



Effects of tandem cognitive behavioral therapy and healthy lifestyle interventions on health-related outcomes in cancer survivors: a systematic review

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Abstract

Purpose Healthy lifestyle (HL) behaviors and cognitive behavioral therapy (CBT) have been individually shown to improve adverse effects of cancer treatment. Little is known about how such programs in tandem affect health-related outcomes. This review evaluates extant literature on tandem CBT/HL interventions on health-related outcomes in cancer survivors.

Methods A comprehensive search of PubMed, PsychINFO, CINAHL, and Embase databases revealed numerous studies involving CBT and HL tandem interventions in cancer survivors in the last 20 years. Studies meeting the inclusion criteria were examined and assessed by the authors.

Results The 36 studies included 5199 participants. Interventions involved the use of CBT in combination with a HL condition (stress reduction, increasing physical activity, etc.). These tandem conditions were compared against no intervention, usual care, and/or CBT alone or HL alone. Interventions were delivered by a variety of interventionists, and over different durations. The most common HL target outcomes were stress, and insomnia. Most studies (31 of 36) reported a reduction in adverse treatment and/or cancer-related effects.

Conclusion Findings were biased with the overrepresentation of breast cancer survivors, and underrepresentation of minority groups, and those with advanced cancer. Thus, this review highlights the need for further research to test tandem interventions against CBT alone and HL alone, and toward identifying the most efficacious interventions for dissemination and implementation across diverse groups of cancer survivors.

Implications for cancer survivors

Tandem CBT/HL interventions can improve health-related outcomes for cancer survivors when compared to usual care, but there is a paucity of knowledge to suggest differential outcomes when compared to CBT or HL alone.

Keywords Cancer survivorship · Healthy lifestyle behaviors · Cognitive behavior therapy · Quality of life · Interventions

Introduction

Cancer is a leading cause of illness and disability in the world today [1]. With the advent of early screening and innovative treatments extending survival, considerable progress has been made in extending the lives of cancer survivors [2]. A cancer survivor, as described by the National Comprehensive Cancer Network (NCCN), is defined as someone who has been diagnosed with cancer, and is still living [3].

The number of cancer survivors in the USA is expected to be over 22 million by 2030 [2]. While this is cause for celebration, this brings the new challenge of minimizing the side effects and psychological burden associated with the aftermath of cancer. Depending on the cancer type, stage of cancer, and type of treatments, survivors may be faced with a sequelae of cancer induced and/or treatment related symptoms that linger from months to years (e.g., fear of cancer recurrence (FCR), cancer related fatigue, hot flashes, insomnia) [4–8]. These effects have a deleterious impact on quality of life in survivors [9]. Thus, the urgency of monitoring and ameliorating these conditions, as the diagnosis of cancer transitions from a fatal condition to a chronic illness, is vital [10].

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Cognitive behavioral therapy (CBT) is a psychological intervention used to alter dysfunctional behaviors and thought patterns. While CBT has been used traditionally for patients with mental health disorders, such as depression, or anxiety, it has been receiving more attention for its use in survivorship care. In fact, it has been shown to be the most successful psychological intervention in improving cancer related fatigue, and there is evidence suggesting that it may improve overall quality of life in cancer survivors [11–18]. Despite these findings, the majority of cancer survivors have not discussed psychological interventions with their providers, nor have they used one [19]

Similar to CBT, healthy lifestyle interventions have been instrumental in improving the quality of life of cancer survivors. The emerging data around healthy lifestyle behaviors (i.e., diet, physical activity, minimizing distress (stress management/spiritual management), sleep, alcohol, sunscreen use, tobacco use, and weight management) suggest promise to improve the side effects of cancer related treatments [3, 18, 20–25]. For example, a recent study found that survivors who quit smoking had reduced levels of FCR compared to survivors who continued to smoke [26]. Unfortunately, the majority of cancer survivors do not meet recommended guidelines from public health entities for physical activity, nor healthy eating [27–31]. Moreover, recent studies describe the amount of cancer survivors who continue to smoke to be anywhere from 12 to 27% [27, 32, 33]. Given the evidence presented, it is not surprising that there may be a benefit in a combined health behavior-oriented and CBT program [13]. By adding the use of CBT, there may be a positive effect on the intention-behavior gap that assists with achieving more sustainable change in survivors [34].

Consequently, it is imperative that we identify and implement methodology and interventions that can be used to lessen the physical and psychological side effects of cancer treatment, while also improving the quality of life of survivors. Other systematic reviews and meta-analyses have analyzed the effectiveness of CBT in cancer survivors, or lifestyle interventions in cancer survivors, yet little is known about how such programs in tandem affect health-related outcomes. One systematic review highlighted the relationship between health promotion activities, and general psychological interventions in young adult cancer survivors. However, it was limited in that it focused solely on young adult survivors, and only evaluated two studies that included CBT as a component [35]. Another systematic review found “moderate” evidence suggesting increased adherence with physiotherapy when combined with CBT [36]. No review has summarized the data on the use of tandem lifestyle interventions and CBT in cancer survivors; however, structured appraisal on such interventions is needed. As such, the purpose of this review was to illuminate and evaluate

the combined efficacy of CBT and lifestyle interventions on quality of life and clinical symptomatology in cancer survivors.

Methods

The PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) 2009 Statement and Checklist provided the methodological framework to enhance the rigor of this review [37, 38]. These guidelines directed the systematic preparation, extraction, appraisal, and reporting of information gathered from randomized studies. The conceptual frameworks used in this review were the cognitive-behavioral model for psychotherapy, quality of life (QOL) model, and aspects of a healthy lifestyle as defined by the NCCN [3, 39–42]

Search strategy

A systematic search protocol was developed with a reference librarian. PubMed, PsychINFO, CINAHL, and Embase databases were searched for randomized studies involving the tandem use of CBT and HL interventions. The outcomes of treatment were not included in the search strategy. The search was limited to quantitative, randomized studies in adults ages 18–80 years old, published in English between 1990 and 2019. The year range was chosen to reflect the timeline surrounding CBT’s use in clinical practice settings, as well as its initial use in cancer patients [42, 43]. The authors and the reference librarian iteratively optimized search strings from conceptual frameworks. They consisted of Boolean phrases of the following database-specific indexed terms (i.e., MeSH, Emtree, subject headings, thesaurus, etc.): healthy lifestyle, lifestyle changes; health behavior, attitude to health, health attitudes, health beliefs; quality of life, health-related quality of life, psychological well-being; cognitive behavior therapy, CBT, cognitive therapy, behavior therapy; neoplasm(s), cancer, cancer survivor(s), cancer patient(s), cancer care facilities, and psycho-oncology.

Selection strategy

The initial inclusion criteria for determining study eligibility were randomized studies involving cognitive behavioral therapy and lifestyle interventions (i.e., stress management, spiritual support, sleep hygiene, alcohol use, tobacco use, weight management, exercise, nutrition) for adult cancer survivors (i.e., from diagnosis through the remainder of life) with quantitative lifestyle and/or quality of life outcomes. Exceptions were made to include interventional studies that randomized to waitlist control groups or multiple

intervention groups instead of simply being randomized to a control group from enrollment. Studies were excluded based on the following criteria: qualitative studies; literature reviews; non-interventional quantitative studies without random sampling; animal studies; pediatric population; intervention involving mindfulness-based stress reduction without CBT, and studies disseminated in a language other than English. Covidence® software facilitated the delimitation process and the creation of the PRISMA flow diagram (see Fig. 1) [44]. The identified abstracts and subsequently full-text studies were evaluated for eligibility criteria by a minimum of two authors independently. In the case of a conflict, all of the authors discussed and reached consensus for eligibility.

Data extraction and evaluation

Data extraction

Data was extracted from the included studies by a minimum of two authors utilizing a data matrix with the

following domains: author (year); purpose; sample; life-style focus and components of the intervention; delivery mode and length of intervention; control conditions; outcome measures; results; quality assessment score. Next, these domains were used to compare the included studies' data patterns and to identify relationships for data synthesis.

Quality appraisal

The included studies' methodological quality, sources of bias, and representativeness were critically appraised by a minimum of two authors using the National Institutes of Health's (NIH) Quality Assessment of Controlled Intervention Studies [45]. Each selected "yes," "no," or "cannot determine/not reported/not applicable" responses to a range of items addressing methodological rigor, internal validity, and sources of bias with respect to the included studies which collectively determined a percentage "yes" total score. Studies with a total score of < 50%, 50–75%, or > 75% were considered to be of poor, fair, or good quality, respectively (see Table 1).

Fig. 1 Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) diagram

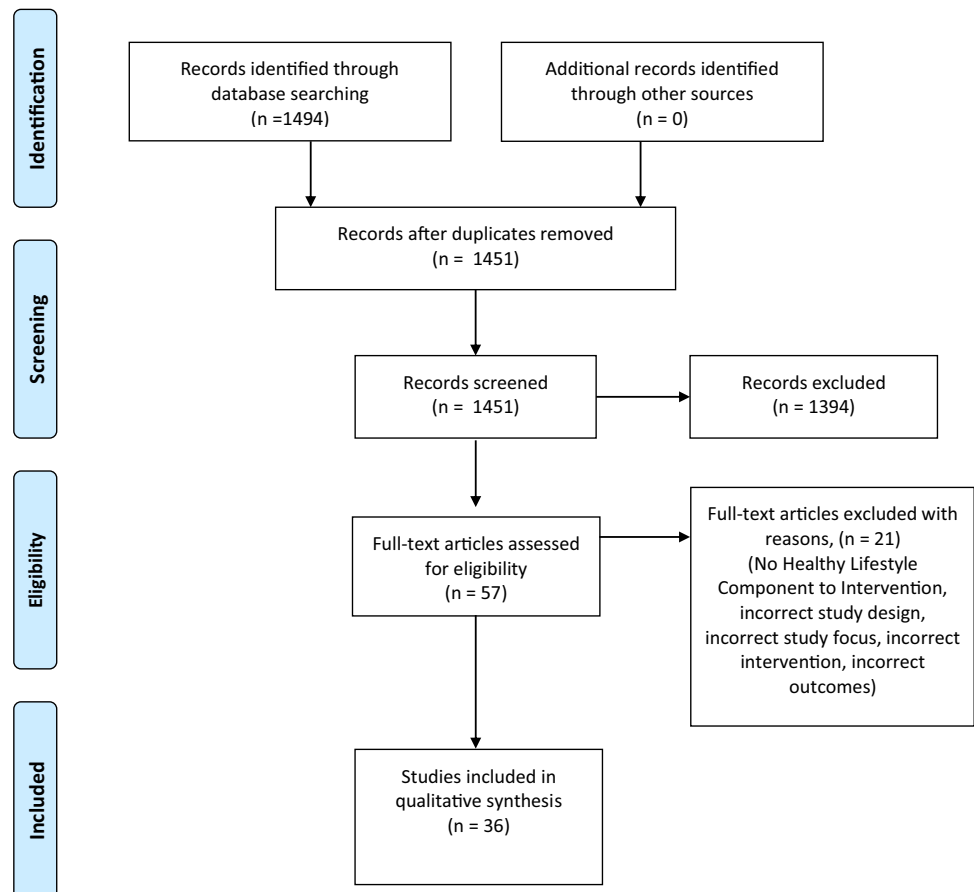


Table 1 Studies included in this review

Author (year) and country	Study purpose	Length/intensity of intervention	Sample population	Cancer type	Outcome measures	Main study findings	Quality assessment score
Abrahams et al. (2017) The Netherlands	To examine whether internet-based cognitive behavioral therapy (ICBT) is superior to care as usual (CAU) in reducing severe fatigue in survivors of breast cancer	The intended length of ICBT was 6 months, and the intervention was completed with a face to face evaluation session	Gender: female only Race: no specifics Mean age: ICBT = 52.5 (8.5) CAU = 50.5 (7.6) Participants: 132	Breast	Fatigue Severity subscale of the Checklist Individual Strength (CIS-Fatigue Severity)	ICBT participants reported significantly lower fatigue scores compared to those who received CAU after 6 months ($\Delta = 11.5$, [95% CI], 7.7–15.3). Large effect size (Cohen $d = 1.0$)	Good (78.6%)
Antoni et al. (2006) USA	To assess psychological outcomes of a cognitive-behavioral stress management (CBSM) intervention for women with breast cancer. To examine whether skills taught account for beneficial effects	The group intervention met weekly for 2-h sessions over the span of 10 weeks	Gender: female only Race: 68.3% White, 24.1% Hispanic, 7.5% African American Mean age: $n_I = 50.83$ (8.97), $n_o = 49.58$ (9.11) Participants: 199	Breast	Sickness Impact Profile, Positive States of Mind (PSOM), Affects Balance Scale (ABS), Measure of Current Status (MOCS)	Reduced reports of social disruption and increased emotional well-being, positive states of mind, positive lifestyle change, increased confidence in being able to relax at will, and positive affect for up to 12 months	Fair (53.6%)
Dirksen and Epstein (2008) USA	To examine the effects of cognitive behavior therapy for insomnia (CBT-I) on psychosocial outcomes associated with insomnia in breast cancer survivors	A 10-week intervention with 2-week pretreatment (baseline) period, a 6-week treatment period, and a 2-week posttreatment period	Gender: female only Race: no specifics Mean age: $n_I = 57.2$ (9.9), $n_o = 59.2$ (10.7) Participants: 72	Breast	Profile of Mood States Fatigue/Inertia Subscale (POMS/FI), State-Trait Anxiety Inventory (STAI), Center for Epidemiologic Studies-Depression Scale (CES-D), Functional Assessment of Cancer Therapy for Breast Cancer (FACT-B), Insomnia Severity Index (ISI)	From pre to post treatment, CBT-I group improved on fatigue, trait anxiety, and depression (with a trend toward significance for the CC group). Significant interaction for fatigue and quality of life. Lower fatigue [$t(70) = 1.87$, $p = 0.07$] and higher quality of life-social [$t(70) = 1.66$, $p = 0.10$] in the CBT-I group	Fair (64.3%)

Table 1 (continued)

Author (year) and country	Study purpose	Length/intensity of intervention	Sample population	Cancer type	Outcome measures	Main study findings	Quality assessment score
Duffy et al. (2006) USA	To examine whether cognitive behavioral therapy (CBT) is superior to enhanced usual care (EUC) in reducing comorbid smoking, problem drinking, and depression in head and neck cancer patients	The intended length of CBT was 6 months, and the intervention was completed with 9 to 11 sessions of telephone and pharmacologic management	Gender: 84% Male Race: 90% White, 10% Other Mean age: $n_1 = 56$ (10.8), $n_2 = 58$ (8.9) Participants: 184	Head and neck	Current smoking measured as smoking within the past six months, 10-item Alcohol Use Disorder Identification Test, Geriatric Depression Scale-Short Form	For smokers who had comorbid depression and problem drinking, quitting rates remained higher in the CBT group as compared to the EUC ($p < 0.05$). The CBT intervention increased smoking cessation rates by 50% over EUC	Fair (53.6%)
Duijts et al. (2012) The Netherlands	To evaluate the effect of cognitive behavioral therapy (CBT), physical exercise (PE), and both CBT + PE on menopausal symptoms in patients with breast cancer experiencing treatment-induced menopause	CBT was six weekly group sessions of 90 min each; PE was 12-week sessions of 2.5 to 3 h per week	Gender: female only Race: no specifics Mean age: 48.2 (5.6) Participants: 422	Breast	Endocrine subscale of the Functional Assessment of Cancer Therapy questionnaire (FACT-ES), Hot Flush Rating Scale	Significant group differences in improvement over time for endocrine symptoms ($p = 0.001$) and perceived burden of hot flashes/night sweats ($p = 0.001$). Each intervention more effective than control	Fair (60.7%)
Espie et al. (2008) UK	To determine whether cognitive behavior therapy (CBT) is effective in treating persistent insomnia in patients with cancer when compared to treatment as usual (TAU)	The intended length of CBT was 6 months, and the intervention was completed with five, weekly, 50-min sessions	Gender: 69% female Race: no specifics Median age: CBT = 60.5 (IR = 53.3–70), TAU = 58 (IR = 52–68) Participants: 150	Breast, prostate, colorectal, and gynecological	Pittsburgh Sleep Quality Index (PSQI), Epworth sleepiness scale, Hospital Anxiety and Depression Scale (HADS), Fatigue Symptom Inventory (FSI), and Functional Assessment of Cancer Therapy Scale-General (FACT-G)	CBT was associated with 16-min reduction in sleep-onset latency, and 38 min in wake time after sleep onset, compared to a 0-min reduction in TAU ($p < 0.001$)	Fair (71.4%)

Table 1 (continued)

Author (year) and country	Study purpose	Length/intensity of intervention	Sample population	Cancer type	Outcome measures	Main study findings	Quality assessment score
Ferguson et al. (2012) USA	To evaluate the efficacy of cognitive-behavioral therapy (CBT) when used for cognitive dysfunction following chemotherapy	An 8-week intervention with four biweekly individual office visits that last 30–50 min with phone contacts between visits	Gender: female only Mean age: $n_i=51.21$ ($n_o=49.43$) (5.1) Race: 97.5% Caucasian Participants: 40	Breast	Multiple Ability Self-Report Questionnaire (MASQ), Quality of Life-Cancer Survivors (QOL-CS), California Verbal Learning Test-2 (CVLT-II)	MAAT participants demonstrated improvement in CVLT-II total score (verbal memory) when compared to the control ($p<0.05$). Effect sizes for MAAT participants were larger than that of wait-list controls from the baseline to both post-treatment and the 2-month follow-up	Good (85.8%)
Ferguson et al. (2016) USA	To determine if cognitive behavioral therapy (CBT)—specifically Memory and Attention Adaptation Training (MAAT)—is effective when delivered through a videoconference platform to cancer survivors who have chemotherapy related cognitive dysfunction	An 8-week intervention with 30- to 45-min videoconferencing visits	Gender: female only Race: 100% Caucasian Mean age: $n_i=54.0$ ($n_o=55.61$) (11.39) Participants: 35	Breast	Perceived Cognitive Impairments (PCI) and Perceived Cognitive Abilities Subscales of the Functional Assessment of Cancer Therapy-Cognitive Function (FACT-Cog)	There was a significant difference between the MAAT and control group at 2-month follow-up ($F(1,28), 6.07$; $p=0.02$), with a medium effect ($d=0.52$)	Good (82.2%)
Cielissen et al. (2006) The Netherlands	To evaluate whether cognitive behavior therapy (CBT) is more effective than remaining on a waiting list in reducing fatigue severity, functional impairment, and psychological distress in cancer survivors	A 6-month intervention with five to twenty-six sessions (number of sessions dependent on the individual) with a 1-h duration	Gender: 51% male Race: no specifics Mean age: $n_i=44.6$ ($n_o=45.3$) (10.3) Participants: 98	Breast, testicular, hematologic, other solid tumors	Fatigue severity subscale of the Checklist Individual Strength (CIS-fatigue), Sickness Impact Profile-8 (SIP-8)	Patients with intervention had significant improvement on fatigue severity, functional impairment, and self-rated improvement as compared to patients on waiting list conditions	Good (78.6%)

Table 1 (continued)

Author (year) and country	Study purpose	Length/intensity of intervention	Sample population	Cancer type	Outcome measures	Main study findings	Quality assessment score
Goedendorp et al. (2012) The Netherlands	To determine whether cognitive behavior therapy (CBT) is effective for fatigue in patients undergoing curative cancer treatment and assess the intervention's long-term effect on post-cancer fatigue	A 6-month intervention with five to twenty-six sessions (number of sessions dependent on the individual) with a 1-h duration	Gender: 65% female Race: no specifics Mean age: BNI: 57.2 (10.1), CBT: 55.6 (11.6), UC: 56.9 (11.1) Participants: 210	Breast, prostate, other solid tumors	Quality of Life Questionnaire of the European Organization for Research and Treatment of Cancer (EORTC-QLQ-C30), Fatigue severity subscale of the Checklist Individual Strength (CIS-fat), Symptom Checklist-90 (SCL-90), Health Survey Short Form-36 (SF-36)	Patients with intervention had significant effect of condition for self-reported cognitive disability ($F(5, 96) = 3.33$; $p = 0.040$); CBT patients (48%) had less clinically relevant concentration problems compared to control (73%) ($p = 0.003$)	Good (89.3%)
Goedendorp et al. (2010) The Netherlands	To determine the efficacy of brief nursing intervention (BNI) + cognitive behavior therapy (CBT), and physical activity in reducing post-cancer fatigue and fatigue during cancer treatment, respectively	BNI intervention was mostly face to face and consisted of two 1-h sessions. The CBT intervention was 7 months with six 1-h sessions	Gender: 61% female Race: no specifics Mean age: BNI: 57.1 (10.0), CBT: 55.6 (11.3), UC: 57.3 (11.1) Participants: 220	Breast, prostate, urogenital, gynecological, lymphoma, sarcoma, melanoma, thyroid, other solid tumors	Fatigue subscale of the Checklist Individual Strength (CIS-fat), Actometer, Questionnaire Physical Activity (QPA), Health Survey Short Form-36 (SF-36), Symptom Checklist-90 (SCL-90), Quality of Life Questionnaire of the European Organization for Research and Treatment of Cancer (EORTC QLQ-C30)	CBT group had significantly had less fatigue than those in control ($p = 0.019$). No significant difference in fatigue between BNI group and control ($p = 1.000$). No significant differences in physical activity between the two intervention groups and control	Good (82.1%)

Table 1 (continued)

Author (year) and country	Study purpose	Length/intensity of intervention	Sample population	Cancer type	Outcome measures	Main study findings	Quality assessment score
Greer et al. (2012) USA	To determine the feasibility and preliminary efficacy of brief cognitive-behavioral therapy (CBT) to patient population	A 2-month intervention with six sessions conducted weekly	Gender: 70% female Race: 95% White, 5% Hispanic/Latino Mean age: $n_I = 54.55$ (11.43), $n_o = 57.25$ (10.41) Participants: 40	Lung, pancreatic, colorectal, other cancer	Hamilton Anxiety Rating Scale (HAM-A), Clinical Global Impression Scale (CGI), Montgomery Asberg Depression Rating Scale (MADRS), Hospital Anxiety and Depression Scale (HADS), Impact of Events Scale (IES), Functional Assessment of Cancer Therapy-General (FACT-G) Questionnaire	Majority of patients who received CBT (80%) participated in at least five of the sessions. Those assigned to CBT had greater improvements in HAM-A scores compared to control (95% CI)	Fair (67.9%)
Groarke et al. (2013) Ireland	To evaluate if a brief Cognitive-Behavioral (CBT) intervention can reduce stress and distress and enhance benefit in woman with cancer	A 5-week intervention with 8 sessions that last for 3 h	Gender: female only Race: majority White Mean age: $n_I = 53.30$ (9.86), $n_o = 54.10$ (10.62) Participants: 179	Breast	Perceived Stress Scale (PSS), Impact of Events Scale (IES), Life Orientation Test (LOT), Hospital Anxiety and Depression Scale (HADS), Silver Linings Questionnaire (SLQ)	Anxiety decreased more in the intervention arm than in the control arm [$F(1.89, 331.11) = 3.39$, $p = 0.04$]. Global stress decreased more in the intervention group as opposed to control [$F(1.90, 332.95) = 3.62$, $p = 0.03$]	Good (82.2%)

Table 1 (continued)

Author (year) and country	Study purpose	Length/intensity of intervention	Sample population	Cancer type	Outcome measures	Main study findings	Quality assessment score
Gudenkauf et al. (2015) USA	To determine if cognitive-behavioral stress management (CBSM) which is composed of Cognitive-Behavioral Training (CBT) and Relaxation Training (RT) improves psychological adaptation	A 5-week intervention with sessions lasting for 1.5 h	Gender: female only Race: 41.5% White, 8.7% African American, 6.6% Other Mean age: 64.28 (10.06) Participants: 183	Breast	Affects Balance Scale (ABS), Impact of Event Scale-Intrusion (IES-I), Social Impact Profile-Social Interaction (SIP-SI) Subscale, Functional Assessment of Cancer Therapy-Breast Emotional Well-being (FACT-EWB) Subscale, Social Provisions Scale (SPS), Measure of Current Status-Part A (MOC5-A)	Women in CBT and RT showed significantly greater improvement in ABS-depressive affect scores compared to control, respectively	Good (82.2%)
Irwin et al. (2017) USA	To determine if Tai Chi Chih (TCC) produces similar effects to cognitive behavioral therapy for insomnia (CBT-I) in reducing insomnia symptoms in cancer survivors	Weekly 120-min sessions for 2 months with additional 1-month period of exposure	Gender: female only Race: 86% White Mean age: TCC = 59.6 (7.9), CBT = 60.0 (9.3) Participants: 90	Breast	Pittsburgh Sleep Quality Index (PSQI), Athens Insomnia Severity Index (AIS)	CBC-I and TCC resulted in similar rate of treatment response. There were no group differences in sleep quality, fatigue, daytime sleepiness, and depression	Good (78.6%)
Korsjens et al. (2008) The Netherlands	To compare the effects of cognitive-behavioral training (CBT) and self-management program with a physical training (PT) program on the quality of life (QoL) of cancer survivors	Both interventions lasted for the duration of 12-weeks with 1 to 2-h sessions	Gender: female only Race: no specifics Mean age: PT + CBT = 47.8 (10.5), PT = 49.9 (11.3), WLC (wait-list comparison) = 51.3 (8.8) Participants: 209	Breast	RAND 36-Item Health Survey (RAND-36)	PT + CBT group showed no significant changes. Self-Management groups showed significant improvements in physical functioning, vitality, and health	Good (89.3%)

Table 1 (continued)

Author (year) and country	Study purpose	Length/intensity of intervention	Sample population	Cancer type	Outcome measures	Main study findings	Quality assessment score
Lee H et al. (2011) Republic of Korea	To analyze the effects of a nurse-led cognitive-behavior therapy (CBT) program on fatigue and quality of life (QOL) with patients undergoing radiotherapy	A 6-week intervention with sessions held once a week and session times lasting 50 to 120 min	Gender: female only Race: no specifics Age range: 30–40 (16.9%), 41–50 (52.1%), 51–60 (31.0%) Participants: 71	Breast	Revised Piper Fatigue Scale, Quality of Life (QOL) Scale for Korean Patients with Cancer	Fatigue levels increased in both groups; however, patients in intervention group experienced lower fatigue than control	Fair (53.6%)
Mann et al. (2012) UK	To investigate how cognitive behavioral therapy (CBT) helps cancer survivors to effectively manage hot flashes and night sweats (HFNS)	A group-based 6-week CBT intervention with weekly 90-min sessions	Gender: female only Race: 89% White Mean age: $n_1 = 53.16$ (8.10), $n_0 = 54.05$ (7.76) Participants: 96	Breast	Hot flushes and night sweats (HFNS) problem rating score, Sternal Skin Conductance (SSC), General Health Survey Short Form 36 (SF-36), Women's Health Questionnaire (WHQ)	Group CBT significantly reduced HFNS problem ratings compared to usual care ($p < 0.0001$). Improvements were maintained at 26 weeks ($p < 0.0001$)	Good (89.3%)
Pakiz et al. (2011) USA	To analyze the effect of weight loss and physical activity on the action of inflammatory markers associated with breast cancer	In-person 16-week intervention of weekly educational and physically active group meetings followed by monthly follow-up sessions for 12 months, telephone calls which decrease in frequency with study duration; control received monthly calls and mailed communications	Gender: female only Race: 94% White, 6% not reported Mean age: $n_1 = 56$ (9), $n_0 = 56$ (8) Participants: 68	Breast	Anthropometric measurements, physical activity data, physical fitness data, presence of certain cytokines (IL-6, IL-8, TNF- α , VEGF)	Intervention group displayed significant weight loss in comparison to control group. Favorable changes in the IL-6 levels and physical activity of intervention participants who increased their physical activity were noted	Fair (67.9%)

Table 1 (continued)

Author (year) and country	Study purpose	Length/intensity of intervention	Sample population	Cancer type	Outcome measures	Main study findings	Quality assessment score
Penedo et al. (2004) USA	To investigate the effect of group cognitive-behavioral stress management (CBSM) on treatment related symptoms, physiologic stress, and mood in a diverse cohort of cancer patients	A 10-week intervention with weekly 2-h meetings. Hourly sessions include a 90-min didactic period and a 30-min relaxation training. Control group taught stress management skills through one, 4-h seminar conducted in groups	Gender: male only Race: 35% White, 34% Hispanic, 22% African American, 9% Other Mean age: 63.1 (2.2) Participants: 92	Prostate	Functional Assessment of Cancer Therapy-General Module (FACT-G), Measure of Current Status (MOCS)	Participation in CBSM intervention was associated with significant improvements in quality of life. Improvement not correlated with ethnic group membership	Fair (57.2%)
Penedo et al. (2006) USA	To determine the effectiveness of a cognitive-behavioral stress management (CBSM) intervention on benefit finding and the quality of life (QoL) of recovering males treated for prostate cancer	In-person, group-based 10-week CBSM intervention of educational and discussion driven sessions (90 min/week) and 30 min/week of relaxation training; control met once for 4 h and got intervention educational materials	Gender: male only Race: 11.5% African American/Black, 40.8% White, 40.8% Hispanic, 6.8% Other Mean age: $n_1=65.30$ (7.77), $n_0=64.87$ (7.64) Participants: 191	Prostate	Measure of Current Status, Positive Contributions Scale-Cancer (PCS-C), Functional Assessment of Cancer Therapy-General Module (FACT-G)	Intervention group exhibited a greater increase in benefit finding (BF), perceived stress management skill (PSMS), and QoL pre- to post-intervention. The increase BF and QoL can be attributed to the increase in PSMS. Control group did not change significantly in any outcome. Post-intervention, QL and BF were positively related	Fair (66.6%)
Penedo et al. (2007) USA	To explore the efficacy of a cognitive-behavioral stress management (CBSM) intervention tailored for ethnic minority group, in the pursuit of behavioral stress management	Culturally modified, 10-week CBSM intervention delivered in groups	Gender: male only Race: Hispanic Mean age: 65.5 (7.6) Participants: 71	Prostate	Functional Assessment of Cancer Therapy-General Module (FACT-G), Expanded Prostate Cancer Index Composite (EPIC)	Physical well-being and emotional well-being for participants significantly improved for the intervention group compared to control ($p < 0.03$ and $p = 0.04$, respectively)	Fair (57.2%)

Table 1 (continued)

Author (year) and country	Study purpose	Length/intensity of intervention	Sample population	Cancer type	Outcome measures	Main study findings	Quality assessment score
Prinsen et al. (2013) The Netherlands	To examine the effect of cognitive-behavioral therapy (CBT) on physical activity and fitness as well as determine whether the effects of CBT are facilitated by physical activity and/or fitness	Physical activity and a maximum of 2 sessions offered within a 6-month follow-up period with a trained therapist	Gender: 51.4% female, 48.6% male Race: no specifics Mean age: $n_f=49.3$ (9.3), $n_o=51.1$ (10.9) Participants: 37	Breast, head and neck, non-Hodgkin's lymphoma, prostate, testicular, thyroid and other solid cancers	Actigraphy, maximal exercise test, fatigue severity scale of the Checklist Individual Strength (CIS-fatigue), Sickness Impact Profile-8 (SIP-8)	Patients administered an average of 12 individual sessions showed larger changes in fatigue scores than waitlist group. Follow-up sessions revealed no significant differences between intervention and waitlist groups	Fair (73.8%)
Qiu et al. (2018) Republic of China	To explore the effectiveness of cognitive-behavioral therapy (CBT) for depression on insomnia and quality of life (QOL) compared to self-care management (SCM), and usual care (UC)	A 12-week intervention with nine sessions, 1 to 5 sessions carried out once a week and 6 to 9 sessions every 2 weeks	Gender: female only Race: no specifics Mean age: CBT = 46.83 (8.91), SCM = 47.29 (8.72), UC = 47.06 (8.32) Participants: 392	Breast	17-Item Hamilton Depression Rating Scale (HAM-D-17), Athens Insomnia Scale (AIS), Functional Assessment of Cancer Therapy for Breast Cancer (FACT-B)	Insomnia scores in CBT group were significantly lower compared with those in control ($p < 0.01$). The improvement in depression for the CBT group was much greater than control	Good (85.7%)
Qui et al. (2013) Republic of China	To investigate the effects of group cognitive-behavioral therapy (GCBT) in treating major depression in cancer patients	A 6-month intervention with weekly 2-h sessions and a booster session during the last month	Gender: female only Race: no specifics Mean age: $n_f=51.68$ (5.95), $n_o=49.58$ (8.03) Participants: 62	Breast	17-Item Hamilton Depression Rating Scale (HAM-D-17), Self-Rating Anxiety Scale, Functional Assessment of Cancer Therapy-Breast (FACT-B), Self-Esteem Scale (SES)	Patients in the GCBT group had a significant (9 point) reduction in depression score as compared to control ($p < 0.001$). Patients in the GCBT group had significantly greater improvement in quality of life ($p < 0.01$) and self-esteem ($p < 0.05$) as compared to control	Good (89.3%)

Table 1 (continued)

Author (year) and country	Study purpose	Length/intensity of intervention	Sample population	Cancer type	Outcome measures	Main study findings	Quality assessment score
Ritterband et al. (2012) USA	To evaluate the ability of a cognitive-behavioral therapy for insomnia (CBT-I) program to improve insomnia symptoms in cancer survivors	SHUTi: an interactive 6 core (45–60 min/core) program accessible for 9 weeks that teaches behaviors to improve sleep quality	Gender: 85.7% females Race: 92.9% White, 3.6% Black, 3.6% Mixed Mean age: $n_i=53.7$ (10.8), $n_o=59.6$ (12.3) Participants: 28	Breast and other cancers	Insomnia severity index (ISI), Multidimensional Fatigue Inventory (MFI), sleep diary	Clinically significant gains made by SHUTi users. Program users improved sleep efficiency by 19% and fatigue scores while control group improved sleep efficiency by 6% only	Good (80.9%)
Savard et al. (2005) Canada	To gauge the short-term effectiveness of cognitive-behavioral therapy (CBT) for chronic primary insomnia in breast cancer survivors	CBT consisted of eight weekly group sessions of 90 min each administered by a master-level psychologist	Gender: not specified Race: no specifics Mean age: $n_i=54.81$ (7.01), $n_o=53.37$ (7.72) Participants: 57	Breast	Insomnia Interview Schedule (IIS), sleep diary, Insomnia Severity Index (ISI), Multidimensional fatigue inventory (MFI), European Organization for Research and Treatment of Cancer Quality of Life Questionnaire (QLQ-C33)	Treatment group had significantly improved subjective sleep indices, lower frequencies of medicated nights, and lower levels of depression and anxiety	Good (89.3%)
Savard et al. (2014) Canada	To assess the effectiveness of a video-based cognitive behavioral therapy for insomnia (VCBT-I) compared to that professionally administered (PCBT-I) in breast cancer patients	In-person weekly sessions of 50 min for 6 weeks for those receiving PCBT-I; 60-min animated video and 6 booklets for those receiving VCBT-I; those receiving psychosocial and pharmacological + P9 services allowed to continue their use	Gender: female only Race: no specifics Mean age: $n_i=54.4$ (8.8), $n_o=55.4$ (8.8) Participants: 242	Breast	Insomnia Severity Index (ISI), sleep diary and actigraphy	Both VCBT-I and PCBT-I programs were associated with significant improvements in insomnia severity, waking up early, depression, fatigue, and dysfunctional sleep attitudes. PCBT-I remission rates of insomnia greater than VCBT-I	Good (82.2%)

Table 1 (continued)

Author (year) and country	Study purpose	Length/intensity of intervention	Sample population	Cancer type	Outcome measures	Main study findings	Quality assessment score
Stagl et al. (2015) USA	To observe whether less depressive symptoms and better quality of life (QOL) are reported in women participating in a group-based cognitive-behavioral stress management (CBSM) intervention 2–10 weeks postsurgery compared to women not participating in intervention 8–15 years postsurgery for early stage breast cancer	In-person 10-week CBSM intervention which includes cognitive-behavioral therapy (CBT) and relaxation training; control group received 1-day self-help seminar and materials to view on their own	Gender: female only Race: 70% White, 21% Hispanic, 5% Black, 3% Asian Mean age: $n_i = 60.75$ (9.21), $n_o = 64.27$ (8.48) Participants: 99	Breast	Center for Epidemiologic Studies Depression Scale (CES-D), Functional Assessment of Cancer Therapy for Breast Cancer (FACT-B)	Intervention group had reduced risk of all-cause mortality ($p = 0.040$) and breast cancer-specific mortality ($p = 0.006$)	Poor (46.5%)
Stefanopoulou et al. (2015) UK	To evaluate the effects of a guided self-help cognitive-behavioral therapy (CBT) intervention on hot flushes and night sweats (HFNS) problem-rating and frequencies as well as on mood and health-related quality of life (HRQOL)	4-week intervention consisting of a booklet of self-guided information, a CD of relaxation breathing exercises, and telephone call every 2 weeks; control received treatment as usual (TAU)	Gender: male only Race: 73.5% White, 25.0% Black, 1.5% Other Mean age: $n_i = 67.97$ (7.65), $n_o = 69.71$ (7.90) Participants: 68	Prostate	Hot Flush Rating Scale (HFRS), Hospital Anxiety and Depression Scale (HADS), European Organization for the Research and Treatment of Cancer Quality of Life Questionnaires (EORTC QLQ-C30 and the EORTC QLQ-PR25 (prostate cancer-specific))	Compared to control, intervention arm had significantly reduced hot flushes ratings ($p = 0.001$) and hot flushes frequency ($p = 0.02$)	Good (85.7%)
Traeger et al. (2013) USA	To assess the effectiveness of (cognitive-behavioral stress management) CBSM in improving the emotional well-being of prostate cancer survivors by improving illness perceptions	10-week, manualized intervention held 2 h/week in groups which focused on managing stress and health; control group attended a half-day seminar	Gender: male only Race: 42% Hispanic, 40.9% White, 16.7% African American Mean age: $n_i = 65.9$ (7.5), $n_o = 64.6$ (7.8) Participants: 257	Prostate	Functional Assessment of Cancer Therapy-General Module (FACT-G), Illness Perception Questionnaire (IPQ-R), Perceived Stress Scale (PSS)	Greater stress at the start of the intervention, predicted greater increase in perceived illness coherence and in perceived treatment control	Fair (57.2%)

Table 1 (continued)

Author (year) and country	Study purpose	Length/intensity of intervention	Sample population	Cancer type	Outcome measures	Main study findings	Quality assessment score
Trask et al. (2003) USA	To examine the effect of a cognitive-behavioral intervention (CBI) on distress levels and HRQOL (health-related quality of life) in melanoma patients with medium-to-high levels of distress compared to those who receive standard medical treatment	CBI group received weekly, in-person training sessions on relaxation, cognitive challenging and problem-solving in the scope of the patient perspective for 4 weeks (50 min/week) and one psychiatric intake session	Gender: 70.8% female Race: 100% Caucasian Mean age: 53.4 (15.36) Participants: 48	Melanoma	BSI (Brief Symptom Inventory), State-Trait Anxiety Inventory (STAI), Survey-Short Form-36 (SF-36)	Distress was not impacted significantly by CBI. Anxiety levels of CBI group were significantly reduced at the 2-month and 6-month follow-up. CBI group's general health, vitality, social functioning, and mental health scores improved immediately after treatment while bodily pain scores improved significantly 2 months after treatment compared to standard medical treatment group	Fair (71.4%)
Van Weert et al. (2010) The Netherlands	To compare the effect of physical training and cognitive based therapy (CBT) on cancer fatigue with physical training alone and no intervention at all	In-person, 12-week intervention including 2 h of CBT/week and 2 h of individual training/week and 2 h of group sports/week; nonintervention control group (WLC) waited 3 months before starting rehabilitation	Gender: 85.6% female Race: no specifics Mean age: PT + CBT = 47.8 (10.5), PT = 49.9 (11.3), WLC = 51.3 (8.8) Participants: 209	Breast, Hematological, Gynecological, other (unspecified)	Multidimensional Fatigue Inventory (MFI)	WLC reported experiencing significantly more fatigue than other groups participating in study. Though the PT group reported reductions in general ($p = .007$), mental ($p = .04$), and physical fatigue ($p < .001$), and reduced activation ($p = .02$). No significant contrasts could be made between the groups experiencing PT + CBT, and PT only	Fair (64.3%)

Table 1 (continued)

Author (year) and country	Study purpose	Length/intensity of intervention	Sample population	Cancer type	Outcome measures	Main study findings	Quality assessment score
Van de Wal et al. (2017) The Netherlands	To evaluate the effectiveness of blended cognitive behavioral therapy (bCBT) in reducing fear of cancer recurrence (FCR) levels in breast, prostate, or colorectal cancer survivors	BCBT over the course of 3 months consisted of: five 1-h, in-person sessions, three 15-min e-consultations with a Web site/three 15-min telephone consultations with a workbook (same content); control received care as usual (CAU)	Gender: 53.4% female Race: no specifics Mean age: $n_1=58$ (11.3), $n_0=59.7$ (10.0) Participants: 88 *Psychosocial services not restricted	Breast, prostate, and colorectal	Cancer Worry Scale, Fear of Cancer Recurrence Inventory (FCRI)	Group receiving bCBT saw a greater reduction in FCR than those receiving CAU. Weak-to-moderate correlation of decreased FCR with therapy sessions completed. Total FCRI scores of bCBT participants greatly improved compared to CAU group	Fair (64.4%)
Yanez et al. (2015) USA	To examine the feasibility, acceptability, and preliminary efficacy of a cognitive-behavioral stress management (CBSM) intervention for psychosocial benefits on a diverse cohort	An internet and group based, 10-week CBSM intervention program delivered through a tablet provided through the study	Gender: male only Race: 56.8% White, 40.5% Black, 2.7% Multiracial, 1.4% Hispanic Mean age: 68.84 (9.23) Participants: 74	Prostate	Patient-Reported Outcomes Measurement Information System (PROMIS) measures by computerized adaptive testing (CAT)	Feasibility was held at high rates (<85%) and acceptable average attendance rates (<70%). Those in intervention group had significant reductions in depressive symptoms ($p<0.05$) and improved relaxation self-efficacy ($p<0.05$)	Fair (71.4%)
Zachariae et al. (2018) Denmark	To determine the efficacy of internet-delivered cognitive-behavioral therapy for insomnia (iCBT) in breast cancer survivors experiencing clinically significant sleep disturbance	An internet-based, 6 core programs delivered via email; email reminders to complete sleep diary	Gender: female only Race: no specifics Mean age: $n_1=53.2$ (8.8), $n_0=52.9$ (8.9) Participants: 255	Breast	Insomnia Severity Index (ISI), Pittsburgh Sleep Quality Index (PSQI), Functional Assessment of Chronic Illness Therapy for Fatigue (FACIT-F), Wake After Sleep Onset (WASO)	Effect sizes for ISI and PSQI saw a large improvement while those for total sleep time were of a medium size. Small effect sizes were for reductions in fatigue and less time spent awake after falling asleep. Follow-up sessions revealed that improvements had been maintained	Good (82.2%)

Results

Selection of studies

The search for studies meeting the criteria resulted in a total of 1494 studies. As denoted in Fig. 1, 1437 of these were removed due to being a duplication, in a language other than English, or not meeting the eligibility criteria. Fifty-seven papers were then selected for full-text evaluation, and screened further. Of these, 36 studies met inclusion criteria and were evaluated (see Table 1). Of note, Goedendorp et al. is a secondary analysis of Goedendorp et al. [46, 47]. Both studies are included in this review.

Study characteristics

The 36 studies included a total of 5199 participants. The majority of studies evaluated several different outcomes, which included quality of life, distress, FCR, insomnia, physical activity, smoking cessation, and other related measures. Thirteen of the 36 papers did not include a longitudinal assessment of participants postintervention [48–60]. Of the 23 that did, the time range for follow up extended anywhere from two months, to 15 years [46, 47, 61–81].

In terms of length, interventions ranged from 4 weeks to 7 months. The interventions also varied in the method of delivery, including face to face, telephone, internet based, or some component of each. Most studies excluded those actively seeking treatment, with advanced cancer (> stage III), or with any type of metastasis. The quality of the studies, as assessed by reviewers, ranged anywhere from 28.5 to 100%.

Tandem CBT and lifestyle interventions

Overview of interventions

Anxiety, depression, and/or stress management were the predominant ($n = 13$) focus of most interventions [53–55, 57, 58, 61, 67, 68, 73, 77, 78, 80, 81]. Following, was the use of CBT and HL interventions in the reduction of insomnia ($n = 9$) [48, 49, 56, 59, 64, 69, 74, 75, 79], and fatigue ($n = 7$) [46, 47, 50, 51, 60, 70, 72]. Very few studies focused on cancer related cognitive changes ($n = 2$) [65, 66], weight loss and diet ($n = 1$) [52], and smoking cessation ($n = 1$) [62].

Tandem content

Stress, depression, anxiety, mood, and FCR

In total, 13 studies concentrated on anxiety, stress, mood, and/or FCR [53–55, 57, 58, 61, 67, 68, 73, 77, 78, 80, 81]. The majority reported positive outcomes in the reduction

of adverse emotional states. Many studies also included HL interventions that were heavily education-based, seemingly aimed at building long lasting stress reduction and coping skills in survivors. For instance, a 2006 study by Antoni et al. examined the use of stress reduction methods such as muscle relaxation, and the recitation of recorded relaxation exercises to facilitate the honing of coping skills in breast cancer survivors, in ten weekly, 2-h sessions [61]. The participants reported several positive outcomes postintervention, including “reduced reports of social disruption and increased emotional well-being,” and greater confidence in their ability to relax at will. Many of these effects were sustained at a 12-month follow-up.

Similarly, in a randomized control trial conducted by Yanez et al., prostate cancer survivors took part in an intervention focused on mitigating depressive symptoms and increasing relaxation [80]. Specifically, the intervention involved “changing negative stressor appraisal... and building or enhancing social networks.” At 6-month follow up, the participants reported clinically significant ($p < 0.05$) positive outcomes.

Only two studies focused on patients with advanced or terminal cancer [67, 80]. One of these, a 2012 study by Greer et al. consisted of a CBT intervention focused on reducing anxiety in those with terminal cancer. The results of the study indicated tremendous improvements in anxiety, but no difference in depressive symptoms between the intervention and control group at posttreatment. Weaknesses of this study include a lack of control for the use of psychotropic medication, and their overwhelmingly (95%) white cohort. A major strength of this study was that the authors tried to ensure that the CBT intervention took place on the same day as other medical visits participants had, to increase accessibility and the rate of retention. The rate of attrition was high in this study, at 30%, in large part due to participants being medically unable to continue, or passing away before the study’s end.

Insomnia and sleep management

Nine studies evaluated insomnia and/or sleep management as a primary outcome [48, 49, 56, 59, 64, 69, 74, 75, 79]. Many used a combination of CBT involving either sleep hygiene education, sleep restriction, and/or stimulus control components. All nine studies reported positive outcomes. Interestingly, to further elucidate the role of each CBT component in the management of insomnia and fatigue, a 2008 study by Dirksen et al. compared the use of CBT with components of sleep restriction, education, hygiene and stimulus control with a control group with only sleep education and hygiene for the treatment of insomnia in breast cancer survivors [49]. While both groups showed improvement in quality of life, the intervention group reported a greater reduction in fatigue

than the control. The intervention group also reported statistically significant improvements in anxiety, and depression. However, longitudinal sustainability was not assessed, so whether or not these results endured is unknown.

Physical activity and fatigue

Seven studies focused on increasing physical activity, and/or the use of physical activity to reduce fatigue or increase functioning [46, 47, 50, 51, 60, 70, 72]. While positive outcomes were reported in all studies, only four of the seven directly analyzed the impact of the addition of CBT to physical activity in the reduction of cancer-induced and/or treatment-related symptoms [46, 60, 70, 72].

One of these, a 2013 study from Prinsen et al., focused on CBT's effect on physical activity and postcancer fatigue [72]. The intervention itself incorporated the encouragement of realistic physical activity standards (i.e., walking or cycling), and CBT. The outcomes of the tandem intervention revealed a statistically significant change, compared to the waitlist control group. At the 6-month follow-up, the difference in fatigue between the intervention and control group was sustained; however, physical activity was found to be statistically insignificant when analyzed between the intervention and waitlist control group. Ultimately, the authors concluded that physical activity did not mediate CBT in reducing fatigue in these patients. Similarly, a 2010 study by Goedendorp et al. compared three conditions—a CBT/physical training based intervention, a brief nursing intervention focused on education, a “usual care” (UC) group to examine the best means of decreasing fatigue among cancer survivors [46]. The CBT/HL intervention focused on encouraging patients to engage in physical activity to minimize fatigue. A significant reduction in fatigue was found in the CBT/HL intervention group, when compared with the brief nursing intervention and UC groups. Despite this positive outcome, further analysis demonstrated that the introduction of physical activity did not mediate the decrease in fatigue.

Weight loss and diet

Only one study focused on diet and weight loss. This study from Pakiz et al. lasted 12 months and aimed to foster “regular physical activity and reduced energy intake in order to facilitate weight loss” [52]. Participants received counseling over the phone, and took part in group meetings with rotating topics (i.e., “portion control, exercise, weight maintenance skills”). The intervention was efficacious, with the difference in weight loss between the control and intervention group found to be statistically significant “(−5.7 [3.5] vs. 0.2 [4.1] kg, $P < 0.001$)”. The intervention group also reported increased levels of physical activity and improvements in fitness; however, there was no follow-up scheduled at the end

of the yearlong intervention, so it is difficult to determine whether or not these results were sustainable.

Alcohol and smoking cessation

Only one study included smoking and alcohol cessation as an intervention focus [62]. The basis of this intervention was to reduce smoking, alcohol consumption, and depressive symptoms in head and neck cancer survivors. The intervention itself consisted of nurse-led CBT with “pharmacologic management as needed.” This pharmacologic therapy consisted of treatments such as nicotine patches, and bupropion. The authors compared this patient set with those who received “enhanced” usual care. This “enhanced” care consisted of an equivalent amount of attention as the intervention group, and a referral “as needed for smoking cessation, and/or alcohol treatment, and/or psychiatric evaluation.” The researchers discovered that the intervention condition increased smoking cessation by greater than 50%, when compared to care as usual. However, they also found that the intervention was not particularly efficacious in reducing alcohol consumption or depression compared to the control group. Of note, the criteria for a current smoker in this study included those who had reported quitting smoking within a month prior to the intervention [62].

Method of delivery

The CBT interventions were delivered by various means, with some studies using in-person groups, in-person one on one, Internet, phone-based interventions, or a combination of them all. A 2014 randomized control trial further probed this dynamic in breast cancer survivors, by exploring the efficacy of self-administered video based CBT (VCBT-I) compared to professionally administered interventions (PCBT-I), and a no treatment control group [59]. The authors concluded that “...PCBT-I was significantly more efficacious than VCBT-I in reducing ISI [Insomnia Severity Index] scores, EMA [early morning awakening], depression, fatigue, and dysfunctional beliefs about sleep.” These results must be taken judiciously, however, considering that the PCBT-I patient received five more treatment sessions compared to the VCBT-I group. Also of note, was the rate of attrition—VCBT-I's dropout rate was more than double that of PCBT-I (13.6% compared to 28.8%).

Interventionist

Another distinction was the type of interventionist. The interventions were most commonly led by psychologists, master degree level psychology students, or clinical psychology fellows ($n = 17$) [53–55, 57–59, 61, 65–68, 71, 72, 75, 76, 78, 81]. However, many other interventions were

led by nurses, therapists, social workers, physiotherapists, or research assistants given CBT training. One such study, performed by Lee et al., examined the efficacy of a “nurse-led” CBT intervention in increasing quality of life, and reducing fatigue in women currently undergoing radiotherapy for breast cancer [51]. The nurses (“registered nurse, student of master’s degree in nursing”), received 36 h of training in cognitive behavioral therapy prior to the intervention. The results were favorable, with women in the intervention group experiencing less fatigue and greater quality of life than the control group.

Effectiveness

Thirty-one out of 36 studies revealed positive outcomes in some but not all of their measures. Those that did not include the following: Prinsen et al., Goedendorp et al. (2010), van Weert et al., Irwin et al., and Korstjens et al. [46, 60, 69, 70, 72]. Similar to aforementioned findings from Goedendorp et al. (2010) and Prinsen et al., studies from Korstjens et al. and van Weert et al. also concluded that the addition of physical activity to CBT did not significantly enhance the results of the intervention condition. The tandem intervention performed by Korstjens et al. combined physical training twice a week, with CBT once per week [70]. This condition was compared against a group of participants completing only physical training. Finally, both conditions were compared against a control group, who were provided no intervention. The authors found that the tandem intervention did not surpass physical training alone, in any of their measured outcomes (role limitations, quality of life). However, both conditions significantly outperformed the control group. Likewise, in the study by van Weert et al., the physical training (PT) condition outperformed the CBT/PT tandem intervention. Specifically, the authors found that “the PT group showed more reduction in 4 domains of fatigue, whereas the PT + CBT group showed more reduction in one domain only.” [60]

Analogously, a 2017 study performed by Irwin et al., found Tai Chi Chih to be noninferior to CBT with sleep education and hygiene components for the treatment of insomnia in breast cancer survivors [69].

Sustainability

Similarly to intervention effectiveness, not all reported positive outcomes reached significance at follow-up. For instance, a 2015 study from Stefanopoulou et al., aimed at reducing hot flashes and improving quality of life in prostate cancer survivors, noted a significant positive improvement for the intervention group in hot flashes and night sweats problem rating and frequency at the end of treatment [76]. But, 26 weeks later, although the results were sustained, the

differences between the care as usual group and the intervention group were not significant.

Overall, of the 23 studies that clearly assessed for longitudinal follow-up (> 2 months), 19 reported sustained positive effects in at least one measured outcome, two (Prinsen 2013, Groarke 2013) reported that the positive outcomes were not sustained at 6 and 12 months, respectively, and another (Espie et al. 2008), reported a diminished positive effect at six months. Finally, Goedendorp et al. (2012) reported reduced positive effects at seven months and a completely absent effect at 12 months [46, 47, 61–81].

Racial demographics

Twenty-four out of the 36 studies either did not record racial demographic data, noted that the participants were “majority Caucasian,” or had greater than 85% white participants [46–52, 56, 59, 60, 62–70, 72, 75, 77–79]. Notably, the 2012 study by Ritterband et al. reported only two black participants out of 28, with the authors remarking that the remaining 26 were mostly “highly educated Caucasian women” [56]. The lack of racial data in some instances is likely due to the country in which the study was conducted. These include studies from the Netherlands, China, South Korea, and Ireland. However, there were many US-based studies that either did not provide a racially diverse pool of participants, or did not report this data at all. In total, only eight of the 36 studies recorded 8% or greater black participants [53, 54, 57, 58, 61, 71, 76, 80]. Hispanics were poorly represented as well, with greater than 5% in only six studies, which includes one study with only Latinos [53–55, 57, 61, 81].

Adherence

Intervention adherence data was absent or unclear in the majority of studies, with only 11 out of 36 studies clearly referencing it, and many of those not providing associated data points [48, 59, 60, 63, 67–69, 71, 76, 77, 79]. Data on adherence is necessary to move forward with large scale trials on these tandem interventions.

Discussion

As the landscape of cancer survivorship care shifts to focus on the lingering effects of cancer, so too must the treatments. As such, the aim of this review was to evaluate and consolidate information on the usefulness of tandem CBT and HL interventions in cancer survivors in hopes of informing clinical practice guidelines. Current survivorship guidelines advocate for the use of CBT and healthy lifestyle interventions (i.e., physical activity, alcohol cessation, etc.) to reduce cancer-induced and/or treatment-related symptom burden;

however, little is known of the efficacy of a hybrid intervention [82].

The results of this review revealed that the majority of included studies reported positive outcomes in at least one aspect, suggesting that there may be benefit in the use of tandem interventions in cancer survivors. However, very few studies compared the combination of CBT/HL against a HL intervention alone [60, 70], or CBT/HL to CBT alone [46, 72]. This lack of direct comparison of each component of a multi-modal intervention makes it challenging to elucidate whether the addition of CBT, or a HL intervention to treatment regimens would be superior to a CBT or HL intervention alone, or merely redundant.

Additionally, due to the heterogeneous nature of each intervention, it is difficult to make generalizations about the integrity of comparisons. Major sources of variability include the duration, mode of delivery, and length of each intervention. For instance, participants in a 2008 study by Espie et al. met for five weekly 50-min sessions, while in another study, by Qiu et al., participants met weekly for 10 weeks, for sessions lasting 2 h each [64, 73]. This leaves us to question whether or not the positive outcomes could be due in part to the amount of contact, or intensity of treatment sessions. Moreover, despite the studies sharing common goals, the criteria and measurements used were not homogenous among the studies. This lack of consistency in outcome measurements makes rigorous comparisons difficult to perform. As such, the quality of evidence for the usefulness of tandem interventions in clinical practice is difficult to extrapolate.

Another emerging area of research in survivorship care involves increasing patient accessibility to survivorship related treatments and care, in hopes of broadening reach. Minimizing the amount of in person contact time needed may be one such avenue [83]. One way to practically achieve this is to allow patients to access these treatments remotely, on their own schedule, as done with recorded video-based interventions. As aforementioned, this was explored by a study in our cohort [59]. The authors concluded that although VCBT is more available, it was not as effective, or as well adhered to as CBT administered face-to-face. However, this may need to be evaluated further due to the impact of SARS-CoV-2, which has pushed healthcare systems to rapidly adopt tele-health and virtual platforms [84]. Nurse led interventions, may be another possibility in making these interventions adaptable for use in clinical practice. Notably, Lee et al. found their nurse led intervention to be more efficacious than “standard care.” Though, this should be taken cautiously considering it was not directly compared to an equivalent physician or psychologist led intervention [51]. However, considering that nursing has been named the most trusted profession for nearly 20 years straight, this should be an area of further study [85]. Moreover, considering that

the average amount of time spent by physicians with cancer survivors in outpatient settings is 22.9 min, the use of a multidisciplinary team, consisting of psychologists, social workers, nurses, and other healthcare professionals, may be a more time efficient avenue for clinical practices to explore, and a more flexible and readily accessible option for patients to receive [86].

The field also appears to be saturated with certain cancer types, while having a paucity of information on others. Breast cancer was the most common cancer type examined, as these survivors were the sole focus of 18 out of the 36 studies [48, 49, 51, 52, 58, 59, 61, 63, 65, 66, 68, 69, 71, 73–75, 79, 81]. Moreover, breast cancer patients also accounted for > 50% of participants in six additional studies [46, 47, 56, 60, 64, 70]. The second most common cancer type examined was prostate cancer, as the sole focus of six studies [53–55, 57, 76, 80]. On the other hand, head and neck cancers were the focus of only one study [62]. This is understandable, considering the high rates of breast and prostate cancer; however, it makes it difficult to take away generalizable evidence for other cancers from these findings [87]. As coping and maintaining health are important for all cancer types, it is disappointing that there is a limited pool of information on the use of multifaceted interventions in cancer types outside of breast and prostate cancer.

Also contributing to a lack of diversity, is the absence of studies focusing on, or even allowing the inclusion of those with terminal, and/or advanced cancers. Of the 36 studies in this review, only two were dedicated to those with advanced or terminal cancers [67, 80]. Yanez et al. conducted an intervention focused on improving distress, and reducing depressive symptoms in men with advanced (stage III or IV) prostate cancer at initial diagnosis, however those with “prior history of surgery or chemotherapy treatment within the past 6 months” were excluded [80]. This has been recently highlighted—with researchers pointing out the staggering absence of studies focused on improving the quality of life of metastatic cancer survivors despite a growing need for such examination [10].

Overall, the evidence suggests that tandem interventions appear to be efficacious, but there is no consensus on the optimal dose or delivery mechanism. To provide tangible conclusions, the next step in the assessment of these tandem interventions may be the use of pragmatic and/or dissemination and implementation trials.

Strengths and limitations

The strengths of this review include the use of randomization in all included studies, the screening of each study by a minimum of two independent evaluators, and the use of the NIH quality assessment tool by a minimum of

two individual screeners to assess quality. Additionally, the rigor of the systematic search and data collection are significant strengths of this review. Accuracy was safeguarded by the use of PRISMA, as well as the involvement of multiple authors to gather outcomes. The authorship group met many times to discuss any discrepancies in consensus and ensure an iterative nature to data collection.

The most salient limitation is the lack of participant diversity of the included studies. This refers not only to the absence of racial diversity, but also in types and stages of cancer. Consequently, this homogeneity makes it difficult to generalize the findings to the average patient population. Also of note, many studies did not include adherence data. The absence of this information makes it challenging to uniformly deduce how much of a given intervention is needed to effect a positive outcome. Moreover, without this data, it is difficult to make thorough comparisons against other interventions, and to determine whether or not pursuing the clinical translation of these multifaceted treatment modalities would be a wise way to allocate resources in survivorship care.

Other limitations of this review include the possibility of publication bias, the variable quality of the studies included, and the exclusion of studies in a non-English language, and those focusing on a populations aged 18 and under. It is possible that the high number of positive outcomes could be due in part to publication bias. As such, it is possible that we would not have access to studies with more negative outcomes, as they would not have been published.

The exclusion of non-English studies, as well as those focusing on the pediatric population (0–17 years old), limits the breadth that can be gleaned from the findings. It is possible that informative studies, otherwise meeting our criteria, may not have been translated into English, and thus were excluded. The same holds true for studies focusing on pediatric patients. With these factors in mind, it is necessary to consider the scope of this systematic review before extrapolating results across a wider spectrum of individuals.

Furthermore, there was also a great deal of variability in mode of delivery and duration of interventions, with some studies including voluntary modules which were left up to the participants to complete and thus completed by some participants, but not others [48]. Such presentations make it difficult to draw conclusions or overarching inferences on the true efficacy of these tandem interventions. Finally, participants were also not blinded in any of the studies, and many studies did not control for attention, as they used wait-list controls or care as usual. Both of these stipulations are understandable given the nature of these interventions; however, it does reduce the rigor of evidence that can be gleaned from their results.

Conclusion

This review is the first to systematically review the extant literature on tandem CBT/HL interventions in the care of cancer survivors. While the results are promising, due to the heterogeneity of studies comparing CBT/HL to CBT only, or HL only, the overrepresentation of certain cancers, underrepresentation of Blacks, and other people of color, and variability of dose and delivery, conclusive evidence cannot be gleaned. While there is evidence emerging on the utility of such tandem interventions, it is difficult to make definitive suggestions for clinical practice guidelines. This serves to highlight the need for further research in this area.

Author contribution Sarah Addison: investigation, writing—original draft, writing—review and editing, data curation, formal analysis, validation. Damalie Shirima: investigation, writing—review and editing, data curation. Emmanuela B. Aboagye-Mensah: investigation, writing—review and editing, data curation. Shanon G. Dunovan: conceptualization, methodology, software, writing—original draft. Esther Y. Pascal: writing—review and editing, data curation. Maryam B. Lustberg: writing—review and editing, validation. Elizabeth K. Arthur: investigation, supervision, writing—review and editing, data curation, formal analysis, validation. Timiya S. Nolan: conceptualization, investigation, project administration, supervision, visualization, writing—review and editing, data curation, formal analysis, validation.

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Conflict of interest The authors declare no competing interests.

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