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Effects of Web-Based Interventions on Anxiety and Depression in Patients With Breast Cancer: A Systematic Review and Meta-Analysis of Randomized Controlled Trials

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ABSTRACT

Objective: This study evaluated the effects of web-based interventions on anxiety and depression in patients with breast cancer by conducting a meta-analysis of relevant randomized controlled trials (RCTs).

Methods: We searched the PubMed, Web of Science, Cochrane Library, Cumulated Index to Nursing and Allied Health Literature, Embase, and PsycINFO databases from their inception to January 5, 2024. When substantial heterogeneity was observed among the studies, a random-effects model was applied to calculate effect sizes in terms of the standardized mean difference (SMD) and assessed the quality of the included studies using the updated Cochrane risk-of-bias tool for RCTs.

Results: Fourteen RCTs were included in this study. The meta-analysis indicated that web-based intervention alleviated anxiety (SMD = −0.26, 95% CI = −0.44 to −0.07, $p < 0.01$, $I^2 = 68\%$) and depression (SMD = −0.15, 95% CI = −0.25 to −0.06, $p = 0.19$, $I^2 = 26\%$) in patients with breast cancer. There was substantial heterogeneity in anxiety, and the analysis of potential causes revealed that the intervention method was a factor influencing the variability in the actual effect size.

Conclusions: This study showed that web-based interventions may help reduce anxiety and depression in patients with breast cancer. It also suggested the potential of these interventions as a strategy for alleviating symptoms in non-face-to-face settings. However, the limited number of studies and high heterogeneity in the subgroup analysis made it difficult to assess the effects of different intervention methods. Further high-quality research is needed to provide more reliable data on the effectiveness of various intervention methods.

1 | Background

Breast cancer remains the leading cause of cancer-related death among women worldwide [1]. Breast cancer in women surpassed lung cancer as the most common cause of global cancer incidence in 2020, with an estimated 2.3 million new cases representing 11.7% of all cancer cases [2]. Women with breast cancer experience various health issues and psychological challenges, including anxiety (17.9%–33.3%) and depression (9.4%–66.1%), due to the disease and its treatment, which are associated with a reduced quality of life [3–6]. Furthermore, breast cancer survivors are at an increased risk of adverse mental health outcomes, such as anxiety and depression [6–8].

Symptom management is of high priority in cancer care. Psychosocial interventions can improve the psychological well-being of patients with breast cancer, with current evidence particularly highlighting the beneficial effects of traditional face-to-face delivery [4, 7, 9–11]. However, there is a need to improve their reach and use, given that no more than 41% of cancer survivors utilize them [12].

Evidence increasingly supports the role of technology in cancer care. Specifically, various online-based interventions have been introduced to help women with breast cancer address their psychological symptoms [13–17]. Currently, medical personnel can provide customized supportive care to patients using the internet as a platform and information technology as a tool, and this type of care is becoming increasingly popular among patients with cancer [14]. This scoping review of 231 studies on digital health interventions for adult cancer patients found that 81% were implemented at home, with 50.2% specifically utilizing web-based platforms. Home-based web interventions, designed for use primarily in the home, ensure convenient and continuous post-discharge care by allowing treatment without the need for hospital visits [15].

To date, several meta-analyses [18, 19] and reviews [16, 17] have attempted to verify the effectiveness of online interventions for each delivery method [18, 20, 21]. Digital health interventions are defined as the delivery or enhancement of health services and information to manage illness and health risks through the internet and related technologies, such as mobile health, telemedicine, telemonitoring, digital therapeutics, health analytics, and digital health systems [22]. Wearables, mobile applications, and Webpages are examples of digital technologies that were applied to enhance health care [15]. Web-based interventions are the most common digital health technology for cancer support, effectively reducing anxiety and depression, followed by mobile apps, telemedicine, telemonitoring, and wearables [15, 23, 24].

In summary, while various internet-based interventions for patients with breast cancer have shown potential, the evidence regarding their effectiveness is mixed. Of the 10 studies that examined symptoms of anxiety and depression, only five reported positive effects [13]. To establish conclusive evidence of their effectiveness, rigorous testing of these interventions is needed [13, 16], as these results should be recognized cautiously due to between-study heterogeneity. This study aimed to provide robust evidence of the efficacy of web-based interventions in reducing anxiety and depression in women with breast cancer by conducting a meta-analysis that exclusively included randomized controlled trials (RCTs) of web-based interventions in this patient group.

2 | Methods

This systematic review was conducted according to the guidelines of the Cochrane Handbook [25] and reported according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines [26]. The review protocol was registered in the International Prospective Register of Systematic Reviews (PROSPERO) under protocol number CRD42023488602.

2.1 | Information Sources and Search Strategies

Data searches were conducted under the guidance of an experienced medical librarian using six electronic databases (PubMed, Web of Science, the Cochrane Library, the Cumulated Index to Nursing and Allied Health Literature, Embase, and PsycINFO) from their inception to January 5, 2024. Furthermore, we searched Google Scholar for relevant articles and manually searched the references to find related articles. Our search strategy involved a combination of subject headings, keywords, entry terms, and free-text terms, employing Boolean operators “AND” and “OR.” The following keywords were used: “web-based intervention,” “breast cancer,” “anxiety,” and “depression.” Detailed search strategies used for each database are provided in Supporting Information S1: Tables S1–S6.

2.2 | Eligibility Criteria

The inclusion criteria, based on the patients, intervention, comparison, outcomes, and study design principle, were as follows: (1) participants: patients with breast cancer aged ≥ 18 years; (2) intervention: web-based intervention (delivered through web browsers on internet-connected devices, including a variety of online platforms that provide information and support, with options for synchronous interactions, such as real-time chat, and asynchronous interactions, such as emails and forums); (3) comparison: usual care, waiting list, routine care, basic care, and standard practice; (4) outcomes: anxiety and depression, measured through self-report questionnaires; and (5) study design: RCTs.

The exclusion criteria were as follows: (1) Studies that included patients diagnosed with other types of cancer besides breast cancer, patients with recurrent breast cancer, and patients with breast cancer who had severe cognitive and mental disorders; (2) studies involving interventions such as providing text messages or phone calls, interventions through mobile applications (which require installation via app stores and are often platform-specific, such as Android or iOS), or interventions combining web-based interventions with others; (3) Studies where the control group received web-based interventions similar to those in the experimental group, or studies where interventions other than usual care, routine care, basic care, and standard practice were conducted in the control group, or studies with no control group at all; (4) quasi-experimental studies; and (5) Studies that provided only statistical information, such as categorical or ordinal data, which do not allow the calculation of means and standard deviations required for meta-analysis.

2.3 | Study Selection and Data Extraction

All the data retrieved from the databases were exported to the EndNote 20 reference software package (Clarivate Analytics,

Philadelphia, PA, USA). Duplicate studies were removed using software functionality. We then used a two-step strategy for the study selection process. First, two independent reviewers (M.K. and S.R.) reviewed only the titles and abstracts of the selected studies based on the inclusion and exclusion criteria. Second, two reviewers (M.K. and S.R.) independently reviewed the full texts of the studies selected in the first step to select studies for the final analysis. Any discrepancies between the reviewers at each step were resolved by discussion with a third reviewer (K.J.K.) to reach a consensus.

An extraction table was developed, and two reviewers (M.K. and S.R.) independently extracted data from the studies included in the final analysis. The extracted data included the author, year of publication, country, participants, time since diagnosis, stage of cancer, sample size, mean age, method of intervention, duration of intervention, outcome measurement, and control group. Any discrepancies between the two reviewers were resolved through discussion among the authors, including a third reviewer (K.J.K.).

2.4 | Assessment of Risk of Bias

Two reviewers (M.K. and S.R.) independently evaluated the quality of the included studies using Cochrane's Risk of Bias Tool 2.0 for RCTs [27]. This tool consists of five domains that assess the risk of bias of a given study: randomization process, deviations from intended interventions, missing outcome data, outcome measurement, and selection of reported results. Each domain and the overall risk of bias were assessed as "low," "some concern," or "high." Any discrepancies between the two reviewers were resolved through discussion with a third reviewer (K.J.K.) until a consensus was reached. The assessment of the overall risk of bias was categorized as "low risk of bias" when all five domains were rated as low risk, "some concerns of bias" if one or more domains showed concerns but none were classified as high risk, and "high risk of bias" if any domain was evaluated as high risk [27].

2.5 | Data Synthesis and Statistical Analysis

Meta-analysis was performed using the R package Meta, version 4.0.3 (R Foundation for Statistical Computing, Vienna, Austria). As different tools were used to measure the outcomes in each study, we calculated the standardized mean difference (SMD) to compare the effects between the two groups according to the intervention. Additionally, as the included studies had small samples, which could lead to overestimation of effect sizes, we calculated Hedges' $\hat{g}$ to correct for this. We presented the 95% confidence interval (CI) of the effect size to indicate statistical significance and assigned weights using the inverse of the variance. Effect sizes were classified into three categories: SMD values were considered small when they ranged from 0.2 to < 0.5, moderate when they ranged from 0.5 to < 0.8, and large when they were ≥ 0.8 [28].

The I^2 statistic was used to evaluate the heterogeneity of the effect sizes: 0%–40% (might not be important), 30%–60% (may represent moderate heterogeneity), 50%–90% (may represent substantial heterogeneity), and 75%–100% (considerable heterogeneity) [25]. The random-effects model was applied when significant heterogeneity between studies was observed ($p \leq 0.1$ and $I^2 \geq 50\%$) and the fixed-effects model when no significant heterogeneity was found ($p > 0.1$ and $I^2 < 50\%$) [29].

When heterogeneity among the studies was substantial, random-effects moderator analyses were conducted to identify potential factors contributing to this variability. Previous meta-analyses evaluating the effects of web-based intervention on anxiety and depression have suggested that forms of intervention, duration of intervention [20, 30, 31], mean age, and sample size [31] may serve as potential moderators influencing these outcomes. Based on these findings, this study selected moderators expected to explain variations in intervention effects: categorical moderators (method and duration of intervention) and continuous moderators (mean age and sample size). Subgroup analyses were conducted for categorical moderators, and meta-regression was used for continuous moderators.

Publication bias was analyzed using funnel plots and Egger's regression tests. In cases where publication bias was detected, the trim-and-fill method was employed to assess the extent to which this bias affected the study results. A sensitivity analysis was conducted to determine the impact of excluding specific studies on the overall mean effect size, allowing us to evaluate the robustness of our findings.

3 | Results

3.1 | Study Selection

We conducted a comprehensive search of six databases, yielding 1447 studies. After removing duplicate records ($n = 327$) before screening, 1120 studies remained. Upon an initial review of the titles and abstracts, 1089 studies were excluded, leaving 31 studies for further consideration. One study that could not be retrieved during the search was excluded, resulting in 30 full-text reviews. Among these, 17 studies were excluded for various reasons, including the absence of a control group ($n = 2$), improper variables ($n = 6$), insufficient data for meta-analysis ($n = 6$), improper intervention ($n = 2$), and presentation as a poster ($n = 1$), resulting in 13 studies being retained from the database searches. Additionally, manual searches yielded five additional studies that lacked a control group ($n = 1$), improper intervention (interventions combining web-based interventions with others) ($n = 2$), and insufficient data for meta-analysis ($n = 1$), resulting in one study being retained from the manual search. Ultimately, 14 articles were included in the final analysis (Figure 1).

3.2 | Characteristics of the Included Studies

The years of publication of the included studies ranged from 2003 to 2023. Most studies were carried out in Europe ($n = 7$), followed by the United States of America ($n = 3$), with one study each in Canada, Turkey, Korea, and Austria. Time since

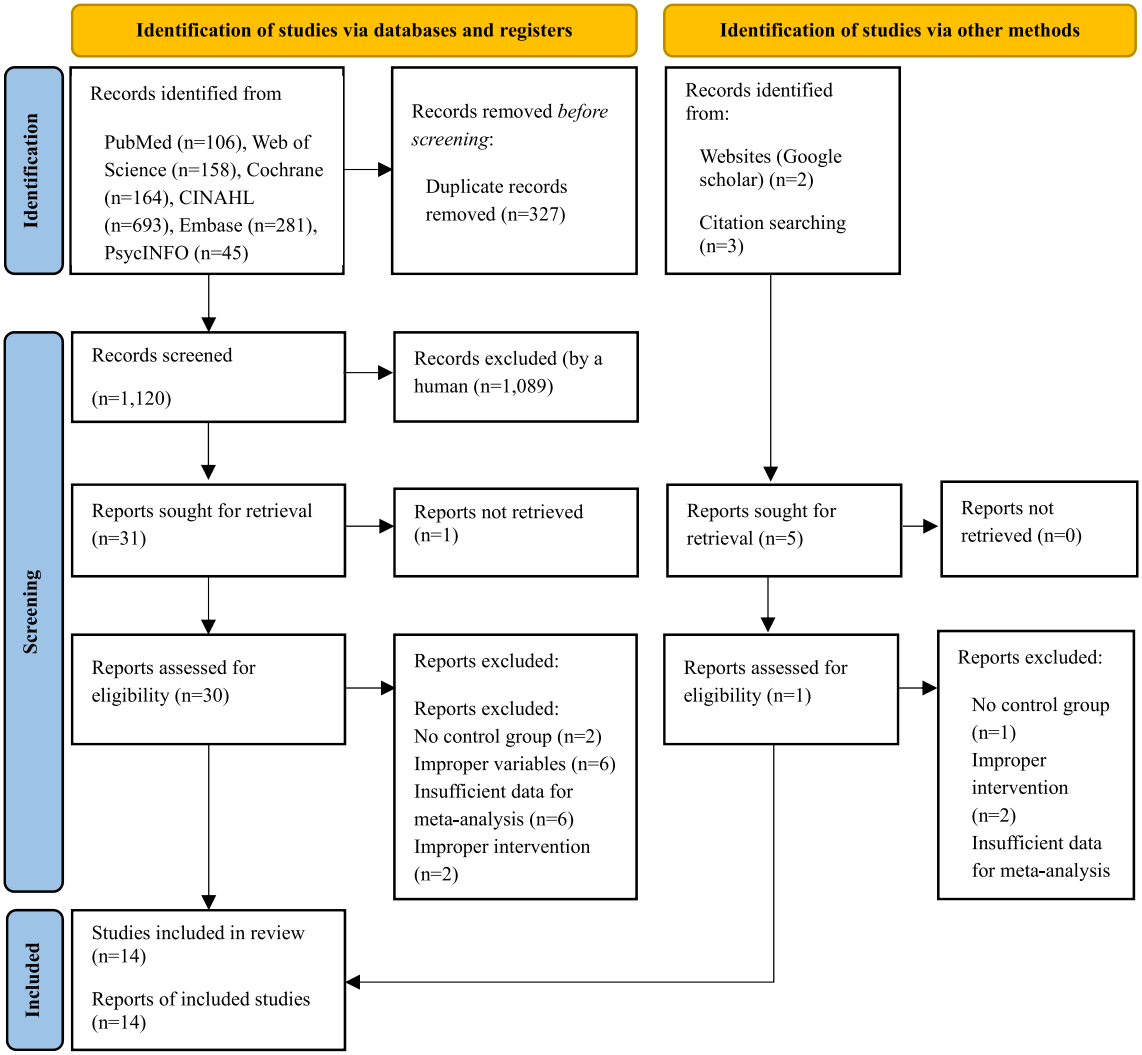

FIGURE 1 | Flowchart summarizing the process of study selection. CINAHL, Cumulated Index to Nursing and Allied Health Literature.

diagnosis ranged from 0.59 to 4.74 years in the experimental group and from 0.6 to 4.44 years in the control group, with seven studies not reporting this information. There was variability in the stage range included across studies, with some studies including stages 0-IV ($n = 2$), I-IV ($n = 2$), or 0-III ($n = 2$), while others included stages I-III ($n = 1$), I-II ($n = 1$), or II-III ($n = 1$), or did not report stage information ($n = 5$). The sample size of the experimental group ranged from 22 to 171 participants, whereas that of the control group ranged from 20 to 165 participants. Most study participants were aged 40–59 years in both the experimental and control groups.

The intervention methods primarily consisted of internet-based cognitive behavioral therapy (CBT), with five studies utilizing this approach. Additionally, other interventions including education ($n = 3$), online support ($n = 3$), psychological counseling ($n = 1$), cognitive training ($n = 1$), and self-management ($n = 1$) were also used. The duration of the interventions ranged from 4 to 30 weeks, lasting < 12 weeks in seven studies and ≥ 12 weeks in seven studies. The Hospital Anxiety and Depression Scale (HADS) ($n = 6$) was the most commonly used tool for assessing anxiety and depression, followed by the Self-Assessment Inventory (SAI) ($n = 3$) for anxiety and the Center for Epidemiological Studies-Depression Scale (CES-D) ($n = 2$) for depression. For the control groups, the majority of the studies used a waiting list ($n = 7$), followed by usual care ($n = 5$) (Table 1).

3.3 | Risk of Bias

The risk of bias in the 14 studies was evaluated. In the first domain, the randomization process, six studies were rated as "low," four studies as "some concerns," and four studies as "high" because they contained no information indicating that the allocation sequence was randomized or concealed until the participants were enrolled and assigned to the interventions. In the second domain, deviations from intended interventions, nine studies were rated as "low" and four studies as "high" because an appropriate analysis was not conducted to estimate the effect of missing outcome data. In the third domain, missing outcome data, 10 studies were rated as "low" and four studies as "high." The reason for the rating of "high" was that no analysis was conducted to correct for bias due to missing outcome data. In the fourth domain, measurement of the outcome, seven studies were rated as "low" and seven as "some concerns"

TABLE 1 | Characteristics of the randomized controlled trial studies ($N = 14$).

Author (Year), Country	Participants	Time since diagnosis (years) mean ± SD	Stage of cancer	Sample size (E:C)	Mean age ± SD	Method of intervention	Duration of intervention	Outcome measurement	Control group
Akkol-Solakoglu (2023), Ireland or UK [32]	Patients with BC who completed primary cancer treatment	E: 3.52 ± 3.98 C: 3.80 ± 6.80	0 to IV	49:23	E: 47.12 ± 7.92 C: 49.30 ± 9.66	Psychosocial intervention: iCBT	8 weeks	1) Anxiety: HADS 2) Depression: HADS	Usual care
Amidi (2022), Denmark [33]	Women who were treated for BC	NR	I To III	77:54	Both groups: 53.7 ± 8.4	Psychosocial intervention: e-CBT-I (SHUTi)	6–9 weeks	1) Depression: BDI-II	Waiting list
Atema (2019), Netherland [34]	Women diagnosed with BC at ≤ 50 years of age	E: 3 ± 1.33 C: 3 ± 1.29	NR	79:80	E: 47.7 ± 5.73 C: 47.0 ± 5.50	Psychosocial intervention: Self-managed iCBT	6 weeks	1) Anxiety: HADS 2) Depression: HADS	Waiting list
Changrani (2008), USA [35]	Spanish-dominant-speaking immigrant women with BC	E: 1.0 ± 4.5 C: 3.2 ± 4.6	NR	42:20	E: 46.2 ± 12.1 C: 50.8 ± 13.9	Support group: OSGs	30 weeks	1) Depression: CES-D	Usual care
Damholdt (2016), Denmark [36]	Patients with BC who experienced subjective complaints of cognitive impairment	E: 4.74 ± 1.54 C: 4.44 ± 2.18	0 to IV	94:63	E: 54.98 ± 8.51 C: 54.56 ± 8.74	Psychosocial intervention: eCogT (cognitive training)	6 weeks	1) Anxiety: SCL-ANX4 2) Depression: BDI	Waiting list
David (2011), German [37]	Patients with BC	E: 2.4 ± 3.1 C: 2.1 ± 2.0	I To IV	31:34	E: 48.2 ± 9.2 C: 45.9 ± 7.8	Psychosocial intervention: Web-based e-mail counseling	2 months	1) Anxiety: BSI 2) Depression: BSI	Waiting list
Fergus (2022), Canada [38]	Patients who received a BC diagnosis within the past 36 months	NR	0 to III	31:36	E: 39.5 ± 5.9 C: 42.2 ± 7.4	Support group: Couplelinks online intervention	8 weeks	1) Anxiety: HADS 2) Depression: HADS	Waiting list
Holtdirk (2021), Germany [39]	Patients with BC who were diagnosed less than 5 years ago	NR	NR	141:165	E: 50.07 ± 8.51 C: 49.8 ± 7.98	Psychosocial intervention: a New CBT-based internet intervention	3 months	1) Anxiety: GAD-7 2) Depression: PHQ-9	Usual care
Hummel (2017), Netherlands [40]	Patients who were diagnosed with confirmed BC 6 months to 5 years ago	E: 3.13 ± 16.3 C: 3.18 ± 17.0	NR	69:82	E: 51.1 ± 7.2 C: 51.5 ± 7.7	Psychosocial interventions: Internet-based CBT	24 weeks	1) Anxiety: HADS 2) Depression: HADS	Waiting list

(Continues)

TABLE 1 | (Continued)

Author (Year), Country	Participants	Time since diagnosis (years) mean ± SD	Stage of cancer	Sample size (E:C)	Mean age ± SD	Method of intervention	Duration of intervention	Outcome measurement	Control group
Korkmaz (2020), Turkey [41]	Patients with BC who were hospitalized and underwent breast surgery (modified radical mastectomy or breast-conserving surgery)	NR	II to III	22:24	E: 44.63 ± 7.53 C: 49.95 ± 8.28	Education: Web-based education associated with the pre-operative and post-operative periods	1 month	1) Anxiety: SAI	Routine education
Lee (2014), Korea [42]	Patients with BC who had undergone curative surgery and completed primary cancer treatment within the past 12 months	NR	0 to III	29:28	E: 41.5 ± 6.3 C: 43.2 ± 5.1	Self-management: WSEDI	12 weeks	1) Anxiety: HADS 2)Depression: HADS	Basic care (Booklet)
Ryhanen (2013), Finland [43]	Patients newly diagnosed with BC	NR	I To IV	47:43	E: 54.4 C: 55.7	Education: Internet-based patient educational program	9 months	1) Anxiety: SAI	Standard practice
White (2018), Australia [44]	BC survivors who were young and diagnosed within the last 6 months	E: 0.59 ± 2.1 C: 0.6 ± 2.1	I To II	171:165	E: 43.6 ± 5.0 C: 43.9 ± 5.3	Education: "*inform*" (information for Me) website: Self-directed information resource	3 months	1) Anxiety: HADS 2) Depression: HADS	Usual care
Winzelberg (2003), USA [45]	Women who were diagnosed with BC within the last 32 months	NR	NR	36:36	Both groups: 49.5	Support group: Internet support group (Bosom Buddies)	12 weeks	1) Anxiety: SAI 2) Depression: CES-D	Waiting list

Abbreviations: BC, breast cancer; BDI, Beck Depression Inventory; BSI, Brief Symptom Inventory; C, control group; CBT, cognitive behavioral therapy; CES-D, Center for Epidemiological Studies-Depression Scale; e-CBT-I, internet-delivered cognitive-behavioral therapy for insomnia; eCogT, web-based cognitive training; E, experimental group; GAD-7, Generalized Anxiety Disorder, seven items; HADS, Hospital Anxiety and Depression Scale; iCBT, internet-delivered cognitive behavioral therapy; NR, not reported; OSGs, Online Support Groups; PHQ-9, Patient Health Questionnaire, nine items; SAI, State Anxiety Inventory; SCL-ANX4, Symptoms Checklist - Anxiety Subscale 4; SD, standard deviation; SHUTi, Sleep Healthy Using the internet; WSEDI, web-based self-management exercise and diet intervention program.

because the assessors knew the interventions received by participants as they were self-reported, and there was a possibility of the outcome evaluation being influenced by the information received through the intervention. In the fifth domain, the selection of the reported result, all studies were rated as "low." The overall risk of bias was assessed as "low" for four studies, "some concerns" for three studies, and "high" for seven studies (Figure 2).

The meta-analysis for anxiety included 12 studies involving 1558 patients with breast cancer. The pooled overall effect of web-based interventions on anxiety in patients with breast cancer showed a small effect size (SMD = −0.26, 95% CI = −0.44 to −0.07), indicating that patients in the web-based intervention group experienced a slight reduction in anxiety compared to the control group. The heterogeneity was represented by I^2 = 68%, indicating "may represent substantial heterogeneity" (Figure 3).

3.4 | Effect of Web-Based Interventions on Depression in Patients With Breast Cancer

The meta-analysis for depression included 12 studies involving 1635 patients with breast cancer. The pooled overall effect of web-based interventions on depression in patients with breast cancer showed a small effect size (SMD = −0.15, 95% CI = −0.25 to −0.06), indicating that patients in the web-based intervention group experienced a slight reduction in depressive symptoms compared to the control group. The heterogeneity was represented by I^2 = 26%, indicating "might not be important" (Figure 4).

3.5 | Subgroup and Moderator Analyses

For anxiety, the heterogeneity estimate was I^2 = 68%, representing substantial heterogeneity; therefore, a moderator analysis was conducted. Subgroup analyses of the categorical moderators, including methods and duration of intervention, were conducted. In the subgroup analysis of the method of intervention, the interventions were categorized into psychosocial (including CBT and psychological counseling), educational, support group, and self-management interventions. Psychosocial interventions did not show statistical significance (SMD = −0.16, 95% CI = −0.39 to 0.07). However, educational interventions showed statistical significance (SMD = −0.43, 95% CI = −0.78 to −0.09). To examine differences in effect sizes across subgroups, a *meta*-ANOVA was conducted, revealing significant differences among the method of interventions (QM = 9.77, df = 3, P_b = 0.032). The findings suggest that the variation in intervention methods contributed to the differences in effect sizes, indicating a potential moderating effect. Furthermore, the explanatory power of the actual variance explained by the moderator variable in the meta-regression, the method of intervention, was R^2 = 23.7%. On the other hand, in the subgroup analysis of the duration of intervention, there was no significant difference between the two subgroups.

We conducted meta-regression analyses to evaluate whether continuous variables, such as mean age and sample size, could explain the heterogeneity of effect sizes across studies. However, the results indicated that neither mean age nor sample size was found to be a statistically significant moderator of the intervention effect size (see Table 2).

3.5.1 | Publication Bias

First, to evaluate publication bias in the anxiety studies, funnel plots were examined to assess symmetry. However, the visual appearance was asymmetric, prompting Egger's regression, which showed no statistical asymmetry (t = 1.866, p = 0.094) (Supporting Information S1: Figure S1A). Subsequently, in the depression studies, a funnel plot detected publication bias; however, it did not exhibit asymmetry. Nonetheless, upon performing Egger's regression for accuracy, no asymmetry was indicated (t = −0.550, p = 0.594) (Supporting Information S1: Figure S1B).

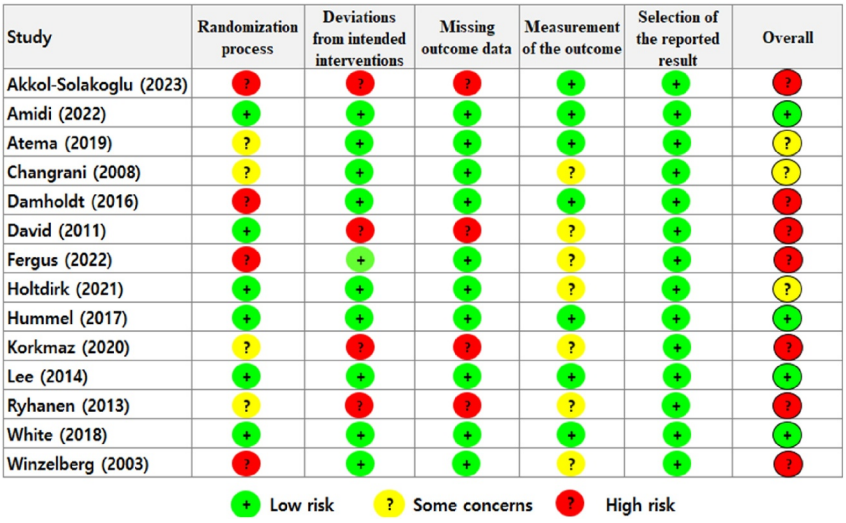

FIGURE 2 | Risk-of-bias summary according to the revised Cochrane risk-of-bias 2.0 tool for randomized trials.

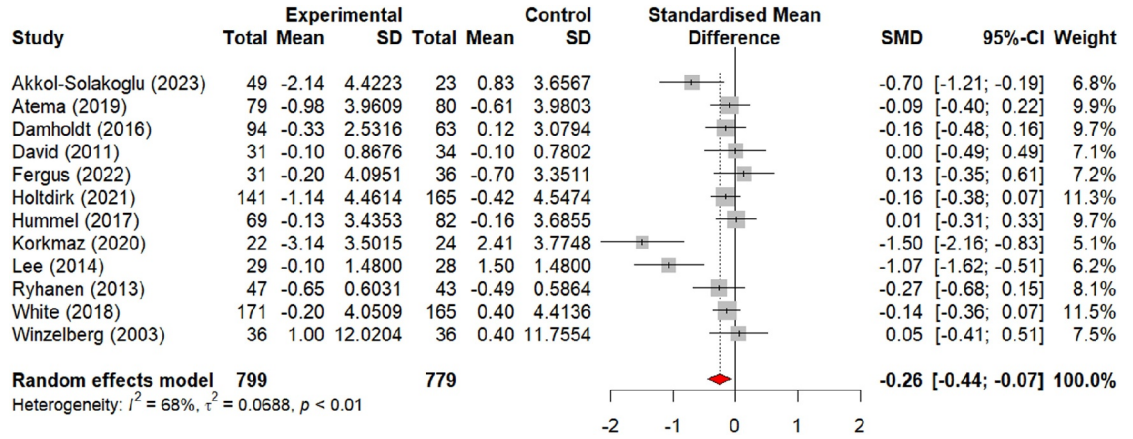

FIGURE 3 | Forest plots: effect of web-based intervention on anxiety. CI: confidence interval; SD: standard deviation; SMD: standardized mean difference.

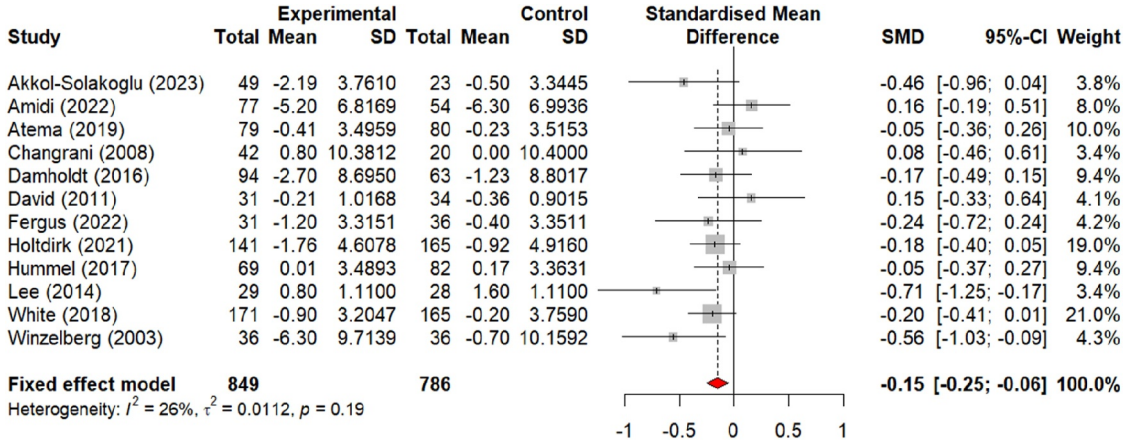

FIGURE 4 | Forest plots: effect of web-based intervention on depression. CI: confidence interval; SD: standard deviation; SMD: standardized mean difference.

TABLE 2 | Moderator analyses for the intervention effects on anxiety.

Moderators	Subgroup	k	Random-effects SMD	95% CI	I^2(%)	Between groups Q_b (df)	p_b
Categorical moderators	Method of intervention					8.77 (3)	0.032
	Psychosocial intervention	6	−0.16	−0.39, 0.07	15.6		
	Educational intervention	3	−0.43	−0.78, −0.09	86.3		
	Support group intervention	2	0.09	−0.36, 0.55	0		
	Self-management intervention	1	−1.06	−1.78, −0.35	—		
	Meta-regression QM (df = 3) = 8.77, p = 0.032						
	R^2 (amount of heterogeneity accounted for): 23.7%						
	Duration of intervention					0.19 (1)	0.660
	< 12 weeks	6	−0.30	−0.60, −0.01	76.6		
	≥ 12 weeks	6	−0.22	−0.49, 0.05	59.3		

	Variables	k	QM	β	SE	p	R^2(%)
Continuous moderators	Mean age	12	0.31	0.013	0.024	0.573	0.0
	Sample size	12	1.58	0.001	0.001	0.207	0.0

Abbreviations: CI, confidence interval; df, degrees of freedom; p_b, P between groups; Q_b, Q between groups; QM, Q moderator; SE, standard error; SMD, standardized mean difference.

3.5.2 | Sensitivity Analysis

Upon conducting sensitivity analysis for anxiety, we found that excluding the study by M. K. Lee et al. [42]. resulted in a decrease in effect size to −0.19, meaning it had the greatest impact on the overall effect size, although not at a significant level (Supporting Information S1: Figure S2A). Additionally, for depression, sensitivity analysis revealed that excluding the studies by M. K. Lee et al. [42] and Winzelberg et al. [45]. led to a reduction in the effect size to −0.13 each, yet no significant difference was observed compared with the overall effect size (Supporting Information S1: Figure S2B). Therefore, our study results suggesting the effectiveness of web-based interventions for anxiety and depression in patients with breast cancer were reliable.

4 | Discussion

This study conducted a systematic review and meta-analysis to explore whether web-based interventions are effective for anxiety and depression in patients with breast cancer. The meta-analysis including 14 studies (12 studies on anxiety, 12 studies on depression) revealed that web-based interventions significantly reduced anxiety and depression in patients with breast cancer. The standardized mean difference for anxiety reduction was 0.26 and for depressive symptoms reduction was 0.15, both of which were small effect sizes, indicating modest effectiveness for reducing anxiety and depression. These results highlight the value of web-based interventions as psychosocial interventions for patients with breast cancer. As has been well reported, web-based interventions have the advantage of overcoming time and space restrictions when providing health-related services [46]. Patients with breast cancer have responded that web-based interventions are more attractive than face-to-face approaches in terms of acceptability, usefulness, and participation, which is due to the advantages of the anonymous environment provided by web-based interventions [46, 47].

This study is the first meta-analysis to comprehensively synthesize the effects of various types of web-based interventions on psychological symptoms in patients with breast cancer. The results of this meta-analysis are consistent with the results of previous studies [30, 48], and this study is meaningful in that it comprehensively covers various types of web-based interventions aimed at reducing anxiety and depression in patients with breast cancer. However, the results of a meta-analysis on the effect of a specific single type of web-based intervention on improving anxiety or depression in patients with breast cancer were confirmed [30, 48]. Li et al. [30] also meta-analyzed internet-based cognitive behavioral interventions, and they confirmed a significant effect size of −0.44 for depression and −0.34 for anxiety. Yang et al. [48] showed that internet-based cognitive behavioral intervention had a significant effect size of −0.38 for depression but did not confirm a significant effect for anxiety. While these two previous studies revealed the effect of cognitive behavioral intervention as a single type of intervention, this study included not only cognitive behavioral therapy but also education, support groups, e-mail counseling, and self-management interventions. And this study was the first to find a combined effect of these various web-based interventions in alleviating psychological problems in patients with breast cancer.

Since the results of this meta-analysis found considerable heterogeneity in the effect on anxiety, a subgroup analysis was performed. Anxiety in patients with breast cancer was significantly reduced when the intervention period was less than 12 weeks and the intervention type was education. The duration of web-based intervention was confirmed to affect the anxiety relief of patients with breast cancer. In a previous meta-analysis of interventions for patients with breast cancer, anxiety was reduced when the intervention period was less than 12 weeks but was not effective when it exceeded 12 weeks [30]. Another previous meta-analysis of RCTs of web-based cognitive behavioral interventions targeting all patients with cancer showed that anxiety was reduced when the intervention period was less than 9 weeks but was not effective when it exceeded 9 weeks [20]. This suggests that patients with breast cancer who participated in web-based interventions could not maintain high compliance after a certain period of time. Patients with breast cancer experience emotional instability due to pain related to the disease or treatment during the process of chronic improvement and deterioration and experience uncertainty about the prognosis or fear of possible deterioration. In such a situation, it would be difficult to effectively manage anxiety while maintaining long-term compliance with the intervention [49, 50]. Therefore, in order for a web-based intervention to be effective in reducing anxiety by improving or maintaining adherence among patients with breast cancer, it may be necessary to design the intervention to last no longer than 12 weeks while incorporating strategies such as periodic and continuous follow-up and individualized interaction with professionals through the web platform [20, 51]. When the intervention type was web-based education, the anxiety of patients with breast cancer decreased. This could be considered in relation to the supportive intervention provided by healthcare professionals [52, 53]. Although peer group interventions provide benefits from interactions among peers in similar situations [23, 45], negative psychological effects such as despair and anxiety learned through transfer from other patients within the peer group have also been identified [47, 54, 55]. Psychoeducational interventions in which healthcare providers provide information about disease, treatment, and symptoms and guide coping strategies and self-management skills for the symptoms related disease and treatment increase knowledge and self-efficacy in patients with breast cancer, thereby improving anxiety symptoms [52].

4.1 | Clinical Implications

This study shows that web-based interventions are useful as a possible alternative to face-to-face treatment as a strategy for psychological relief in patients with breast cancer, which may increase accessibility and decrease costs due to lower need for resources. Clinicians should consider incorporating web-based programs as part of routine psychosocial care for patients with breast cancer to support mental health, especially when face-to-face therapy is inaccessible or impractical. The results of this study also suggest that the type and duration of web-based interventions should be carefully considered when developing

interventions or making decisions to improve practices aimed at alleviating depression in patients with breast cancer. For instance, when designing web-based interventions to reduce anxiety, emphasis should be placed on structured, high-quality educational content. It may be beneficial to limit the intervention duration to no more than 12 weeks while incorporating strategies such as periodic and continuous follow-up, as well as individualized interactions with healthcare professionals through the web platform. These findings inform clinical practice, guiding the creation of accessible and efficient interventions tailored to the unique needs of patients with breast cancer, ultimately contributing to improved patient outcomes and satisfaction.

4.2 | Study Limitations

This study had some limitations. First, this study conducted a systematic review and meta-analysis using only RCTs; there was no publication bias, and the robustness of the results was verified through sensitivity analysis. However, some of the included studies were evaluated as having a high overall risk of bias because they had insufficient information on randomization and allocation concealment. More RCTs with high methodological quality are needed to evaluate the effectiveness of web-based interventions for psychological variables such as anxiety and depression. Second, the number of studies included in the analysis of this study was small, and the intervention types, components, and application conditions were different, which probably resulted in high heterogeneity in the anxiety reduction effect, so the study results should be interpreted cautiously. Third, although intervention methods were an important moderator, the small number of studies and high heterogeneity in each subgroup may limit the generalizability and reliability of the results. Future research should include more studies and provide stronger evidence for various intervention methods. Lastly, although the studies included in the analysis of this study had different time elapsed since breast cancer diagnosis and breast cancer stages during the intervention period, this meta-analysis was performed without controlling for these.

5 | Conclusions

This study showed that web-based interventions may help reduce anxiety and depression in patients with breast cancer. It also suggested the potential of these interventions as a strategy for alleviating symptoms in non-face-to-face settings. However, the limited number of studies and high heterogeneity in the subgroup analysis made it difficult to assess the effects of different intervention methods. Further high-quality research is needed to provide more reliable data on the effectiveness of various intervention methods.

Author Contributions

Myoungsuk Kim: conceptualization, investigation, data curation, formal analysis, methodology, project administration, writing – original draft, validation, visualization. **Kyung Ja Kang:** conceptualization, investigation, data curation, methodology, writing – original draft. **Seang Ryu:** conceptualization, investigation, data curation, formal analysis, methodology, writing – original draft, writing – review and editing, validation.

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The authors have nothing to report.

Ethics Statement

Ethical approval and patient consent are not necessary for this meta-analysis, as the data used were obtained from primary studies that had ethical approval and did not involve the use of original raw data.

Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

The data that support the findings of this study are available upon reasonable request.

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Supporting Information

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