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Effects of Mindfulness-Based Online Interventions in Patients with Breast Cancer: A Systematic Review and Meta-Analysis

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Abstract: *This study evaluated the efficacy of mindfulness-based online interventions for patients with breast cancer. A systematic review and meta-analysis was conducted across nine databases: CNKI, VIP, WanFang, PubMed, Web of Science, The Cochrane Library, Embase, CINAHL, and SinoMed. The search period was from the establishment of the databases to May 2025. We included randomized controlled trials examining the effects of mindfulness-based online interventions for patients with breast cancer. Two independent researchers performed literature screening according to predefined inclusion and exclusion criteria, followed by data extraction and methodological quality assessment. The systematic review and meta-analysis was performed using Review Manager 5.3 software. Finally, a total of 15 randomized controlled trials involving 1,379 participants were included. The meta-analysis results showed that mindfulness-based online interventions can effectively improve anxiety, depression, cancer-related fatigue, stress, sleep quality, self-efficacy, and quality of life. In conclusion, Mindfulness-based online interventions demonstrate significant efficacy in improving multidimensional health outcomes among patients with breast cancer.*

Keywords: *Mindfulness-Based Intervention; Online; Breast Cancer; Meta-Analysis*

1. Introduction

Globally, breast cancer ranks as the most frequently diagnosed malignancy among women and the second-leading cause of new cancer cases worldwide [1]. The treatment process for breast cancer is often accompanied by various adverse reactions, such as pain, bleeding, infection, and changes in body image caused by surgery[2]. Chemotherapy often induces nausea, vomiting, alopecia, and anorexia[3]. Both the disease and its therapies confer substantial psychophysiological burdens, frequently manifesting as anxiety, depressive symptoms, sleep disturbances, and cancer-related fatigue, thereby affecting their quality of life[4].

Mindfulness emphasizes conscious awareness of present-moment experiences with a non-judgmental acceptance of one's feelings, thereby enhancing emotional regulation capacity[5]. Mindfulness-based interventions represent a category of psychological interventions centered on mindfulness training. Common clinical intervention programs include Mindfulness-Based Stress Reduction (MBSR), Mindfulness-Based Cognitive Therapy (MBCT), and Mindfulness-Based Cancer Recovery (MBCR)[6]. MBSR employs practices such as breathing awareness, body scans, and meditation to help patients increase their awareness of their present experiences and reduce their stress responses[7]. MBCT integrates core components of MBSR with cognitive behavioral therapy techniques, specifically designed for depressive relapse prevention[8]. MBCR represents an adaptation of MBSR specifically tailored for cancer patients, incorporating additional modules addressing disease-related distress, including fear of recurrence and body image disturbances[9]. Existing studies demonstrate that mindfulness-based interventions significantly alleviate anxiety and depressive symptoms in patients with breast cancer, while concurrently reducing treatment-related physical discomfort, including pain and fatigue[10]. Another meta-analysis of Chinese patients with breast cancer[11] showed that mindfulness-based interventions can improve the quality of life of breast cancer patients.

However, conventional mindfulness-based interventions are typically conducted in the form of eight weeks of group face-to-face sessions. This high-intensity requirement makes it difficult for many patients with breast cancer to persevere due to treatment side effects, mobility issues, or scheduling

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conflicts. These temporal and geographical constraints substantially limit intervention accessibility in this vulnerable population. In recent years, mindfulness-based online interventions have emerged, overcoming the limitations of traditional mindfulness intervention models. Through mobile apps, online courses, and video conferencing[12, 13], patients can flexibly schedule practice times while accessing core content comparable to in-person courses. Research[14] indicates that their efficacy in enhancing mindfulness skills and reducing psychological distress among breast cancer patients. Although FengYT et al.'s[15] meta-analysis confirmed the benefits of ehealth mindfulness-based interventions for broader cancer populations, breast cancer patients have unique characteristics in terms of disease experience, treatment side effects, and psychosocial needs. Current online mindfulness-based intervention studies targeting this population are relatively scattered. Therefore, this study conducted a systematic review of online mindfulness-based interventions for patients with breast cancer to provide evidence-based guidance for clinical practice.

2. Methods

2.1 Inclusion and exclusion criteria

Inclusion criteria: (1) Study population (P): Patients pathologically diagnosed with breast cancer and aged ≥18 years ; (2) Intervention (I): including mindfulness-based online interventions, based on mindfulness, regardless of the online format; (3) Control group (C): usual care; (4) Outcomes (O): anxiety, depression, cancer-related fatigue, stress, sleep quality, self-efficacy, mindfulness, quality of life; (5) Study design (S): randomized controlled trial (RCT). Exclusion criteria: (1)Studies published in languages other than Chinese or English; (2) Full text was unavailable; and (3) Studies that did not report quantitative scores for primary outcome measures were excluded.

2.2 Search strategy

We systematically searched for RCTs on mindfulness-based online interventions in breast cancer patients across both Chinese (CNKI, VIP, SinoMed and Wanfang) and English (PubMed, Web of Science, Embase, CINAHL and Cochrane Library) databases from inception to May 2025. Our search strategy employed a combination of subject terms and free text keywords. Search words were “Breast Neoplasm”, “Breast Cancer”, “Breast Tumor”, “Mammary Cancer”, “Breast Neoplasm”, “Randomized Controlled Trial”, “Mindfulness”, “Mindfulness-Based Stress Reduction”, “Mindfulness-Based Therapy”, “Mindfulness-Based Cognitive Therapy”, “Internet-Based Intervention”, “Mobile Applications”, “Online Intervention”, “Web”, “Telemedicine”, etc.

2.3 Data screening and extraction

The retrieved literature was imported into EndNote 20.0 software. Two investigators (Zhang and Liu) independently screened titles and abstracts for initial eligibility. After irrelevant records were excluded, further screening was done by reading the full text according to the inclusion and exclusion criteria. Discrepancies were resolved through discussion with a third reviewer (Yang). Microsoft Excel software was used to extract relevant information, including the first author's name, year of publication, age, sample size, type of intervention, duration of intervention, and outcome indicators.

2.4 Risk of bias assessment

In accordance with the Cochrane Handbook[16], two independent reviewers (Zhang and Liu) conducted the risk of bias assessment for included RCTs. The evaluation included random sequence generation, allocation concealment, blinding of participants and personal, blinding of outcome assessment, completeness of outcome data, selective reporting, and other biases. If the two researchers disagree, a third researcher (Yang) will participate in the discussion to reach a consensus. The risk of bias was plotted using Review Manager 5.3 software. Studies were considered to have a high risk of bias if two or more domains were rated as high risk; studies were considered to have a low risk of bias if five or more domains were rated as low risk and none of the domains was rated as high risk; and the rest of the studies were considered to have a moderate risk of bias[17].

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2.5 Statistical analysis

The meta-analysis was conducted using Review Manager 5.3 software. For continuous outcomes, we calculated weighted mean difference (MD) with 95% confidence interval (CI) when studies used identical measurement tools and units; for studies employing different measurement instruments or units, standardized mean difference (SMD) with 95% CI were computed instead. Heterogeneity was assessed using Cochran's Q test and I^2 statistics. If $I^2 < 50\%$ and $P > 0.10$, it was suggested that the heterogeneity was acceptable, and a fixed-effects model was selected for analysis. If $I^2 \geq 50\%$ and $P \leq 0.10$, it suggests that the heterogeneity is significant, and the random effect model was chosen for analysis.

3. Results

3.1 Search results

The initial search resulted in 1809 publications, of which 99 were duplicates. After removing duplicates, 1454 documents were excluded after screening the remaining 1710 documents for title and abstract based on inclusion and exclusion criteria. The full text of 256 more literature was then read carefully and further screened on the basis of irrelevant topics, non-randomized controlled trials and missing outcome data. Finally, 15 studies were included in the meta-analysis. The flowchart of literature screening is shown in Figure 1.

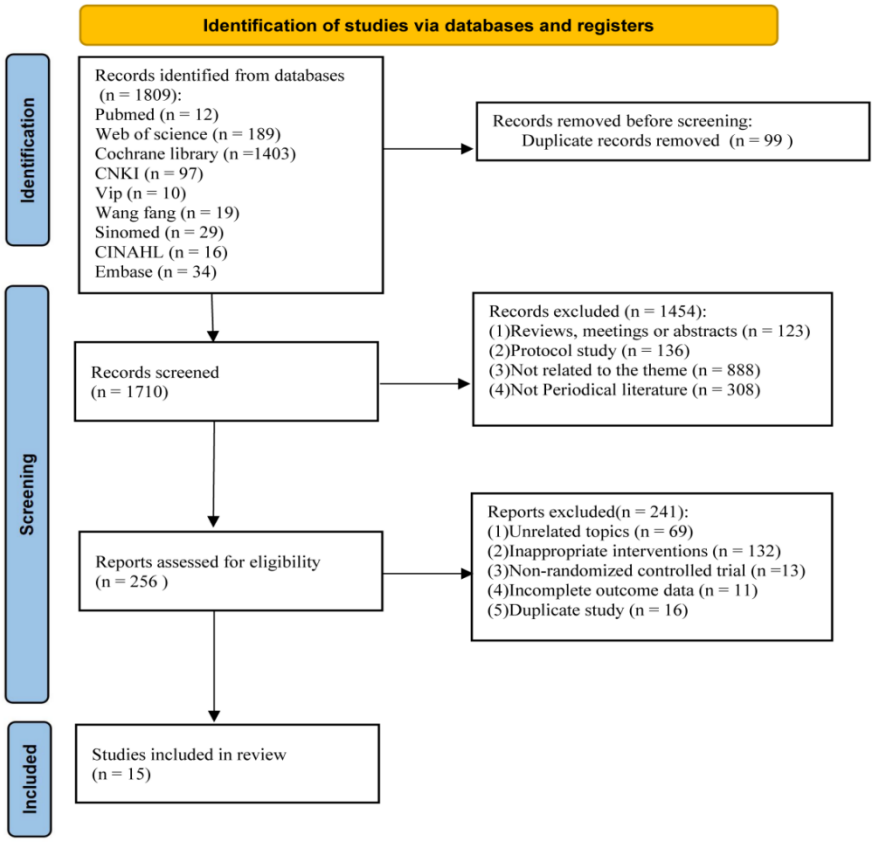

Figure 1: Prisma flow diagram.

3.2 Characteristics of the included studies

The 15 included studies were published between 2018 and 2025. A total of 1379 patients with breast cancer were included, involving nine PPIs and intervention durations ranging from 4 weeks to 6 months. The basic characteristics of the included studies are shown in Table 1.

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Table 1: Characteristics of included studies.

No	Author	Year	Sample size		Age (years)		Interventions		Intervention duration	Outcomes
			T	C	T	C	T	C		
1	YuC[18]	2022	20	20	47.10 ±4.38	46.45± 3.47	MBCT delivered via video-conferencing	UC	8 weeks	1) 2) 3) 4)
2	FuSJ[19]	2025	61	61	72.50 ± 6.20	72.90± 6.10	Virtual Reality-based MBI	UC	8 weeks	4) 5)
3	GuoY[20]	2021	54	54	51.10 ±2.60	51.30± 2.40	Home care platform-based MBSR	UC	6 months	1) 2)
4	ShenAM[21]	2021	37	40	45.30 ±7.20	47.90± 7.50	Web-based MBCR	UC	8 weeks	1) 5) 6)
5	BanY[22]	2025	95	95	56.60 ± 10.98	55.38± 10.37	Online MBSR	UC	8 weeks	2) 7)
6	LiuY[23]	2023	50	50	49.8± 11.5	50.2±12.7	WeChat-based MBI	UC	During chemotherapy	3) 5)
7	Maria Juarez-Reyes[13]	2024	16	14	51.50 ±8.00	51.50± 8.00	Remotely Delivered MBI	UC	6 weeks	1) 2) 3)
8	WangLY[12]	2022	51	52	45.37 ±7.59	48.17± 8.05	Web-based MBCR	UC	4 weeks	4)
9	Zahra Ahmadi Yegane[24]	2023	31	31	45.7± 55.28	43.7± 45.39	Online MBSR	UC	4 weeks	3)
10	GuC[25]	2024	51	52	45.37 ±7.59	48.17± 8.05	Web-based MBCR	UC	4 weeks	1) 2) 8)
11	Li Peng[26]	2022	28	29	/	/	Online Mindfulness-Based Intervention (MBI)	UC	6 weeks	4) 8)
12	Yanli Chen[27]	2024	32	32	/	/	Online MSC Intervention	UC	6 weeks	6)
13	Kristen D. Rosen[14]	2018	57	55	51.40 ±10.73	53.22± 9.91	Mobile App-Based MBI	UC	8 weeks	4) 8)
14	Yun-Chen Chang[28]	2022	41	26	53.38 ±13.04	47.21± 10.83	Online Mindfulness-Based Stress Reduction (MBSR)	UC	6 weeks	1) 2) 6) 7)
15	Di Shao[29]	2021	72	72	40.3 ± 7.0	44.4 ± 8.2	A guided self-hel MBI	UC	6 weeks	1) 2) 3)

MBCT: Mindfulness-Based Cognitive Therapy; MBI: Mindfulness-Based Intervention; MBSR: Mindfulness-Based Stress Reduction; MBCR: Mindfulness-Based Cancer Recovery; MSC: Mindful Self-Compassion; UC: usual care; 1) anxiety; 2) depression; 3) sleep problems; 4) Quality of Life; 5) fatigue; 6) stress; 7) self-efficacy; 8) mindfulness;

3.3 Risk of bias assessment

Figure 2 summarizes the risk of bias assessment for the included 15 RCTs. Among these, 13 studies were rated as moderate risk of bias, 1 study demonstrated low risk of bias, and 1 studies were classified as high risk of bias.

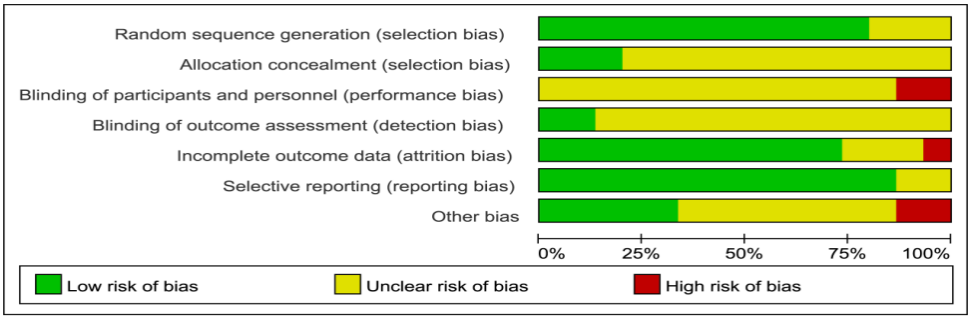

Figure 2: Risk of bias assessment.

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3.4 Meta-analysis results

3.4.1 Anxiety

Among the 15 included studies, 7 studies evaluated the effects of mindfulness-based online interventions on anxiety in breast cancer patients. Due to heterogeneity in assessment scales across studies, we pooled the data using SMD. The random-effects model was employed given substantial between-study heterogeneity (I^2= 84%, p < 0.01). The meta-analysis demonstrated that mindfulness-based online interventions significantly reduced anxiety levels in breast cancer patients [SMD = -0.71, 95% CI (-1.17, -0.26)], with a statistically significant difference (p < 0.01).

3.4.2 Depression

7 studies evaluated the impact of mindfulness-based online interventions on depression levels in breast cancer patients. Heterogeneity tests revealed significant heterogeneity among the studies (I^2= 93%, p < 0.01), prompting the use of a random-effects model for analysis. The results showed that mindfulness-based online interventions effectively reduced depression levels in breast cancer patients [SMD = -0.93, 95% CI (-1.09, -0.77)], with a statistically significant difference (p < 0.01).

3.4.3 Cancer-related fatigue

3 studies evaluated the effects of mindfulness-based online interventions on cancer-related fatigue in breast cancer patients. Heterogeneity tests revealed no significant heterogeneity among the studies (I^2= 34%, p = 0.22), and a fixed-effects model was used for analysis. The results showed that mindfulness-based online interventions effectively reduced cancer-related fatigue symptoms in breast cancer patients [SMD = -0.78, 95% CI (-1.02, -0.54)], with a statistically significant difference (p < 0.01).

3.4.4 Stress

3 studies evaluated the impact of mindfulness-based online interventions on stress levels in breast cancer patients. Heterogeneity tests revealed significant heterogeneity among the studies (I^2= 52%, p = 0.13), prompting the use of a random-effects model for analysis. The results showed that mindfulness-based online interventions effectively reduced stress levels in breast cancer patients [SMD = -0.70, 95% CI (-1.11, -0.29)], with a statistically significant difference (p < 0.01).

3.4.5 Sleep problems

5 studies evaluated the effects of mindfulness-based online interventions on sleep problems in breast cancer patients. Heterogeneity tests revealed significant heterogeneity among the studies (I^2= 93%, p < 0.01), prompting the use of a random-effects model for analysis. The results showed that mindfulness-based online interventions significantly improved sleep quality in breast cancer patients [SMD = -0.94, 95% CI (-1.85, -0.04)], with the difference being statistically significant (p < 0.01).

3.4.6 Self-efficacy

2 studies examined the effects of mindfulness-based online interventions on self-efficacy in breast cancer patients, so a weighted MD was used for the meta-analysis. Due to the limited number of included studies, a conservative estimate was made using a random-effects model. The meta-analysis revealed that the self-efficacy scores in the intervention group were significantly higher than those in the control group [MD = 4.51, 95% CI (3.42, 5.60)], with the difference being statistically significant (p < 0.01).

3.4.7 Mindfulness

3 studies evaluated the impact of mindfulness-based online interventions on mindfulness levels in breast cancer patients. Heterogeneity tests revealed high heterogeneity among studies (I^2 = 87%, p < 0.01), so a random-effects model was used. The meta-analysis showed no statistically significant difference in mindfulness levels between the intervention and control groups [SMD = -0.33, 95% CI (-0.36, 1.02)].

3.4.8 Quality of life

5 studies evaluated the impact of mindfulness-based online interventions on the quality of life of breast cancer patients. The heterogeneity test results showed significant heterogeneity among the studies (I^2= 95%, p < 0.01), so a random-effects model was used for analysis. The results indicated that mindfulness-based online interventions effectively improved the quality of life of breast cancer patients

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[SMD = 1.56, 95% CI (0.57, 2.56)], with a statistically significant difference ($p < 0.01$).

4. Discussion

4.1 Mindfulness-based online interventions effectively alleviate negative emotions and stress in breast cancer patients

The study results indicate that mindfulness-based online interventions can significantly reduce anxiety, depression, and stress levels in breast cancer patients, with all three psychological measures showing statistically significant improvements in the intervention groups. These findings are consistent with previous meta-analysis results on mindfulness interventions[29], though it's worth noting that the online format appears to yield more pronounced effects. This enhanced efficacy may be attributed to several advantages of digital platforms: eliminating geographical barriers to make psychological support more accessible during recovery; offering flexible scheduling to accommodate patients' variable physical conditions during treatment; and providing anonymity to reduce mental health stigma and improve participation rates. From a mechanistic perspective, mindfulness practice helps patients break negative thought cycles by cultivating non-judgmental awareness of present-moment experiences. Techniques like breath awareness may help regulate autonomic nervous system function to mitigate stress responses, while the practice's emphasis on accepting rather than avoiding emotions reduces psychological burdens. Together, these findings provide compelling evidence for incorporating online mindfulness interventions into psychological support systems for breast cancer patients.

4.2 Mindfulness-based online interventions effectively reduce cancer-related fatigue and improve sleep quality in breast cancer patients

This study confirms that mindfulness-based online interventions effectively alleviate cancer-related fatigue and improve sleep quality in breast cancer patients, consistent with findings from Liu et al.[23]. Fatigue and sleep disturbances are common treatment side effects in this population[30]. The body scan practice enhances awareness of physical sensations, helping patients distinguish between actual physical fatigue and anxiety-exaggerated tiredness, thereby reducing catastrophic interpretations of symptoms. For sleep improvement, audio-guided mindfulness exercises before bedtime may activate the parasympathetic nervous system, counteracting treatment-induced neurological hyperactivity. Future studies should incorporate standardized sleep assessment tools. Collectively, these findings support using online mindfulness interventions as an adjunct approach for symptom management in breast cancer care.

4.3 Mindfulness-based online interventions enhance self-efficacy and quality of life in breast cancer patients

This study evaluated the effects of mindfulness-based online interventions on self-efficacy and quality of life in breast cancer patients, showing statistically significant improvements in the intervention group compared to controls. These findings align with Guo et al.'s research[31]. The notable increase in self-efficacy likely reflects key features of the online format: (1) modular course design allowing gradual skill acquisition, (2) immediate practice feedback enhancing sense of control, and (3) peer support in online communities providing role models. The substantial quality of life improvement probably results from combined psychological and physical symptom relief. The convenience of digital platforms enables patients to integrate mindfulness practice into daily routines, potentially enhancing intervention effects. These findings offer new approaches for expanding accessible rehabilitation services. Future research should examine response differences across disease stages and evaluate long-term outcomes.

5. Conclusion

This study demonstrates that mindfulness-based online interventions significantly improve anxiety, depression, stress, cancer-related fatigue, sleep quality, self-efficacy, and quality of life in breast cancer patients compared to routine care. However, several limitations should be noted: (1) high heterogeneity in some outcomes (e.g., sleep quality, QoL) suggests variations in intervention protocols or measurement tools across studies; (2) the limited number of included studies, particularly those assessing self-efficacy and mindfulness levels, may affect result reliability; and (3) insufficient

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long-term follow-up data prevents evaluation of sustained effects. In conclusion, online mindfulness interventions serve as valuable complementary approaches for comprehensive breast cancer rehabilitation, especially for resource-limited or mobility-restricted patients. Future research should standardize intervention protocols and assessment methods, while conducting large-scale, multicenter studies with extended follow-up to verify clinical applicability.

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