heterogeneity of the depression outcomes. In contrast, Zhu et al. used the FLIC to measure QoL [30]. Three studies used a waiting list control, and five studies used usual or standard care. This variation in control conditions may affect effect sizes, as participants on the waiting list usually show greater postintervention contrast than participants receiving an active standard care program.

This meta-analysis mainly focused on FACT-B and FACT-G measurement indicators, and according to Gok Metin et al., mindfulness meditation positively impacts QoL. This finding aligns with our meta-analysis results.

The age range of participants in the eight included studies is primarily between 40 and 55 years old, with only Liu et al.'s study including participants aged 18–70 years. According to a systematic review by Liu et al. [31], different age groups experience varying levels of anxiety and depression and face different life stressors. While Liu et al.'s results align with our meta-analysis, relying on a single study limits the accuracy of this result. Future research should include more original studies covering various age groups to gather comprehensive evidence for more reliable conclusions.

Despite the rigorous design of the included RCT studies, they generally had small sample sizes, and most studies originated from the same country, which may limit the generalizability of our findings. Additionally, differences in measurement tools and intervention durations across studies may have impacted the consistency and comparability of the results.

Another important source of heterogeneity may be attributed to differences in the design and delivery of MBIs across the included studies. The eight trials included in this review employed various MBI formats, including MBSR, MBCT, mindfulness yoga, and mindfulness with acupressure. Intervention durations ranged from 6 to 12 weeks, with session frequencies from once to twice per week, and session lengths varying from 60 to 120 min. Most interventions were conducted face-to-face in a group format, although one study integrated acupressure and mindfulness body scanning.

These differences likely influenced the magnitude and consistency of the observed effects. For instance, MBCT integrates cognitive therapy components that may offer more targeted benefits for rumination and depressive symptoms, whereas MBSR emphasizes body awareness and stress reduction through mindfulness meditation and yoga, potentially benefiting physical symptoms and anxiety. The group format may provide social support and shared experiences, whereas individual sessions may offer more flexibility. Longer interventions may enable deeper skill acquisition, but also risk higher dropout due to time burden. As such, future studies should consider head-to-head comparisons of MBI types and delivery modes to optimize both efficacy and feasibility.

5. Conclusion

Overall, MBIs effectively improve the psychological health and QoL of breast cancer patients undergoing chemotherapy. Despite some limitations, MBIs have broad potential for clinical application as an adjunct therapy and merit further validation through larger-scale RCTs. Additionally, future research should explore the responses of breast cancer patients from different cultural backgrounds to MBIs, aiming to optimize intervention strategies to meet the needs of a more diverse population. There was heterogeneity in the meta-analysis results, with three studies using a waiting list control and five studies using usual or standard care. This variation in control conditions may affect effect sizes, as participants on waiting lists typically show greater post-intervention contrast than participants receiving an active standard care regimen.

Data Availability Statement

All data generated or analyzed during this study are included in this published article.

Ethics Statement

The authors have nothing to report.

Consent

The authors have nothing to report.

Conflicts of Interest

The authors declare no conflicts of interest.

Author Contributions

Conceptualization: Zhuorong Xiang; writing–original draft preparation: Zhuorong Xiang; writing–review and editing: Zhuorong Xiang, Xue Li, and Youjia Ma; methodology: Zhuorong Xiang and Xue Li; resources: Zhuorong Xiang and

Xue Li; formal analysis and investigation: Zhuorong Xiang and Xue Li; supervision: Youjia Ma.

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Supporting Information

Additional supporting information can be found online in the Supporting Information section.
Supporting Information 1. Supporting file 1: search strategy for details.

Supporting Information 2. Supporting file 2: Sensitivity and regression analysis.

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