Review

Digital Health Psychosocial Intervention in Adult Patients With Cancer and Their Families: Systematic Review and Meta-Analysis

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Abstract

Background: Patients with cancer and their families often experience significant distress and deterioration in their quality of life. Psychosocial interventions were used to address patients' and families' psychosocial needs. Digital technology is increasingly being used to deliver psychosocial interventions to patients with cancer and their families.

Objective: A systematic review and meta-analysis were conducted to review the characteristics and effectiveness of digital health interventions on psychosocial outcomes in adult patients with cancer and their family members.

Methods: Databases (PubMed, Cochrane Library, Web of Science, Embase, CINAHL, PsycINFO, ProQuest Dissertations and Theses Global, and ClinicalTrials.gov) were searched for randomized controlled trials (RCTs) or quasi-experimental studies that tested the effects of a digital intervention on psychosocial outcomes. The Joanna Briggs Institute's critical appraisal checklists for RCTs and quasi-experimental studies were used to assess quality. Standardized mean differences (ie, Hedges g) were calculated to compare intervention effectiveness. Subgroup analysis was planned to examine the effect of delivery mode, duration of the intervention, type of control, and dosage on outcomes using a random-effects modeling approach.

Results: A total of 65 studies involving 10,361 patients (mean 159, SD 166; range 9-803 patients per study) and 1045 caregivers or partners (mean 16, SD 54; range 9-244 caregivers or partners per study) were included in the systematic review. Of these, 32 studies were included in a meta-analysis of the effects of digital health interventions on quality of life, anxiety, depression, distress, and self-efficacy. Overall, the RCT studies' general quality was mixed (applicable scores: mean 0.61, SD 0.12; range 0.38-0.91). Quasi-experimental studies were generally of moderate to high quality (applicable scores: mean 0.75, SD 0.08; range 0.63-0.89). Psychoeducation and cognitive-behavioral strategies were commonly used. More than half (n=38, 59%) did not identify a conceptual or theoretical framework. Most interventions were delivered through the internet (n=40, 62%). The median number of intervention sessions was 6 (range 1-56). The frequency of the intervention was highly variable, with self-paced (n=26, 40%) being the most common. The median duration was 8 weeks. The meta-analysis results showed that digital psychosocial interventions were effective in improving patients' quality of life with a small effect size (Hedges g=0.05, 95% CI –0.01 to 0.10; I^2=42.7%; P=.01). The interventions effectively reduced anxiety and depression symptoms in patients, as shown by moderate effect sizes on Hospital Anxiety and Depression Scale total scores (Hedges g=–0.72, 95% CI –1.89 to 0.46; I^2=97.6%; P<.001).

Conclusions: This study demonstrated the effectiveness of digital health interventions on quality of life, anxiety, and depression in patients. Future research with a clear description of the methodology to enhance the ability to perform meta-analysis is needed. Moreover, this study provides preliminary evidence to support the integration of existing digital health psychosocial interventions in clinical practice.

Introduction

Cancer is often associated with psychological distress in patients and their family members. Emerging evidence shows that psychological distress contributes to cancer mortality [1,2]. Given that over 2 million new cancer cases are expected to be diagnosed in 2024 in the United States, psychosocial distress is a significant public health problem [3]. Psychosocial distress can be triggered by many challenges, such as decision-making regarding treatment, self-care challenges due to side effects from cancer treatment, maintaining work-life balance, and financial burden. A large body of research documents the negative influence of a cancer diagnosis and treatment on a patient's experience, including depression, anxiety, and decreased quality of life [4,5]. Cancer not only affects the patient but also imposes changes on the family [6]. Family members, who often assume caregiving roles to complement the roles of the health care team, often experience deteriorating quality of life and significant psychological distress [7,8]. For many years, researchers have examined psychosocial interventions addressing patients' and family members' needs to help maintain psychosocial well-being and quality of life during the cancer experience [9-12].

Increasingly, studies have used digital technology to deliver psychosocial interventions. In this report, we refer to digital health intervention as the use of digital, mobile, and wireless technologies to deliver an intervention. Digital health interventions have gained popularity due to their geographic accessibility, self-paced nature, user-friendly design, up-to-date information provision, and time-sensitive interaction with health care providers [13,14]. Further, digital interventions have significant potential for reaching people, mainly in rural areas or people with limited mobility [15]. There are various delivery modes for digital interventions, such as smartphone apps, websites, the internet, and virtual reality. There are also drawbacks, including concerns related to security and privacy and inaccessibility for people without smart device ownership. Psychosocial interventions may incorporate various components, such as communication skills training, cognitive behavioral therapy, patient education, peer support, and problem-solving training [16].

Despite the plethora of individual research studies, a synthesis of digital psychosocial interventions for patients with cancer and their families is needed to provide a summary of existing evidence regarding the effects of interventions and provide directions for future research and clinical practice. A range of systematic reviews have examined digital health psychosocial interventions for patients with cancer [17-22] and their family members [23,24]. However, these reviews have limitations. For example, some reviews primarily focused on a specific population, such as individuals with breast [17] or prostate cancer [19,20]; a particular delivery mode, such as internet-based [17,23,24]; or a specific psychosocial outcome, such as quality of life or psychological distress [21,22]. In addition, Slev et al [25] synthesized evidence from systematic reviews of interventions delivered through computers or the internet for patients with cancer and their caregivers; however, the authors failed to quantify the effectiveness of interventions across studies using advanced statistical techniques, such as a meta-analysis. To date, no studies have used meta-analytical strategies to quantify the impact of digital health interventions on psychosocial outcomes in patients with cancer and family members. To fill these gaps, we conducted a systematic review and meta-analysis to comprehensively review the characteristics and effectiveness of digital psychosocial interventions on psychosocial outcomes across different available delivery modes in adult patients with cancer and their family members.

The specific aims were to answer the following questions:

1. What are the characteristics of digital psychosocial interventions for adult patients and families living with cancer? (ie, intervention component, theoretical or conceptual framework, tailored or standardized, mode of delivery, prescribed dosage, duration of the intervention, and actual dosage)?
2. What is the efficacy of interventions on psychosocial outcomes for adult individuals diagnosed with cancer and their family members and associated factors (ie, delivery mode, control condition, and dosage, including the number of sessions, frequency, and duration)?

Methods

The review followed the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) checklist [26].

Study Identification

The medical librarian (DR) and first author (YZ) worked together to identify search terms to build a comprehensive search strategy ([Multimedia Appendix 1](#)). Using controlled vocabulary and keywords when available, the search strategy was executed in the following databases: PubMed, Cochrane Library, Web of Science, Embase, CINAHL, PsycINFO, ProQuest Dissertations and Theses Global, and ClinicalTrials.gov. The results were limited to the English language and those published from each resource's inception until March 2019, when the search was completed. An initial limited search of PubMed and CINAHL was undertaken, followed by an analysis of the text words in the abstract and the index terms used to describe the article. Relevancy was determined by the first author (YZ) and medical librarian (DR). A second search was undertaken across

all included databases using all identified keywords and index terms.

Study Selection

The inclusion criteria were studies that (1) included adult patients (≥18 years of age with any cancer diagnosis) or their adult family members (eg, partner, caregiver, adult children, parent, or relative); (2) tested a digital health psychosocial intervention, which was defined as any nonpharmacological therapeutic intervention that addressed the psychological, social, personal, or relational adjustment needs associated with cancer through a digital health mechanism (eg, application and website); (3) measured at least 1 psychosocial outcome; and (4) used an experimental (randomized controlled trial [RCT]) or a quasi-experimental design. Studies were excluded if they enrolled pediatric patients with cancer; were review articles, letters to the editor, editorial reports, case reports, or commentaries; were published as abstracts only; and were not published in English. For meta-analysis, we excluded articles that did not provide data or when only a single study included the outcome measure.

After removing duplicates, the first author (YZ) read all titles and abstracts to identify articles based on inclusion and exclusion criteria. The full texts of all included articles were then screened independently by 2 reviewers (master's-level or above), and final decisions were made based on consensus. Finally, articles identified in the search were imported to Endnote X8 (Clarivate Analytics).

Data Extraction and Management

A Microsoft Excel (Microsoft Corporation) spreadsheet was used to record information [27], including the description of the interventions (eg, theory basis, mode of delivery, content, actual dosage, planned dosage, standardized, or tailored), study sample (eg, age, sex, education, race, ethnicity, and cancer diagnosis), study characteristics (eg, design, randomization method, and control condition), intervention outcome variables and measurements, follow-ups, and quantitative data (ie, mean, SD, and sample size). Dosage was described as the number of intervention sessions, frequency, and duration of access to intervention. A standardized intervention was defined as all participants receiving the same intervention, while a tailored intervention involved customization of the intervention based on individual characteristics or needs [28]. We defined the prescribed dosage as the intended treatment dose, including the number of intervention sessions, frequency, and total length according to the study protocol. A codebook was created for data extraction, and the team's decisions were tracked and recorded. All authors extracted data from 3 articles to pilot-test the spreadsheet. The research team discussed any ambiguity, resolved differences in interpretation, and modified the data extraction spreadsheet. Subsequently, each article underwent independent data extraction by YZ and another author (6 trained reviewers). The research team met throughout the study period every other week to resolve any discrepancies. A total of 15 original study authors were contacted to request missing information (eg, mean, SD, and sample size), and no additional data were received.

Assessment of Methodological Quality

The reviewers assessed the included studies for methodological rigor using standardized critical appraisal instruments from the 13-item Joanna Briggs Institute (JBI) Critical Appraisal Checklist for RCT and the 9-item JBI Critical Appraisal Checklist for quasi-experimental studies [29]. Reviewers answered each risk of bias item as "yes" (score=1), "no" (score=0), "unclear" (score=0), or "not applicable." Possible composite scores ranged from 0 to 9 for quasi-experimental studies and 0-13 for RCTs, with higher scores indicating less risk of bias and better study quality. The applicable score (range 0-1) was calculated by dividing the composite score by the maximum score possible after subtracting any "not applicable" responses [30]. All studies were double-coded, and any disagreements were resolved through discussion with the research team [26].

Data Synthesis and Meta-Analysis

Data Synthesis

Data synthesis was completed on all articles that met the inclusion criteria. Only primary study results were included if multiple articles were published from the same intervention study. Simple descriptive statistics (ie, mean, SD, frequency, and percentage) were used to summarize study characteristics (eg, study design and participant characteristics) and key features of interventions (ie, theory, mode of delivery, number of sessions, frequency, and total length). Intervention content was grouped and narratively summarized according to the description of the intervention components.

Meta-Analytical Procedure

An a priori decision was made to only include studies in the meta-analysis if at least 2 studies used the same instrument to assess the same psychosocial outcome [31]. Standardized mean differences (ie, Hedges g) were calculated to compare intervention effectiveness across studies that used different scales or measurements. Mean differences between the scores before the intervention and the follow-up assessment after the intervention were calculated for pre-post interventions. Similarly, for the RCT studies, the results from follow-up in each study were selected and analyzed using difference scores from before and after the intervention for both intervention and control groups, with the pooled SDs. We computed the overall effect size across different time points for studies with multiple follow-ups. By doing so, we captured the time-varying effect on intervention effectiveness [31]. The overall effect (including all information across all time points) and time-varying effects, including the interim effect (during the intervention period), immediate effect (after the intervention), short-term effect (follow-up ≤8 weeks after completion of the intervention), and long-term effect (follow-up >8 weeks after completion of the intervention), were calculated. A cutoff of 8 weeks was chosen because it was the median length of the follow-up period across the included studies.

To assess study heterogeneity, the I^2 statistic was examined. The I^2 statistic quantifies the proportion of total variance across studies caused by a fundamental difference between trials rather than chance. An I^2 statistic of <25% indicates low heterogeneity,

between 25% and 75% indicates moderate heterogeneity, and >75% indicates high heterogeneity [32]. Lower heterogeneity is better. Funnel plots (ie, to visually assess the asymmetry) and Egger test (ie, to test the asymmetry statistically) assessed publication bias [33]. In funnel plots, if points are distributed equally between positive and negative effects, bias is lacking; variability is expected to be greater near the bottom of the chart among smaller sample size studies. For the analysis of data from studies with more than 1 digital psychosocial intervention group, we compared each digital psychosocial intervention group to the control group separately. Additionally, subgroup analysis was planned based on the review's focus on examining the effect of delivery mode, type of control condition, and dosage on outcomes. Furthermore, we performed sensitivity analyses by including and excluding studies with extreme weights in the analyses. We used the DerSimonial-Laird random-effects model to weight and pool the individual estimates to capture variance across different studies, as all included studies were conducted in heterogeneous populations across various settings [34]. We performed all statistical and meta-analyses using STATA (version 17; StataCorp LLC).

Results

Search Results

After removing duplicates, a total of 2108 studies were identified. Figure 1 shows a flow diagram of studies identified, screened, included, and excluded from this systematic review and meta-analysis. After screening titles and abstracts and applying inclusion and exclusion criteria, a total of 70 records with 65 unique studies (for multiple manuscripts published from the same intervention study, only primary manuscripts were included) were included in the systematic review [35-99] and 32 studies [35,36,38,40,41,43,44,47,50,53-55,57,64,66,68-72, 74,77,80,82,83,86,88,91,93,95,96,99] with available data were included in the meta-analysis. A total of 33 studies were excluded from the meta-analysis because either data were unavailable to calculate the effect size (n=14) [42,46,51,62,73,76,78,79,81,84,87,89,94,98] or no other study used the same measure (n=19) [37,39,45,48,49,52, 56,58-61,63,65,67,75,85,90,92,97].

Figure 1. PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) flow diagram.
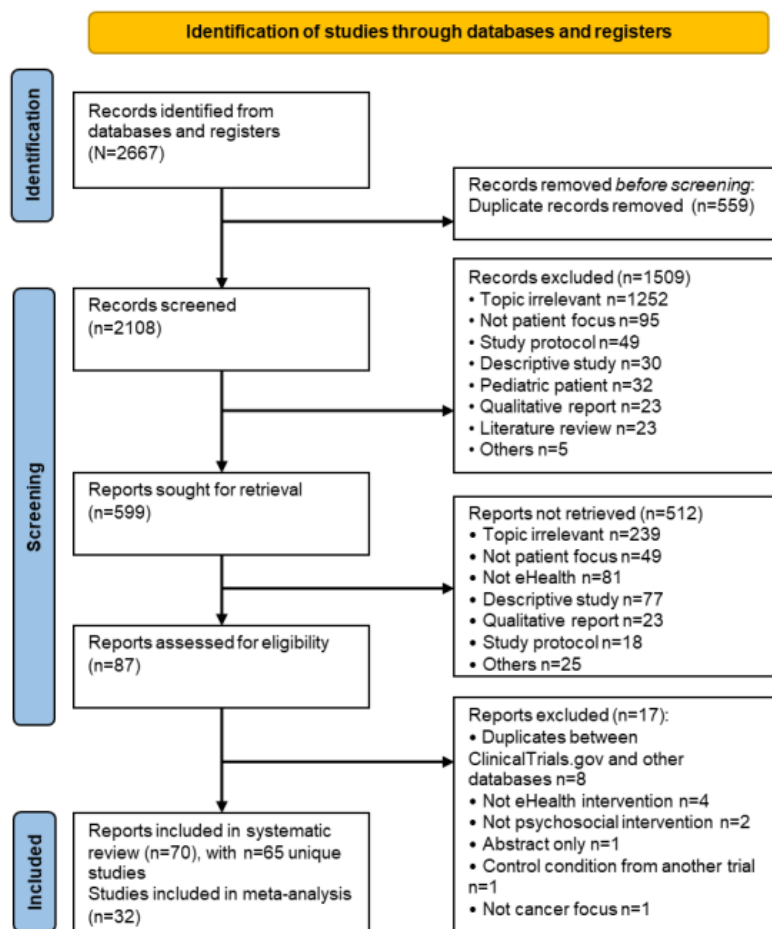
Study Characteristics

Overview

Of the 65 studies, 48 (74%) were RCTs [35-37, 39-50,52-57,59-65,72,73,76-82,85,89-91,93-99], and 17 (26%) were quasi-experimental [38,51,58,66-71,74,75,83,84,86-88,92].

More than half (n=37, 58%) of the studies were conducted in the United States [36-40,44,48-50,54,56-61,63, 65,67-69,71,72,74,77,79,80,83-85,87-90,94,97,98], and the rest were from the Netherlands (n=9, 14%) [35,41,43,47,64,70,91,92,96], Australia (n=5, 8%) [45,66,75,86,95], and other countries (eg, Denmark and Ireland). In total, 10,361 patients (mean 159, SD 166; range 9-803

patients per study) were included: 7098 female patients and 3263 male patients; 1045 caregivers or partners were enrolled (mean 16, SD 54; range 9-244 caregivers or partners per study), including 781 female individuals and 264 male individuals. The average age of patients ranged from 39.9 to 72 years, and the average age of caregivers or partners ranged from 51.5 to 58.8 years. In the 33 studies that provided information about race and ethnicity, most patients (n=3495, 90%) and family members (n=259, 97%) were described as "White" or "Caucasian." The cancer diagnoses varied across studies, with the most prevalent being breast cancer (n=24, 37%) [35,37,38,42, 44,52,54,58,60,61,64-66,70-72,74,76,80,82,84,91,93,95], mixed cancer diagnosis (n=19, 29%) [36,40,45, 47,50,51,53,57,62,69,75,77,78,81,83,94,96,97,99], and prostate cancer (n=7, 11%) [39,48,56,67,85,88,98]. The attrition rate ranged from 0% to 76%, with a median of 16.8% (mean 20.4%, SD 13.7%). The recruitment rate ranged from 4.4% to 94.2%, with a median of 59.5% (mean 56%, SD 24.6%). Detailed information about the study and sample characteristics from the included studies is provided in Table S1 in Multimedia Appendix 2 [35-99].

Control Condition

Of the 48 RCTs, 29 (60%) studies included a usual care control group [35,36,39,41-44,46,47,52,54,55,62,64,65,73,76-80,82, 85,91,93-96,99], and 19 (40%) included an active control [37,40,45,48-50,53,56,57,59-61,63,72,81,89,90,97,98]. Among the 17 quasi-experimental studies, 11 (65%) did not have a control group [38,51,67-71,74,86-88], and 6 (35%) studies included a usual care control group [58,66,75,83,84,92].

Outcome Assessment

A total of 21 studies had 1 follow-up assessment [22,38,45,47,48,50,51,57,68-70,72,74,76-78,88-90,98,99], 23 had 2 follow-up assessments [35,39,44,46,52-55, 63-65,67,71,75,79,83,84,86,87,92,93,95,97], 11 had 3 follow-up assessments [37,40-43,60-62,66,80,91], and 7 had 4 or more follow-up assessments [49,56,58,59,73,81,85]. The timing of follow-up assessments varied, ranging from immediately to 6 months after the intervention. The commonly reported outcomes and relevant measures are reported below in *Aim 2: Effects on Patients' and Family Members' Psychosocial Outcomes*.

Quality Assessment (Risk of Bias)

The quality assessment scores of the included studies are summarized in Table S1 in Multimedia Appendix 2. Overall, the RCT studies' general quality was mixed, with applicable scores ranging from 0.38 to 0.91 (mean 0.61, SD 0.12). Quasi-experimental studies were generally of moderate to high quality, with applicable scores ranging from 0.63 to 0.89 (mean 0.75, SD 0.08) on the JBI Critical Appraisal Checklist for quasi-experimental studies. The publication year and applicable appraisal score were not significantly correlated in RCTs ($r=0.12$; $P=.40$) and quasi-experimental studies ($r=-0.04$; $P=.88$).

Aim 1: Intervention Characteristics

Overview

There was large heterogeneity in intervention components, theoretical or conceptual framework, type of intervention (ie, tailored or standardized), mode of delivery, prescribed dosage (ie, number of sessions, frequency, and length), and received dosage (Table S2 in Multimedia Appendix 2).

Intervention Components

A total of 37 (57%) out of 65 studies included a single intervention component [36,38-40,44,45,47,51,52,55-57,63-66, 68,69,71-77,79,80,82-84,86,87,90,91,93,94,98], 13 (20%) studies included 2 intervention components [35,41,43,46,48,50,62,67,78,85,88,95,96], and 15 (23%) studies included 3-5 intervention components [37,42, 49,53,54,58-61,70,81,89,92,97,99]. The most common intervention components were information and resources, or psychoeducation (n=29, 45%) [35,37,39-43,46,48,49, 52-56,58-61,70,81,82,87-90,92,95,97], and cognitive-behavioral strategies (n=20, 31%) [44,45,47,50,54,57,63,64, 67,68,71,74,75,80,85-87,89,91,98].

Theoretical or Conceptual Framework

More than half (n=38, 59%) of the included studies did not identify a conceptual or theoretical framework [37,41,42,45-47,51,52,54,55,57-63,66,69,71,73,75,76,78-81,85-90,92,93,95,97,98].

Standardized or Tailored Intervention

Of the 65 studies, 26 (40%) included both standardized and tailored interventions [37,39,42,43,46,47,49,53,55, 59-61,64,68,70,73-75,77-79,81,85,89,92,94], 28 (43%) studies included only standardized interventions [36,38, 41,44,50,51,54,56-58,63,65-67,69,71,72,76,80,82-84,87,88,91,93,95,98], and 11 (17%) studies had only tailored interventions [35,40,45,48,52,62,86,90,96,97,99].

Modes of Delivery

The majority of studies conducted interventions through an internet website (n=40, 62%) [35-37,39-50, 53,55,59-62,64,67,68,70,72,75,77,81,82,85,88-91,93,95-99] or smart device app (n=8) [43,52,56,57,63,69,80,87]. A total of 7 (11%) studies conducted interventions through virtual reality [51,66,73,76,78,83,84], 3 (5%) studies through telehealth [54,74,79], and 2 (3%) studies through a computer program [38,65]. Electronic health information systems [92], interaction portals [58], and videoconferences [86] were each used in 1 study. Overall, 2 studies used multimodal interventions delivered through the combination of either telephone and videoconference [94] or internet and telephone [61].

Dosage

The dosage prescribed and received were highly variable. The number of intervention sessions ranged from 1 to 56, with a median of 6. A total of 27 (42%) studies did not specify the prescribed dose; 19 (29%) only stated the number of days participants had access to the intervention [35,36,42,49,56,59-62,67,70,80,81,85,87,89,92,95,99] and 8 (12%) did not provide information on the prescribed dosage [37,39,40,52,55,58,72,73]. Frequency was highly variable, with

self-paced (n=26, 40%) as the most common [35,36,42,45,49,50,56,59-63,67,70,80,81,85,87-90,92,95-97,99], meaning no specific intervention frequency was defined and the intervention content was available throughout the study period. The other common frequencies of intervention sessions were weekly (n=17, 26%) [38,41,44,45,47,53,54,64, 68,71,74,75,77,86,91,94,98] and 1-time intervention sessions (n=8, 12%) [48,65,66,76,78,82-84]. The median length of the intervention was 8 weeks, with the length ranging from 1 hour (ie, use of the intervention on an iPad for an hour) to 24 months. Received dosage was defined as the uptake of the intervention by the participants. A total of 18 (28%) studies did not report the received dosage [36,37,39,48,52,56,58,65,69,75, 76,78,79,82,85,86,93,94]. Various information was reported, including attendance rate, number of times participants used the app, frequency with which participants logged into the website, number of website pages reviewed, skill practice time, and intervention session completion rate. Most of the interventions (n=43, 66%) were self-delivered without an

interventionist, with self-paced being most common [35-37,39,40,42,44,45,48-53,55,57-60,62,63,67,69-73, 75,76,78,80-84,87,88,91-93,95,96,99].

Aim 2: Effects on Patients' and Family Members' Psychosocial Outcomes

Patients' Outcomes

Overview

A meta-analysis was conducted on 32 studies. Overall, 5 outcomes were examined. A summary of the interventions' overall effect sizes; time-varying effect sizes for quality of life, anxiety, depression, distress, and self-efficacy; and heterogeneity statistics for each outcome is displayed in Table 1. The forest plots for overall effect sizes and time-varying effects are displayed in Multimedia Appendix 3. The funnel plots for overall effect sizes and time-varying effects are displayed in Multimedia Appendix 4.

Table 1. Summary of the meta-analysis.

Population, outcome, measure, and value	Effect at different time points				
	Overall[a]	Immediate	Interim	Short	Medium
Patient					
QOL[b]					
FACT-B[c]					
Pooled ES[d], Hedges g (95% CI)	0.13 (–0.05 to 0.31)	—[e]	—	—	—
I^2	62.3	—	—	—	—
Heterogeneity, χ^2 (df)	10.61 (4)	—	—	—	—
P value	.03	—	—	—	—
FACT-G[f]					
Pooled ES, Hedges g (95% CI)	–0.04 (–0.17 to 0.09)	—	—	—	—
I^2	0	—	—	—	—
Heterogeneity, χ^2 (df)	1.91 (4)	—	—	—	—
P value	.43	—	—	—	—
QLQ-30[g]					
Pooled ES, Hedges g (95% CI)	0.05 (–0.04 to 0.14)	—	—	—	—
I^2	58.4	—	—	—	—
Heterogeneity, χ^2 (df)	19.95 (6)	—	—	—	—
P value	.03	—	—	—	—
SF36[h]					
Pooled ES, Hedges g (95% CI)	0.03 (–0.10 to 0.15)	—	—	—	—
I^2	14.4	—	—	—	—
Heterogeneity, χ^2 (df)	8.41 (8)	—	—	—	—
P value	.31	—	—	—	—
Overall					
Pooled ES, Hedges g (95% CI)	0.05 (–0.01 to 0.10)	0.95 (–1.99 to 3.89)	–0.16 (–0.39 to 0.06)	2.25 (0.36 to 4.14)	0.18 (0 to 0.35)
I^2	42.7	100	70	98	18.3
Heterogeneity, χ^2 (df)	48.12 (20)	93227.62 (19)	3.34 (1)	203.50 (4)	7.35 (6)
P value	.01	<.001	.07	<.001	.29
Anxiety and depression					
HADS[i] total score					
Pooled ES, Hedges g (95% CI)	–0.72 (–1.89 to 0.46)	–0.04 (–0.23 to 0.16)	—	–0.22 (–0.54 to 0.10)	0.14 (–0.09 to 0.38)
I^2	97.6	0	—	0	0
Heterogeneity, χ^2 (df)	165.82 (14)	3.71 (4)	—	0.19 (1)	0.51 (1)
P value	<.001	.45	—	.66	.47
Depression					

Population, outcome, measure, and value	Effect at different time points				
	Overall[a]	Immediate	Interim	Short	Medium
HADS-depression					
Pooled ES, Hedges g (95% CI)	–0.13 (–0.23 to –0.02)	—	—	—	—
I^2	0	—	—	—	—
Heterogeneity, χ^2 (*df*)	4.17 (7)	—	—	—	—
P value	.73	—	—	—	—
CESD[j]					
Pooled ES, Hedges g (95% CI)	0.10 (–0.10 to 0.30)	—	—	—	—
I^2	0	—	—	—	—
Heterogeneity, χ^2 (*df*)	0.99 (4)	—	—	—	—
P value	.91	—	—	—	—
PHQ9[k]					
Pooled ES, Hedges g (95% CI)	–0.05 (–0.17 to 0.08)	—	—	—	—
I^2	0	—	—	—	—
Heterogeneity, χ^2 (*df*)	0.78 (1)	—	—	—	—
P value	.38	—	—	—	—
Multiple scales					
Pooled ES, Hedges g (95% CI)	0.32 (–0.35 to 0.99)	—	—	—	—
I^2	95	—	—	—	—
Heterogeneity, χ^2 (*df*)	19.86 (1)	—	—	—	—
P value	<.001	—	—	—	—
Overall					
Pooled ES, Hedges g (95% CI)	0.03 (–0.10 to 0.16)	0.06 (–0.10, 0.22)	-0.04 (–0.22, 0.14)	—	—
I^2	60.9	69.4	29.8	—	—
Heterogeneity, χ^2 (*df*)	40.77 (16)	58.85 (16)	4.27 (1)	—	—
P value	<.001	<.001	0.23	—	—
Anxiety					
HADS-anxiety					
Pooled ES, Hedges g (95% CI)	0.32 (–0.20 to 0.84)	—	—	—	—
I^2	94.3	—	—	—	—
Heterogeneity, χ^2 (*df*)	123.33 (7)	—	—	—	—
P value	<.001	—	—	—	—
SATI[l]					
Pooled ES, Hedges g (95% CI)	–0.19 (–0.41 to 0.04)	—	—	—	—
I^2	26.8	—	—	—	—

Population, outcome, measure, and value	Effect at different time points				
	Overall[a]	Immediate	Interim	Short	Medium
Heterogeneity, χ^2 (*df*)	5.46 (4)	—	—	—	—
P value	.24	—	—	—	—
Overall					
Pooled ES, Hedges *g* (95% CI)	0.12 (–0.19 to 0.43)	–0.10 (–0.19 to 0)	–0.04 (–0.19 to 0.12)	–0.13 (–0.43 to 0.17)	—
I^2	90.2	6.7	35.1	10.5	—
Heterogeneity, χ^2 (*df*)	132.99 (13)	13.94 (13)	6.16 (4)	1.12 (1)	—
P value	<.001	.38	.19	.29	—
Distress					
DT[m]					
Pooled ES, Hedges *g* (95% CI)	0.98 (–0.18 to 2.14)	0.51 (0.10 to 0.92)	—	—	—
I^2	98.5	54.2	—	—	—
Heterogeneity, χ^2 (*df*)	332.71 (2)	4.37 (2)	—	—	—
P value	<.001	.11	—	—	—
Self-efficacy					
CBI[n]					
Pooled ES, Hedges *g* (95% CI)	–1.41 (–4.02 to 1.20)	2.56 (–1.22 to 6.35)	—	—	—
I^2	99	98.2	—	—	—
Heterogeneity, χ^2 (*df*)	1.06 (1)	55.43 (1)	—	—	—
P value	.29	<.001	—	—	—
Family member					
Depression					
HADS-depression					
Pooled ES, Hedges *g* (95% CI)	–0.25 (–0.72 to 0.21)	—	—	—	—
I^2	0	—	—	—	—
Heterogeneity, χ^2 (*df*)	0.41 (1)	—	—	—	—
P value	.52	—	—	—	—
Anxiety					
HADS-anxiety					
Pooled ES, Hedges *g* (95% CI)	–0.23 (–0.70 to 0.23)	—	—	—	—
I^2	0	—	—	—	—
Heterogeneity, χ^2 (*df*)	0.65 (1)	—	—	—	—

Population, outcome, measure, and value	Effect at different time points				
	Overall[a]	Immediate	Interim	Short	Medium
P value	.42	—	—	—	—

[a]The overall effect accounts for time-varying effect across different time points.

[b]QOL: quality of life.

[c]FACT-B: Functional Assessment of Cancer Therapy–Breast.

[d]ES: effect size.

[e]Not applicable.

[f]FACT-G: Functional Assessment of Cancer Therapy–General.

[g]QLQ-30: Quality of Life Questionnaire, 30 items.

[h]SF36: Short Form Survey 36-item.

[i]HADS: Hospital Anxiety and Depression Scale.

[j]CESD: Center for Epidemiologic Studies Depression Scale.

[k]PHQ9: Patient Health Questionnaire-9.

[l]SATI: State-Trait Anxiety Inventory.

[m]DT: Distress Thermometer.

[n]CBI: Coping Behaviors Inventory.

Quality of Life

Quality of life was measured by the Functional Assessment of Cancer Therapy–Breast [44,54,80,93,95], Functional Assessment of Cancer Therapy–General [38,53,57,86,88], European Organization for Research and Treatment of Cancer Quality of Life Questionnaire, 30-items [35,40,43,74,91,96,99], and 36-item Short Form Survey [41,54,64,70,71]. Overall, a total of 21 studies with 1847 participants in the intervention groups showed an increase in quality of life, with a mean difference between groups of Hedges g=0.05 (95% CI –0.01 to 0.10). The impact of heterogeneity within the studies was significant (I^2=42.7%; P=.01). With respect to publication bias, the funnel plot displayed a greater number of studies toward the top of the mean (Egger test, P<.001). The time-varying effects were as follows: Hedges g=–0.16 (95% CI –0.39 to 0.06) for the interim effect; Hedges g=0.95 (95% CI –1.99 to 3.89) for the immediate effect; Hedges g=2.25 (95% CI 0.36-4.14) for the short-term effect; and Hedges g=0.18 (95% CI 0-0.35) for the long-term effect. The statistical heterogeneity among studies was I^2=70% (P=.07) for the interim effect; I^2=100% (P<.001) for the immediate effect; I^2=98% (P<.001) for the short-term effect; and I^2=18.3% (P=.29) for the long-term effect.

Anxiety and Depression

Hospital Anxiety and Depression Scale (HADS) total scores (without subscale scores reported) were reported in 5 studies with 338 participants in the intervention groups [43,47,64,86,91]. Overall, participants receiving interventions reported decreased anxiety and depression with a standardized mean difference of Hedges g=–0.72 (95% CI –1.89 to 0.46). The heterogeneity within the studies was significant (I^2=97.6%; P<.001). The funnel plot was found to be asymmetric, and Egger test was found to be not statistically significant (P=.77). The time-varying effects were as follows: Hedges g=–0.04 (95% CI –0.23 to 0.16) for the immediate effect; Hedges g=–0.22 (95% CI –0.54 to 0.10) for the short-term effect; and Hedges g=0.14 (95% CI –0.09 to 0.38) for the medium-term effect. The statistical heterogeneity among studies was I^2=0% across all time-varying effects.

Depression

Depression was assessed by the HADS-depression subscale [50,69,74,86,95,96,99], Center for Epidemiologic Studies Depression Scale [41,68,71,77], Patient Health Questionnaire-9 (PHQ-9) [40,53], and a combination of the PHQ-9 and HADS-anxiety [43,57] in 1509 participants in the intervention groups. Overall, interventions were not more effective than control conditions for reducing depression (Hedges g=0.03, 95% CI –0.10 to 0.16), with a high heterogeneity of 60.9% (P<.001). With respect to publication bias, the funnel plot displayed a greater number of studies toward the top of the mean (Egger test, P=.25). The time-varying effects were as follows: Hedges g=0.06 (95% CI –0.10 to 0.22) for the immediate effect and Hedges g=–0.04 (95% CI –0.22 to 0.14) for the interim effect. The statistical heterogeneity among studies was I^2=69.4% for the immediate effect and I^2=29.8% for the interim effect.

Anxiety

Anxiety was assessed by the HADS-anxiety subscale [57,64,69,74,86,95,96,99], State-Trait Anxiety Inventory (STAI) [66,71,72,82,83], and a combination of the STAI and HADS-anxiety [43] in 1075 participants in the intervention groups. Overall, interventions were not more effective than control conditions for reducing anxiety (Hedges g=0.12, 95% CI –0.19 to 0.43), with high heterogeneity of 90.2% (P<.001). The funnel plot displayed a greater number of studies toward the top of the mean (Egger test, P=.46). The interim effect was Hedges g=–0.04 (95% CI –0.19 to 0.12), and the immediate effect was Hedges g=–0.10 (95% CI –0.19 to 0), and the short-term effect was Hedges g=–0.13 (95% CI –0.43 to 0.17). The statistical heterogeneity among studies was I^2=35.1% for the interim effect, I^2=6.7% for the immediate effect, and I^2=10.5% for the short-term effect.

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Distress

Psychological distress was assessed in 182 participants in the intervention groups using the distress thermometer [35,69,91]. Overall, participants in the intervention groups showed no reduction in distress, with a mean difference between groups of Hedges g=0.98 (95% CI –0.18 to 2.14). The impact of heterogeneity within the studies was significant (I^2=98.5%; P<.001). Regarding publication bias, the funnel plot displayed a symmetric distribution around the mean effect (Egger test, P=.46). The immediate effect was Hedges g=0.51 (95% CI 0.10-0.92), with statistical heterogeneity I^2=54.2%.

Self-Efficacy

Self-efficacy was measured by the Coping Behaviors Inventory in 174 participants in the intervention groups [44,55]. Overall, participants in the intervention groups did not report improvement in self-efficacy, with a standardized mean difference of Hedges g=–1.41 (95% CI –4.02 to 1.20). However, the impact of heterogeneity within studies was significant (I^2=99%; P<.001). Regarding the publication bias, the funnel plot displayed a symmetric distribution around the mean effect (Egger test, P=.22). The immediate effect was Hedges g=2.56 (95% CI –1.22 to 6.35) with high heterogeneity (I^2=98.2%; P<.001).

Subgroup Analyses

Given the heterogeneity of reporting on dosage information and limited data, the subgroup analysis of dosage on intervention effect was not conducted. Table 2 includes the results of the subgroup analysis on the effect on quality of life, depression and anxiety, and distress. Overall, the associations between delivery mode and control condition with patient outcomes were not statistically significant (P>.05).

Table 2. Subgroup analyses on the effect of delivery mode (internet vs noninternet) and control condition (usual care vs active control) on patient outcomes.

Outcome and moderators	Effect size, Hedges g (95% CI)	SE	P value
Quality of life (27 studies)			
Delivery mode	0.04 (–0.06 to 0.14)	0.05	.45
Control condition	–0.01 (–0.99 to 0.06)	0.04	.78
HADS[a] total (6 studies)			
Delivery mode	0.16 (–0.30 to 0.62)	0.24	.50
Control condition	N/A[b]	N/A	N/A
Depression (21 studies)			
Delivery mode	0.10 (–0.09 to 0.29)	0.10	.31
Control condition	–0.04 (–0.17 to 0.09)	0.07	.55
Anxiety (15 studies)			
Delivery mode	0.01 (–0.07 to 0.09)	0.04	.79
Control condition	–0.06 (–0.34 to 0.22)	0.14	.67
Distress (8 studies)			
Delivery mode	N/A	N/A	N/A
Control condition	–0.03 (–0.34 to 0.28)	0.15	.86

[a]HADS: Hospital Anxiety and Depression Scale.

[b]N/A: not applicable.

Family Members' Outcomes

The forest plots for overall effect sizes are displayed in Multimedia Appendix 5. The funnel plots for overall effect sizes are displayed in Multimedia Appendix 6. For family members' data, we pooled 2 studies [36,69] on anxiety and depression for the meta-analysis with 68 participants in the intervention groups. Due to the small sample size, no time-varying effect or subgroup analysis was calculated. The overall effect on anxiety was Hedges g=–0.23 (95% CI –0.70 to 0.23), with heterogeneity of I^2=0% (P=.42). The overall effect on depression was Hedges g=–0.25 (95% CI –0.72 to 0.21), with heterogeneity of I^2=0% (P=.52). Regarding publication bias, the funnel plot displayed asymmetrical scattered points with statistical significance (Egger test, P<.001).

Discussion

Overview

This systematic review and meta-analysis of 65 unique digital psychosocial intervention studies for patients with cancer and their family members provides strong evidence that psychosocial interventions delivered through digital health significantly improve psychosocial outcomes. There were 3 major findings. First, this review included a large group of participants with various cancer diagnoses; however, underrepresented

populations affected by cancer were not included, and the results predominantly focused on White patients. Second, we found that various intervention modes and components were used. There is a lack of specificity with respect to the description of interventions or theoretical basis for interventions, which may hinder future replication or refinement of the interventions and understanding of underlying mechanisms. Third, despite high heterogeneity across studies, the available data suggest that digital psychosocial interventions effectively improve some psychosocial outcomes, including patients' quality of life, anxiety, and depression.

Principal Findings

First, the majority of participants in the included studies were White and female, which does not reflect the broader patient population with cancer, including non-White ethno-racial groups (ie, African American or Black, American Indian and Alaska Native, Asian, Native Hawaiian or other Pacific Islander, and Hispanic or Latino populations). It is well documented in the literature that the impact of cancer on psychological distress and quality of life is worse for racial and ethnic minority groups [100-102]. Therefore, future trials should include more participants from underrepresented groups to reduce health care disparities and improve generalizability in diverse populations [103]. Family members and caregivers were rarely included in the studies reviewed. However, there is ample evidence that family members and caregivers experience significant caregiver burden, worsening quality of life, and difficulty with psychological adjustment, therefore needing support [104,105]. Previous systematic reviews suggest that interventions targeting problem-solving and communication skills may ease the burden related to patient care and improve caregivers' quality of life [106]. Many reviews focus on the evaluation of nondigital interventions targeting the psychosocial experience in family members and caregivers, including several reviews of caregiver interventions [9,107-109]. Therefore, with growing technology usage, more digital interventions are needed to address family members' or caregivers' needs.

Few RCTs met all quality criteria, including blinding, analysis by treatment assignment, and standardized outcome assessment [110]. While concealing assignments from participants and those delivering interventions is not always possible, single blinding of assessors should occur in well-designed research. Few studies used power calculations for sample size, making it difficult to determine whether sample sizes were adequate [111]. Generally, results from group sizes <20 are questionable. There are several effective strategies known to increase the retention rate, such as adding monetary incentives and using an open trial design [112,113]. The critical appraisal also depends on comprehensive reporting of study details, which were limited in the identified studies. Although attempts have been made to improve reporting using the CONSORT (Consolidated Standards of Reporting Trials) statement for RCTs and the Transparent Reporting of Evaluations with Nonrandomized Designs (TREND) statement for nonrandomized intervention studies in the early 2000s [114,115], we did not see improvement in appraisal scores over time. The main limitations of the results include underpowered and methodologically weaker studies.

These highlight the need for improved methodologies in future research, as the overall methodological quality was moderate.

Second, this study identified various intervention modes and components, which is consistent with a previous systematic review of psychosocial interventions for patients with advanced cancer, which identified similar intervention components, including psychoeducation and CBT-based intervention, as 2 of the most common [11]. However, more than half of the included studies did not use theoretical or conceptual frameworks to guide the development of intervention components or selection of outcomes. The lack of a theoretical framework leads to a lack of clarity about the mechanisms through which intervention components impact psychosocial outcomes [116]. In future research, theories or conceptual frameworks need to be incorporated to help us better understand the mechanisms that explain the changes in psychosocial outcomes when using digital health interventions.

In addition, the prescribed dosage information (ie, the number of sessions, duration, and frequency) was inconsistently reported, making it difficult to estimate an efficacious intervention dose. Most of the interventions were self-paced, without the involvement of an interventionist, which gives the patient autonomy to choose which intervention component or module they would like to focus on and how much time to allocate. However, there is a lack of information on intervention uptake, which may have influenced the effectiveness of interventions. Approaches that tackle barriers to adherence at various levels (eg, individual, family, clinician, agency, and environment) and improve engagement should be implemented [117]. For example, a scoping review about engagement strategies in digital interventions for mental health promotion recommended personalized feedback, e-coaching to guide content and individual progress, social platforms and interaction with peers, content gamification, reminders, and ease of use [118].

Third, we found some significant improvement in the patient's quality of life. Some studies with a smaller number of participants or with a focus on internet-based interventions reported an improvement, but the results from these studies were not consistent [21,119]. This meta-analysis, including 21 studies, revealed a small effect size for overall effectiveness of digital health interventions in improving patients' quality of life (Hedges g=0.05, 95% CI –0.01 to 0.10), with time-varying effects shown as promising. Another meta-analysis that pooled 16 studies demonstrated a larger positive effect of mHealth interventions on the quality of life of patients with cancer (standardized mean difference 0.28, 95% CI 0.03-0.53) [21]. Another meta-analysis that included 6 internet-based psychoeducational interventions for patients with cancer showed no significant improvement in quality of life (mean difference 1.10, 95% CI –4.42 to 6.63) [119]. Importantly, our analyses found the largest improvements in quality of life occurred from post intervention to 8 weeks (Hedges g=2.25, 95% CI 0.36-4.14). The effect of psychosocial interventions decreased after 8 weeks of follow-up, suggesting that interventions may need booster sessions or tailoring to time-sensitive needs in order to maintain effectiveness in the long term. This result was limited by substantial inconsistency across studies in all

evaluation periods except the medium-term effect [32]. In addition, given the heterogeneity of follow-up periods in selected studies, the time-varying effect was only tested with a small number of studies, not in the 21 studies we used to calculate the overall effect.

This meta-analysis was able to demonstrate the effectiveness of digital health interventions on both anxiety and depression (measured by HADS: Hedges g=–0.72, 95% CI –1.89 to 0.46). Our finding was partially consistent with the other meta-analyses. One study showed that internet-based psychoeducational interventions had a significant effect on decreasing depression (standardized mean difference –0.58, 95% CI –1.12 to –0.03), but found no evidence for effects on distress (standardized mean difference –1.03, 95% CI –2.63 to 0.57) [119]. However, there was considerable heterogeneity in measurements among the studies included in the review by Wang et al [119]; it is difficult to determine how meaningful it is to make direct comparisons between the studies included in this meta-analysis and past reports. Possible ways to address this problem could be using similar outcome measures and a standardized study report.

Our meta-analysis demonstrated that the interventions were effective in reducing anxiety and depression in family caregivers. However, the effect size was small, perhaps due to the limited number of studies. This is partially consistent with findings from another meta-analysis, which found depressive symptoms decreased from baseline to post intervention (Hedges g=–0.44, 95% CI –1.03 to 0.15) [120], while anxiety remained relatively stable when comparing intervention to control either at postintervention (Hedges g=0.12, 95% CI –0.16 to 0.44) or during follow-up (Hedges g=–0.08, 95% CI –0.34 to 0.19).

Strengths and Limitations

This review's strength lies in its rigorous design, sophisticated data synthesis, and enduring empirical contributions. We acknowledge that our literature search was conducted 4 years before manuscript submission. The findings and contributions from our research remain pertinent and enduring. This is because, as digital psychosocial interventions continue to evolve, the core intervention content and outcomes have remained relatively consistent over the past 4 years. It would be valuable to conduct a reassessment of the evolving body of evidence concerning digital psychosocial interventions that have emerged since the onset of the COVID-19 pandemic. Moreover, this study was conducted in line with best practices by double-coding and following the PRISMA guidelines. The meta-analysis, including subgroup analysis, was conducted using appropriate methods for combining studies across various follow-up periods. Although we did an extensive search at the start of this review, we may have missed some critical studies, unreported, or unfinished studies. If all data were available, the meta-analysis could have reduced the chances of inflated type-1 error for both observed and unobserved effects that were available for assessment [121]. There was not enough data to perform post hoc analyses to examine the effect of factors such as intervention components and length of intervention on outcomes due to insufficient data.

Conclusions

Patients with cancer and their family members need high-quality psychosocial interventions throughout the cancer trajectory. Digital technologies provide a platform to deliver evidence-based psychosocial interventions from a distance, without the heightened risk of contracting viruses, especially for patients with cancer whose immune systems are compromised. This study comprehensively synthesized the effects of digital psychosocial interventions for people affected by cancer. Our findings suggest that digital health interventions are effective for adult patients with cancer and their family members. Further research development in this area needs to include large, high-quality studies with a clear description of the methodology, theoretical foundations, and standardized tools to permit inclusion in meta-analyses to inform the effectiveness of interventions for a better understanding of the mechanisms.

Conflicts of Interest

None declared.

Multimedia Appendix 1

Literature search strategy.
[DOCX File , 16 KB-Multimedia Appendix 1]

Multimedia Appendix 2

Summary tables.
[DOCX File , 53 KB-Multimedia Appendix 2]

Multimedia Appendix 3

Forest plots of studies reported on intervention effect on patient outcomes.

[DOCX File , 1723 KB-Multimedia Appendix 3]

Multimedia Appendix 4

Funnel plots of studies reported on intervention effect on patient outcomes.
[DOCX File , 91 KB-Multimedia Appendix 4]

Multimedia Appendix 5

Forest plots of studies reported on intervention effect on family member outcomes.
[DOCX File , 110 KB-Multimedia Appendix 5]

Multimedia Appendix 6

Funnel plots of studies reported on intervention effect on family member outcomes.
[DOCX File , 23 KB-Multimedia Appendix 6]

Multimedia Appendix 7

PRISMA checklist.
[PDF File (Adobe PDF File), 72 KB-Multimedia Appendix 7]

References

1. Batty GD, Russ TC, Stamatakis E, Kivimäki M. Psychological distress in relation to site specific cancer mortality: pooling of unpublished data from 16 prospective cohort studies. BMJ. 2017;356:j108. [FREE Full text] [doi: 10.1136/bmj.j108] [Medline: 28122812]

2. Lee H, Singh GK. The association between psychological distress and cancer mortality in the United States: results from the 1997-2014 NHIS-NDI record linkage study. Ann Behav Med. 2021;55(7):621-640. [FREE Full text] [doi: 10.1093/abm/kaaa111] [Medline: 33410477]

3. Cancer facts and figures 2024. American Cancer Society. URL: https://www.cancer.org/research/cancer-facts-statistics/all-cancer-facts-figures/2024-cancer-facts-figures.html [accessed 2024-01-30]

4. Fortin J, Leblanc M, Elgbeili G, Cordova MJ, Marin MF, Brunet A. The mental health impacts of receiving a breast cancer diagnosis: a meta-analysis. Br J Cancer. 2021;125(11):1582-1592. [FREE Full text] [doi: 10.1038/s41416-021-01542-3] [Medline: 34482373]

5. Niedzwiedz CL, Knifton L, Robb KA, Katikireddi SV, Smith DJ. Depression and anxiety among people living with and beyond cancer: a growing clinical and research priority. BMC Cancer. 2019;19(1):943. [FREE Full text] [doi: 10.1186/s12885-019-6181-4] [Medline: 31604468]

6. Northouse LL. Helping patients and their family caregivers cope with cancer. Oncol Nurs Forum. 2012;39(5):500-506. [doi: 10.1188/12.ONF.500-506] [Medline: 22940514]

7. Friðriksdóttir N, Saevarsdóttir T, Halfdánardóttir S, Jónsdóttir A, Magnúsdóttir H, Olafsdóttir KL, et al. Family members of cancer patients: needs, quality of life and symptoms of anxiety and depression. Acta Oncol. 2011;50(2):252-258. [FREE Full text] [doi: 10.3109/0284186X.2010.529821] [Medline: 21231786]

8. Johansen S, Cvancarova M, Ruland C. The effect of cancer patients' and their family caregivers' physical and emotional symptoms on caregiver burden. Cancer Nurs. 2018;41(2):91-99. [doi: 10.1097/NCC.0000000000000493] [Medline: 28426539]

9. Fu F, Zhao H, Tong F, Chi I. A systematic review of psychosocial interventions to cancer caregivers. Front Psychol. 2017;8:834. [FREE Full text] [doi: 10.3389/fpsyg.2017.00834] [Medline: 28596746]

10. Gabriel I, Creedy D, Coyne E. A systematic review of psychosocial interventions to improve quality of life of people with cancer and their family caregivers. Nurs Open. 2020;7(5):1299-1312. [FREE Full text] [doi: 10.1002/nop2.543] [Medline: 32802350]

11. Teo I, Krishnan A, Lee GL. Psychosocial interventions for advanced cancer patients: a systematic review. Psychooncology. 2019;28(7):1394-1407. [FREE Full text] [doi: 10.1002/pon.5103] [Medline: 31077475]

12. Badr H. Psychosocial interventions for patients with advanced cancer and their families. Am J Lifestyle Med. 2016;10(1):53-63. [FREE Full text] [doi: 10.1177/1559827614530966] [Medline: 30202258]

13. Chattu VK, Lopes CA, Javed S, Yaya S. Fulfilling the promise of digital health interventions (DHI) to promote women's sexual, reproductive and mental health in the aftermath of COVID-19. Reprod Health. 2021;18(1):112. [FREE Full text] [doi: 10.1186/s12978-021-01168-x] [Medline: 34088319]

14. Ventura F, Brovall M, Smith F. Beyond effectiveness evaluation: contributing to the discussion on complexity of digital health interventions with examples from cancer care. Front Public Health. 2022;10:883315. [FREE Full text] [doi: 10.3389/fpubh.2022.883315] [Medline: 35968430]

15. Kontos E, Blake KD, Chou WYS, Prestin A. Predictors of eHealth usage: insights on the digital divide from the health information national trends survey 2012. J Med Internet Res. 2014;16(7):e172. [FREE Full text] [doi: 10.2196/jmir.3117] [Medline: 25048379]

16. Hodges LJ, Walker J, Kleiboer AM, Ramirez AJ, Richardson A, Velikova G, et al. What is a psychological intervention? a metareview and practical proposal. Psychooncology. 2011;20(5):470-478. [doi: 10.1002/pon.1780] [Medline: 20878870]

17. McCaughan E, Parahoo K, Hueter I, Northouse L, Bradbury I. Online support groups for women with breast cancer. Cochrane Database Syst Rev. 2017;3(3):CD011652. [FREE Full text] [doi: 10.1002/14651858.CD011652.pub2] [Medline: 28278559]

18. Boulley GE, Leroy T, Bernetière C, Paquienseguy F, Desfriches-Doria O, Préau M. Digital health interventions to help living with cancer: a systematic review of participants' engagement and psychosocial effects. Psychooncology. 2018;27(12):2677-2686. [doi: 10.1002/pon.4867] [Medline: 30152074]

19. Qan'ir Y, Song L. Systematic review of technology-based interventions to improve anxiety, depression, and health-related quality of life among patients with prostate cancer. Psychooncology. 2019;28(8):1601-1613. [FREE Full text] [doi: 10.1002/pon.5158] [Medline: 31222956]

20. Neto LSS, Dias FCF, Osório NB, Rolim CLA. eHealth-based interventions for older patients with prostate cancer: a quick review of the literature. Telemed Rep. 2022;3(1):79-92. [FREE Full text] [doi: 10.1089/tmr.2021.0048] [Medline: 35720442]

21. Buneviciene I, Mekary RA, Smith TR, Onnela JP, Bunevicius A. Can mHealth interventions improve quality of life of cancer patients? a systematic review and meta-analysis. Crit Rev Oncol Hematol. 2021;157:103123. [FREE Full text] [doi: 10.1016/j.critrevonc.2020.103123] [Medline: 33190065]

22. Willems RA, Bolman CAW, Lechner L, Mesters I, Gunn KM, Ross XS, et al. Online interventions aimed at reducing psychological distress in cancer patients: evidence update and suggestions for future directions. Curr Opin Support Palliat Care. 2020;14(1):27-39. [doi: 10.1097/SPC.0000000000000483] [Medline: 31895066]

23. Tang WP, Chan CW, So WK, Leung DY. Web-based interventions for caregivers of cancer patients: a review of literatures. Asia Pac J Oncol Nurs. 2014;1(1):9-15. [FREE Full text] [doi: 10.4103/2347-5625.135811] [Medline: 27981077]

24. Kaltenbaugh DJ, Klem ML, Hu L, Turi E, Haines AJ, Lingler JH. Using web-based interventions to support caregivers of patients with cancer: a systematic review. Oncol Nurs Forum. 2015;42(2):156-164. [doi: 10.1188/15.ONF.156-164] [Medline: 25806882]

25. Slev VN, Mistiaen P, Pasman HRW, Verdonck-de Leeuw IM, van Uden-Kraan CF, Francke AL. Effects of eHealth for patients and informal caregivers confronted with cancer: a meta-review. Int J Med Inform. 2016;87:54-67. [doi: 10.1016/j.ijmedinf.2015.12.013] [Medline: 26806712]

26. Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ. 2021;372:n71. [FREE Full text] [doi: 10.1136/bmj.n71] [Medline: 33782057]

27. Gibbs KD, Loveless J, Crane S. A guide to using technological applications to facilitate systematic reviews. Worldviews Evid Based Nurs. 2022;19(6):442-449. [doi: 10.1111/wvn.12611] [Medline: 36380454]

28. Lauver DR, Ward SE, Heidrich SM, Keller ML, Bowers BJ, Brennan PF, et al. Patient-centered interventions. Res Nurs Health. 2002;25(4):246-255. [doi: 10.1002/nur.10044] [Medline: 12124719]

29. Aromataris E, Munn Z, editors. JBI Manual for Evidence Synthesis—JBI Global Wiki. South Australia, Australia. JBI; 2020.

30. Glasgow MJ, Edlin R, Harding JE. Comparison of risk-of-bias assessment approaches for selection of studies reporting prevalence for economic analyses. BMJ Open. 2020;10(9):e037324. [FREE Full text] [doi: 10.1136/bmjopen-2020-037324] [Medline: 32938593]

31. Borenstein M, Hedges LV, Higgins JPT, Rothstein HR. A basic introduction to fixed-effect and random-effects models for meta-analysis. Res Synth Methods. 2010;1(2):97-111. [doi: 10.1002/jrsm.12] [Medline: 26061376]

32. Higgins JPT, Thompson SG, Deeks JJ, Altman DG. Measuring inconsistency in meta-analyses. BMJ. 2003;327(7414):557-560. [FREE Full text] [doi: 10.1136/bmj.327.7414.557] [Medline: 12958120]

33. Egger M, Smith GD, Schneider M, Minder C. Bias in meta-analysis detected by a simple, graphical test. BMJ. 1997;315(7109):629-634. [FREE Full text] [doi: 10.1136/bmj.315.7109.629] [Medline: 9310563]

34. Borenstein M, Hedges L, Rothstein H. Fixed effect vs. random effects. Meta-Analysis. 2007. URL: https://meta-analysis.com/download/M-a_f_e_v_r_e_sv.pdf [accessed 2024-01-05]

35. Admiraal JM, van der Velden AWG, Geerling JI, Burgerhof JGM, Bouma G, Walenkamp AME, et al. Web-based tailored psychoeducation for breast cancer patients at the onset of the survivorship phase: a multicenter randomized controlled trial. J Pain Symptom Manage. 2017;54(4):466-475. [FREE Full text] [doi: 10.1016/j.jpainsymman.2017.07.009] [Medline: 28711750]

36. Applebaum AJ, Buda KL, Schofield E, Farberov M, Teitelbaum ND, Evans K, et al. Exploring the cancer caregiver's journey through web-based meaning-centered psychotherapy. Psychooncology. 2018;27(3):847-856. [FREE Full text] [doi: 10.1002/pon.4583] [Medline: 29136682]

37.   Baker TB, Hawkins R, Pingree S, Roberts LJ, McDowell HE, Shaw BR, et al. Optimizing eHealth breast cancer interventions: which types of eHealth services are effective? Transl Behav Med. 2011;1(1):134-145. [FREE Full text] [doi: 10.1007/s13142-010-0004-0] [Medline: 21709810]

38.   Becker H, Henneghan AM, Volker DL, Mikan SQ. A pilot study of a cognitive-behavioral intervention for breast cancer survivors. Oncol Nurs Forum. 2017;44(2):255-264. [doi: 10.1188/17.ONF.255-264] [Medline: 28222075]

39.   Berry DL, Halpenny B, Hong F, Wolpin S, Lober WB, Russell KJ, et al. The personal patient profile-prostate decision support for men with localized prostate cancer: a multi-center randomized trial. Urol Oncol. 2013;31(7):1012-1021. [FREE Full text] [doi: 10.1016/j.urolonc.2011.10.004] [Medline: 22153756]

40.   Berry DL, Hong F, Halpenny B, Partridge A, Fox E, Fann JR, et al. The electronic self report assessment and intervention for cancer: promoting patient verbal reporting of symptom and quality of life issues in a randomized controlled trial. BMC Cancer. 2014;14:513. [FREE Full text] [doi: 10.1186/1471-2407-14-513] [Medline: 25014995]

41.   Boele FW, Klein M, Verdonck-de Leeuw IM, Cuijpers P, Heimans JJ, Snijders TJ, et al. Internet-based guided self-help for glioma patients with depressive symptoms: a randomized controlled trial. J Neurooncol. 2018;137(1):191-203. [FREE Full text] [doi: 10.1007/s11060-017-2712-5] [Medline: 29236238]

42.   Børøsund E, Cvancarova M, Moore SM, Ekstedt M, Ruland CM. Comparing effects in regular practice of e-communication and web-based self-management support among breast cancer patients: preliminary results from a randomized controlled trial. J Med Internet Res. 2014;16(12):e295. [FREE Full text] [doi: 10.2196/jmir.3348] [Medline: 25525672]

43.   Braamse AMJ, van Meijel B, Visser OJ, Boenink AD, Cuijpers P, Eeltink CE, et al. A randomized clinical trial on the effectiveness of an intervention to treat psychological distress and improve quality of life after autologous stem cell transplantation. Ann Hematol. 2016;95(1):105-114. [FREE Full text] [doi: 10.1007/s00277-015-2509-6] [Medline: 26420062]

44.   Carpenter KM, Stoner SA, Schmitz K, McGregor BA, Doorenbos AZ. An online stress management workbook for breast cancer. J Behav Med. 2014;37(3):458-468. [FREE Full text] [doi: 10.1007/s10865-012-9481-6] [Medline: 23212928]

45.   Chambers SK, Ritterband LM, Thorndike F, Nielsen L, Aitken JF, Clutton S, et al. Web-delivered cognitive behavioral therapy for distressed cancer patients: randomized controlled trial. J Med Internet Res. 2018;20(1):e42. [FREE Full text] [doi: 10.2196/jmir.8850] [Medline: 29386173]

46.   Classen CC, Chivers ML, Urowitz S, Barbera L, Wiljer D, O'Rinn S, et al. Psychosexual distress in women with gynecologic cancer: a feasibility study of an online support group. Psychooncology. 2013;22(4):930-935. [doi: 10.1002/pon.3058] [Medline: 22374732]

47.   Compen F, Bisseling E, Schellekens M, Donders R, Carlson L, van der Lee M, et al. Face-to-face and internet-based mindfulness-based cognitive therapy compared with treatment as usual in reducing psychological distress in patients with cancer: a multicenter randomized controlled trial. J Clin Oncol. 2018;36(23):2413-2421. [FREE Full text] [doi: 10.1200/JCO.2017.76.5669] [Medline: 29953304]

48.   Diefenbach MA, Mohamed NE, Butz BP, Bar-Chama N, Stock R, Cesaretti J, et al. Acceptability and preliminary feasibility of an internet/CD-ROM-based education and decision program for early-stage prostate cancer patients: randomized pilot study. J Med Internet Res. 2012;14(1):e6. [FREE Full text] [doi: 10.2196/jmir.1891] [Medline: 22246148]

49.   DuBenske LL, Gustafson DH, Namkoong K, Hawkins RP, Atwood AK, Brown RL, et al. CHESS improves cancer caregivers' burden and mood: results of an eHealth RCT. Health Psychol. 2014;33(10):1261-1272. [FREE Full text] [doi: 10.1037/a0034216] [Medline: 24245838]

50.   Duffecy J, Sanford S, Wagner L, Begale M, Nawacki E, Mohr DC. Project onward: an innovative e-health intervention for cancer survivors. Psychooncology. 2013;22(4):947-951. [FREE Full text] [doi: 10.1002/pon.3075] [Medline: 22438297]

51.   Espinoza M, Baños RM, García-Palacios A, Cervera JM, Esquerdo G, Barrajón E, et al. Promotion of emotional wellbeing in oncology inpatients using VR. Stud Health Technol Inform. 2012;181:53-57. [Medline: 22954828]

52.   Foley NM, O'Connell EP, Lehane EA, Livingstone V, Maher B, Kaimkhani S, et al. PATI: Patient Accessed Tailored Information: a pilot study to evaluate the effect on preoperative breast cancer patients of information delivered via a mobile application. Breast. 2016;30:54-58. [doi: 10.1016/j.breast.2016.08.012] [Medline: 27611236]

53.   Foster C, Grimmett C, May CM, Ewings S, Myall M, Hulme C, et al. A web-based intervention (RESTORE) to support self-management of cancer-related fatigue following primary cancer treatment: a multi-centre proof of concept randomised controlled trial. Support Care Cancer. 2016;24(6):2445-2453. [FREE Full text] [doi: 10.1007/s00520-015-3044-7] [Medline: 26643072]

54.   Freeman LW, White R, Ratcliff CG, Sutton S, Stewart M, Palmer JL, et al. A randomized trial comparing live and telemedicine deliveries of an imagery-based behavioral intervention for breast cancer survivors: reducing symptoms and barriers to care. Psychooncology. 2015;24(8):910-918. [FREE Full text] [doi: 10.1002/pon.3656] [Medline: 25146413]

55.   Giesler JM, Keller B, Repke T, Leonhart R, Weis J, Muckelbauer R, et al. Effect of a website that presents patients' experiences on self-efficacy and patient competence of colorectal cancer patients: web-based randomized controlled trial. J Med Internet Res. 2017;19(10):e334. [FREE Full text] [doi: 10.2196/jmir.7639] [Medline: 29030329]

56.   Green BL, Small B, Damonte J, Ikan JB. Navigator-guided e-psychoeducational intervention for prostate cancer patients and their caregivers. Patient-Centered Outcomes Research Institute. 2019. URL: https://www.pcori.org/research-results/2013/treatment-decision-support-men-prostate-cancer-and-their-caregivers [accessed 2021-08-09]

57.   Greer JA, Jacobs J, Pensak N, MacDonald JJ, Fuh CX, Perez GK, et al. Randomized trial of a tailored cognitive-behavioral therapy mobile application for anxiety in patients with incurable cancer. Oncologist. 2019;24(8):1111-1120. [FREE Full text] [doi: 10.1634/theoncologist.2018-0536] [Medline: 30683710]

58.   Gustafson DH, DuBenske LL, Atwood AK, Chih MY, Johnson RA, McTavish F, et al. Reducing symptom distress in patients with advanced cancer using an e-Alert system for caregivers: pooled analysis of two randomized clinical trials. J Med Internet Res. 2017;19(11):e354. [FREE Full text] [doi: 10.2196/jmir.7466] [Medline: 29138131]

59.   Gustafson DH, DuBenske LL, Namkoong K, Hawkins R, Chih MY, Atwood AK, et al. An eHealth system supporting palliative care for patients with non-small cell lung cancer: a randomized trial. Cancer. 2013;119(9):1744-1751. [FREE Full text] [doi: 10.1002/cncr.27939] [Medline: 23355273]

60.   Gustafson DH, Hawkins R, McTavish F, Pingree S, Chen WC, Volrathongchai K, et al. Internet-based interactive support for cancer patients: are integrated systems better? J Commun. 2008;58(2):238-257. [FREE Full text] [doi: 10.1111/j.1460-2466.2008.00383.x] [Medline: 21804645]

61.   Hawkins RP, Pingree S, Baker T, Roberts LJ, Shaw BR, McDowell H, et al. Integrating eHealth with human services for breast cancer patients. Transl Behav Med. 2011;1(1):146-154. [FREE Full text] [doi: 10.1007/s13142-011-0027-1] [Medline: 22496712]

62.   Høybye MT, Dalton SO, Deltour I, Bidstrup PE, Frederiksen K, Johansen C. Effect of internet peer-support groups on psychosocial adjustment to cancer: a randomised study. Br J Cancer. 2010;102(9):1348-1354. [FREE Full text] [doi: 10.1038/sj.bjc.6605646] [Medline: 20424614]

63.   Huberty J, Eckert R, Larkey L, Kurka J, De Jesús SAR, Yoo W, et al. Smartphone-based meditation for myeloproliferative neoplasm patients: feasibility study to inform future trials. JMIR Form Res. 2019;3(2):e12662. [FREE Full text] [doi: 10.2196/12662] [Medline: 31033443]

64.   Hummel SB, van Lankveld JJDM, Oldenburg HSA, Hahn DEE, Kieffer JM, Gerritsma MA, et al. Efficacy of internet-based cognitive behavioral therapy in improving sexual functioning of breast cancer survivors: results of a randomized controlled trial. J Clin Oncol. 2017;35(12):1328-1340. [FREE Full text] [doi: 10.1200/JCO.2016.69.6021] [Medline: 28240966]

65.   Jibaja-Weiss ML, Volk RJ, Granchi TS, Neff NE, Robinson EK, Spann SJ, et al. Entertainment education for breast cancer surgery decisions: a randomized trial among patients with low health literacy. Patient Educ Couns. 2011;84(1):41-48. [doi: 10.1016/j.pec.2010.06.009] [Medline: 20609546]

66.   Jimenez YA, Cumming S, Wang W, Stuart K, Thwaites DI, Lewis SJ. Patient education using virtual reality increases knowledge and positive experience for breast cancer patients undergoing radiation therapy. Support Care Cancer. 2018;26(8):2879-2888. [doi: 10.1007/s00520-018-4114-4] [Medline: 29536200]

67.   Kazer MW, Bailey DE, Sanda M, Colberg J, Kelly WK. An internet intervention for management of uncertainty during active surveillance for prostate cancer. Oncol Nurs Forum. 2011;38(5):561-568. [doi: 10.1188/11.ONF.561-568] [Medline: 21875843]

68.   Kinner EM, Armer JS, McGregor BA, Duffecy J, Leighton S, Corden ME, et al. Internet-based group intervention for ovarian cancer survivors: feasibility and preliminary results. JMIR Cancer. 2018;4(1):e1. [FREE Full text] [doi: 10.2196/cancer.8430] [Medline: 29335233]

69.   Kubo A, Altschuler A, Kurtovich E, Hendlish S, Laurent CA, Kolevska T, et al. A pilot mobile-based mindfulness intervention for cancer patients and their informal caregivers. Mindfulness (N Y). 2018;9(6):1885-1894. [FREE Full text] [doi: 10.1007/s12671-018-0931-2] [Medline: 30740187]

70.   Kuijpers W, Groen WG, Oldenburg HS, Wouters MW, Aaronson NK, van Harten WH. eHealth for breast cancer survivors: use, feasibility and impact of an interactive portal. JMIR Cancer. 2016;2(1):e3. [FREE Full text] [doi: 10.2196/cancer.5456] [Medline: 28410178]

71.   Lengacher CA, Reich RR, Ramesar S, Alinat CB, Moscoso M, Cousin L, et al. Feasibility of the mobile Mindfulness-Based Stress Reduction for Breast Cancer (mMBSR(BC)) program for symptom improvement among breast cancer survivors. Psychooncology. 2018;27(2):524-531. [FREE Full text] [doi: 10.1002/pon.4491] [Medline: 28665541]

72.   Manne SL, Topham N, D'Agostino TA, Virtue SM, Kirstein L, Brill K, et al. Acceptability and pilot efficacy trial of a web-based breast reconstruction decision support aid for women considering mastectomy. Psychooncology. 2016;25(12):1424-1433. [FREE Full text] [doi: 10.1002/pon.3984] [Medline: 26383833]

73.   McCabe C, Roche D, Hegarty F, McCann S. 'Open window': a randomized trial of the effect of new media art using a virtual window on quality of life in patients' experiencing stem cell transplantation. Psychooncology. 2013;22(2):330-337. [doi: 10.1002/pon.2093] [Medline: 22147646]

74.   McCarthy MS, Matthews EE, Battaglia C, Meek PM. Feasibility of a telemedicine-delivered cognitive behavioral therapy for insomnia in rural breast cancer survivors. Oncol Nurs Forum. 2018;45(5):607-618. [doi: 10.1188/18.ONF.607-618] [Medline: 30118453]

75.   Mihuta ME, Green HJ, Shum DHK. Efficacy of a web-based cognitive rehabilitation intervention for adult cancer survivors: a pilot study. Eur J Cancer Care (Engl). 2018;27(2):e12805. [doi: 10.1111/ecc.12805] [Medline: 29314350]

76.   Mohammad EB, Ahmad M. Virtual reality as a distraction technique for pain and anxiety among patients with breast cancer: a randomized control trial. Palliat Support Care. 2019;17(1):29-34. [doi: 10.1017/S1478951518000639] [Medline: 30198451]

77.   Owen JE, Bantum EO, Pagano IS, Stanton A. Randomized trial of a social networking intervention for cancer-related distress. Ann Behav Med. 2017;51(5):661-672. [FREE Full text] [doi: 10.1007/s12160-017-9890-4] [Medline: 28244002]

78.   Oyama H, Kaneda M, Katsumata N, Akechi T, Ohsuga M. Using the bedside wellness system during chemotherapy decreases fatigue and emesis in cancer patients. J Med Syst. 2000;24(3):173-182. [doi: 10.1023/a:1005591626518] [Medline: 10984871]

79.   Pfeifer MP, Keeney C, Bumpous J, Schapmire TJ, Studts JL, Myers J, et al. Impact of a telehealth intervention on quality of life and symptom distress in patients with head and neck cancer. J Community Support Oncol. 2015;13(1):14-21. [FREE Full text] [doi: 10.12788/jcso.0101] [Medline: 25839061]

80.   Rosen KD, Paniagua SM, Kazanis W, Jones S, Potter JS. Quality of life among women diagnosed with breast cancer: a randomized waitlist controlled trial of commercially available mobile app-delivered mindfulness training. Psychooncology. 2018;27(8):2023-2030. [doi: 10.1002/pon.4764] [Medline: 29766596]

81.   Ruland CM, Andersen T, Jeneson A, Moore S, Grimsbø GH, Børøsund E, et al. Effects of an internet support system to assist cancer patients in reducing symptom distress: a randomized controlled trial. Cancer Nurs. 2013;36(1):6-17. [FREE Full text] [doi: 10.1097/NCC.0b013e31824d90d4] [Medline: 22495503]

82.   Ryhänen AM, Rankinen S, Siekkinen M, Saarinen M, Korvenranta H, Leino-Kilpi H. The impact of an empowering internet-based breast cancer patient pathway program on breast cancer patients' clinical outcomes: a randomised controlled trial. J Clin Nurs. 2013;22(7-8):1016-1025. [doi: 10.1111/jocn.12007] [Medline: 23480498]

83.   Schneider SM, Hood LE. Virtual reality: a distraction intervention for chemotherapy. Oncol Nurs Forum. 2007;34(1):39-46. [FREE Full text] [doi: 10.1188/07.ONF.39-46] [Medline: 17562631]

84.   Schneider SM, Prince-Paul M, Allen MJ, Silverman P, Talaba D. Virtual reality as a distraction intervention for women receiving chemotherapy. Oncol Nurs Forum. 2004;31(1):81-88. [doi: 10.1188/04.ONF.81-88] [Medline: 14722591]

85.   Schover LR, Canada AL, Yuan Y, Sui D, Neese L, Jenkins R, et al. A randomized trial of internet-based versus traditional sexual counseling for couples after localized prostate cancer treatment. Cancer. 2012;118(2):500-509. [FREE Full text] [doi: 10.1002/cncr.26308] [Medline: 21953578]

86.   Shepherd L, Goldstein D, Whitford H, Thewes B, Brummell V, Hicks M. The utility of videoconferencing to provide innovative delivery of psychological treatment for rural cancer patients: results of a pilot study. J Pain Symptom Manage. 2006;32(5):453-461. [FREE Full text] [doi: 10.1016/j.jpainsymman.2006.05.018] [Medline: 17085271]

87.   Smith SK, Kuhn E, O'Donnell J, Koontz BF, Nelson N, Molloy K, et al. Cancer distress coach: pilot study of a mobile app for managing posttraumatic stress. Psychooncology. 2018;27(1):350-353. [FREE Full text] [doi: 10.1002/pon.4363] [Medline: 28032921]

88.   Song L, Rini C, Deal AM, Nielsen ME, Chang H, Kinneer P, et al. Improving couples' quality of life through a web-based prostate cancer education intervention. Oncol Nurs Forum. 2015;42(2):183-192. [FREE Full text] [doi: 10.1188/15.ONF.183-192] [Medline: 25806885]

89.   Steel JL, Geller DA, Kim KH, Butterfield LH, Spring M, Grady J, et al. Web-based collaborative care intervention to manage cancer-related symptoms in the palliative care setting. Cancer. 2016;122(8):1270-1282. [FREE Full text] [doi: 10.1002/cncr.29906] [Medline: 26970434]

90.   Syrjala KL, Yi JC, Artherholt SB, Romano JM, Crouch ML, Fiscalini AS, et al. An online randomized controlled trial, with or without problem-solving treatment, for long-term cancer survivors after hematopoietic cell transplantation. J Cancer Surviv. 2018;12(4):560-570. [FREE Full text] [doi: 10.1007/s11764-018-0693-9] [Medline: 29730827]

91.   van den Berg SW, Gielissen MFM, Custers JAE, van der Graaf WTA, Ottevanger PB, Prins JB. BREATH: web-based self-management for psychological adjustment after primary breast cancer--results of a multicenter randomized controlled trial. J Clin Oncol. 2015;33(25):2763-2771. [FREE Full text] [doi: 10.1200/JCO.2013.54.9386] [Medline: 26169621]

92.   van den Brink JL, Moorman PW, de Boer MF, Hop WCJ, Pruyn JFA, Verwoerd CDA, et al. Impact on quality of life of a telemedicine system supporting head and neck cancer patients: a controlled trial during the postoperative period at home. J Am Med Inform Assoc. 2007;14(2):198-205. [FREE Full text] [doi: 10.1197/jamia.M2199] [Medline: 17213498]

93.   Villani D, Cognetta C, Repetto C, Serino S, Toniolo D, Scanzi F, et al. Promoting emotional well-being in older breast cancer patients: results from an eHealth intervention. Front Psychol. 2018;9:2279. [FREE Full text] [doi: 10.3389/fpsyg.2018.02279] [Medline: 30538650]

94.   Washington KT, Demiris G, Oliver DP, Albright DL, Craig KW, Tatum P. Delivering problem-solving therapy to family caregivers of people with cancer: a feasibility study in outpatient palliative care. Psychooncology. 2018;27(10):2494-2499. [FREE Full text] [doi: 10.1002/pon.4859] [Medline: 30107070]

95.   White V, Farrelly A, Pitcher M, Hill D. Does access to an information-based, breast cancer specific website help to reduce distress in young women with breast cancer? Results from a randomised trial. Eur J Cancer Care (Engl). 2018;27(6):e12897. [doi: 10.1111/ecc.12897] [Medline: 30137657]

96.   Willems RA, Bolman CAW, Mesters I, Kanera IM, Beaulen AAJM, Lechner L. Short-term effectiveness of a web-based tailored intervention for cancer survivors on quality of life, anxiety, depression, and fatigue: randomized controlled trial. Psychooncology. 2017;26(2):222-230. [doi: 10.1002/pon.4113] [Medline: 26988800]

97.   Wise M, Marchand LR, Roberts LJ, Chih MY. Suffering in advanced cancer: a randomized control trial of a narrative intervention. J Palliat Med. 2018;21(2):200-207. [FREE Full text] [doi: 10.1089/jpm.2017.0007] [Medline: 29135330]

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98. Yanez B, McGinty HL, Mohr DC, Begale MJ, Dahn JR, Flury SC, et al. Feasibility, acceptability, and preliminary efficacy of a technology-assisted psychosocial intervention for racially diverse men with advanced prostate cancer. Cancer. 2015;121(24):4407-4415. [FREE Full text] [doi: 10.1002/cncr.29658] [Medline: 26348661]

99. Yun YH, Lee KS, Kim YW, Park SY, Lee ES, Noh DY, et al. Web-based tailored education program for disease-free cancer survivors with cancer-related fatigue: a randomized controlled trial. J Clin Oncol. 2012;30(12):1296-1303. [FREE Full text] [doi: 10.1200/JCO.2011.37.2979] [Medline: 22412149]

100. Pinheiro LC, Samuel CA, Reeder-Hayes KE, Wheeler SB, Olshan AF, Reeve BB. Understanding racial differences in health-related quality of life in a population-based cohort of breast cancer survivors. Breast Cancer Res Treat. 2016;159(3):535-543. [FREE Full text] [doi: 10.1007/s10549-016-3965-y] [Medline: 27585477]

101. Apenteng BA, Hansen AR, Opoku ST, Mase WA. Racial disparities in emotional distress among cancer survivors: Insights from the Health Information National Trends Survey (HINTS). J Cancer Educ. 2017;32(3):556-565. [doi: 10.1007/s13187-016-0984-7] [Medline: 26801510]

102. Sánchez-Díaz CT, Strayhorn S, Tejeda S, Vijayasiri G, Rauscher GH, Molina Y. What mediates the racial/ethnic disparity in psychosocial stress among breast cancer patients? Cancer Causes Control. 2021;32(4):357-367. [FREE Full text] [doi: 10.1007/s10552-021-01392-7] [Medline: 33559770]

103. Erves JC, Mayo-Gamble TL, Malin-Fair A, Boyer A, Joosten Y, Vaughn YC, et al. Needs, priorities, and recommendations for engaging underrepresented populations in clinical research: a community perspective. J Community Health. 2017;42(3):472-480. [FREE Full text] [doi: 10.1007/s10900-016-0279-2] [Medline: 27812847]

104. Deshields TL, Rihanek A, Potter P, Zhang Q, Kuhrik M, Kuhrik N, et al. Psychosocial aspects of caregiving: perceptions of cancer patients and family caregivers. Support Care Cancer. 2012;20(2):349-356. [FREE Full text] [doi: 10.1007/s00520-011-1092-1] [Medline: 21298291]

105. Given BA, Given CW, Sherwood PR. Family and caregiver needs over the course of the cancer trajectory. J Support Oncol. 2012;10(2):57-64. [doi: 10.1016/j.suponc.2011.10.003] [Medline: 22222251]

106. Waldron EA, Janke EA, Bechtel CF, Ramirez M, Cohen A. A systematic review of psychosocial interventions to improve cancer caregiver quality of life. Psychooncology. 2013;22(6):1200-1207. [doi: 10.1002/pon.3118] [Medline: 22729992]

107. Ugalde A, Gaskin CJ, Rankin NM, Schofield P, Boltong A, Aranda S, et al. A systematic review of cancer caregiver interventions: appraising the potential for implementation of evidence into practice. Psychooncology. 2019;28(4):687-701. [FREE Full text] [doi: 10.1002/pon.5018] [Medline: 30716183]

108. Ferrell B, Wittenberg E. A review of family caregiving intervention trials in oncology. CA Cancer J Clin. 2017;67(4):318-325. [FREE Full text] [doi: 10.3322/caac.21396] [Medline: 28319263]

109. Northouse LL, Katapodi MC, Song L, Zhang L, Mood DW. Interventions with family caregivers of cancer patients: meta-analysis of randomized trials. CA Cancer J Clin. 2010;60(5):317-339. [FREE Full text] [doi: 10.3322/caac.20081] [Medline: 20709946]

110. Glasziou P, Irwig L, Bain C, Colditz G. Systematic Reviews in Health Care: A Practical Guide. Cambridge, England. Cambridge University Press; 2001;151.

111. Devane D, Begley CM, Clarke M. How many do i need? Basic principles of sample size estimation. J Adv Nurs. 2004;47(3):297-302. [doi: 10.1111/j.1365-2648.2004.03093.x] [Medline: 15238124]

112. Bower P, Brueton V, Gamble C, Treweek S, Smith CT, Young B, et al. Interventions to improve recruitment and retention in clinical trials: a survey and workshop to assess current practice and future priorities. Trials. 2014;15:399. [FREE Full text] [doi: 10.1186/1745-6215-15-399] [Medline: 25322807]

113. Treweek S, Lockhart P, Pitkethly M, Cook JA, Kjeldstrøm M, Johansen M, et al. Methods to improve recruitment to randomised controlled trials: cochrane systematic review and meta-analysis. BMJ Open. 2013;3(2):e002360. [FREE Full text] [doi: 10.1136/bmjopen-2012-002360] [Medline: 23396504]

114. Moher D, Schulz KF, Altman DG, CONSORT. The CONSORT statement: revised recommendations for improving the quality of reports of parallel group randomized trials. BMC Med Res Methodol. 2001;1:2. [FREE Full text] [doi: 10.1186/1471-2288-1-2] [Medline: 11336663]

115. Des Jarlais DC, Lyles C, Crepaz N, TREND Group. Improving the reporting quality of nonrandomized evaluations of behavioral and public health interventions: the TREND statement. Am J Public Health. 2004;94(3):361-366. [FREE Full text] [doi: 10.2105/ajph.94.3.361] [Medline: 14998794]

116. Stanton AL, Luecken LJ, MacKinnon DP, Thompson EH. Mechanisms in psychosocial interventions for adults living with cancer: opportunity for integration of theory, research, and practice. J Consult Clin Psychol. 2013;81(2):318-335. [doi: 10.1037/a0028833] [Medline: 22663900]

117. Moore L, Britten N, Lydahl D, Naldemirci Ö, Elam M, Wolf A. Barriers and facilitators to the implementation of person-centred care in different healthcare contexts. Scand J Caring Sci. 2017;31(4):662-673. [FREE Full text] [doi: 10.1111/scs.12376] [Medline: 27859459]

118. Saleem M, Kühne L, De Santis KK, Christianson L, Brand T, Busse H. Understanding engagement strategies in digital interventions for mental health promotion: scoping review. JMIR Ment Health. 2021;8(12):e30000. [FREE Full text] [doi: 10.2196/30000] [Medline: 34931995]

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119. Wang Y, Lin Y, Chen J, Wang C, Hu R, Wu Y. Effects of internet-based psycho-educational interventions on mental health and quality of life among cancer patients: a systematic review and meta-analysis. Support Care Cancer. 2020;28(6):2541-2552. [doi: 10.1007/s00520-020-05383-3] [Medline: 32179998]

120. Pang X, Jin Y, Wang H. Effectiveness and moderators of cancer patient-caregiver dyad interventions in improving psychological distress: a systematic review and meta-analysis. Asia Pac J Oncol Nurs. 2022;9(8):100104. [FREE Full text] [doi: 10.1016/j.apjon.2022.100104] [Medline: 35990241]

121. Schuit E, Roes KCB, Mol BWJ, Kwee A, Moons KGM, Groenwold RHH. Meta-analyses triggered by previous (false-)significant findings: problems and solutions. Syst Rev. 2015;4(1):57. [FREE Full text] [doi: 10.1186/s13643-015-0048-9] [Medline: 25908184]

Abbreviations

CONSORT: Consolidated Standards of Reporting Trials
HADS: Hospital Anxiety and Depression Scale
JBI: Joanna Briggs Institute
PHQ-9: Patient Health Questionnaire-9
PRISMA: Preferred Reporting Items for Systematic Reviews and Meta-Analyses
RCT: randomized controlled trial
STAI: State-Trait Anxiety Inventory
TREND: Transparent Reporting of Evaluations with Nonrandomized Designs

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