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REVIEW ARTICLE

# Effects of Internet-based psycho-educational interventions on mental health and quality of life among cancer patients: a systematic review and meta-analysis

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## Abstract

**Purpose** To systematically review evidence regarding the benefits of Internet-based psycho-educational interventions among cancer patients.

**Methods** We performed a systematic review with meta-analysis and qualitative evidence synthesis. Systematic searches for published studies in English or Chinese identified eligible randomized and clinical controlled trials. The following databases were searched: Medline, Embase, CINAHL, PsycINFO, Web of Science, Cochrane Central Register of Controlled Trials (CENTRAL), Proquest Digital Dissertations, Foreign Medical Retrieval System, China National Knowledge Infrastructure, China Science and Technology Journal Database, China Wanfang Database, and Taiwanese Airiti Library. We also searched the gray literature and reviewed reference lists from relevant articles. Studies were scored for quality using the Cochrane Risk of Bias Tool.

**Results** Seven eligible studies (1220 participants) were identified that used three intervention tools: website programs ($n = 5$), e-mail counseling ($n = 1$), and a single-session psycho-educational intervention ($n = 1$). The quality of all studies was moderate. The meta-analysis showed that Internet-based psycho-educational interventions had a significant effect on decreasing depression (standardized mean difference (SMD) − 0.58, 95% confidence interval (CI) (− 1.12, − 0.03), $p = 0.04$) and fatigue (mean difference (MD) − 9.83, 95% CI (− 14.63, − 5.03), $p < 0.01$). However, there was no evidence for effects on distress (SMD − 1.03, 95% CI (− 2.63, 0.57), $p = 0.21$) or quality of life (MD 1.10, 95% CI (− 4.42, 6.63), $p = 0.70$).

**Conclusion** Internet-based psycho-educational interventions reduce fatigue and depression in cancer patients. More rigorous studies with larger samples and long-term follow-up are warranted to investigate the effects of these interventions on cancer patient quality of life and other psychosocial outcomes.

**Keywords** Internet · Psycho-educational · Neoplasms · Mental health · Quality of life · Systematic review · Literature review · Meta-analysis

## Introduction

Cancer is the highest barrier to increasing life expectancy and may be the leading cause of death worldwide in the twenty-first century [1]. The process of treating cancer is usually complex. The side effects of cancer treatments (e.g., chemotherapy, radiation therapy) may have an impact on cancer patients' self-efficacy and quality of life (QoL) and their physical function [2]. Even after treatment, cancer survivors continue to face a variety of difficulties and challenges that can affect their QoL [3], a term describing the modification and enhancement of life attributes. There are a few common symptoms in patients with cancer, such as anxiety, depression, and fatigue [4–7]. In addition to physical symptoms, patients frequently struggle with psychological issues [8, 9]. Moreover,

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cancer patients often lack confidence [10] or feel ill-prepared to effectively manage life following cancer treatment, resulting in a common need for information [11]. These cancer-related sequelae may significantly impact patient mental health and QoL [12, 13]. In response, supportive and rehabilitative services may be used to promote health [14]. Furthermore, cancer survivors may feel a need to cope with and relieve symptoms after treatment [15].

## Background

Psycho-educational interventions are defined as information provided about health-related condition and management [16]. Psycho-educational interventions combine patient education with activities [17, 18], such as structured, time-limited interventions consisting of stress management, health education, and psychological support [19]. This differs from psychosocial interventions that represent less specific interventions through social support, suggestions, and encouragement in order to improve mental health [20]. There is considerable overlap between psycho-educational interventions and specific psychotherapies, such as cognitive behavioral therapy (CBT) and family-focused therapy (FFT) [21]. CBT can be conducted individually and in a group, family involvement, and the computer or Internet-based [22], which can be included as a component of psycho-education.

Given the educational and support needs of patients regarding their disease, they increasingly use online resources to learn how to cope with illness, as opposed to traditional psychosocial resources such as healthcare professionals, family members, and friends [23]. A systematic review has shown that e-Health interventions (e.g., teleconference, interactive app-based project, and internet-based program) can improve fatigue and self-efficacy in cancer survivors [24]. The Internet has various advantages, including accessibility, availability, and anonymity, which can overcome spatial, temporal, and psychological barriers [25]. The online environment can allow anonymous access to information and support, at anytime, anywhere, and in a format easily tailored and personalized for patients [26, 27]. Thus, use of the Internet has facilitated numerous new ways to deliver psycho-educational interventions to cancer patients [28].

The Internet is used more frequently for particular types of intervention and to provide psycho-oncological support [27, 29]. Cancer patients use the Internet to seek information after diagnosis [30]. Recent studies have integrated the use of the Internet into patient care through information support [31], peer support groups [32, 33], patient forums [34], and therapeutic games [35]. Several online interventions are therapist guided and appear to have similar efficacy as face-to-face interventions [21]. Hence, this is a promising medium to deliver psycho-oncological interventions [27]. Several stand-alone web-based psychosocial interventions have been evaluated; however, only preliminary results have been published [32, 36–38]. Studies have explored the effects of Internet-based psycho-educational interventions on QoL [39], distress [40], anxiety [41], and fatigue [42]. These studies included different instruments, durations, frequencies, and outcomes. Furthermore, several groups investigated the use and effects of Internet-based self-help and reported meaningful results; for example, the use of discussion boards can improve social support [43, 44]. To date, evidence regarding the effects of Internet-based psycho-educational intervention on cancer patients has not been synthesized for clinical practice.

## The review

### Aims

The aim of this review was to evaluate the available evidence regarding the effects of Internet-based psycho-educational interventions on mental health and QoL among cancer patients.

### Design

This systematic review was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) statement, using the order prescribed by the Cochrane Collaboration. The protocol for this systematic review was registered in PROSPERO (registration number: CRD42018097205).

### Search methods

Articles were identified through a systematic search of 12 electronic databases: Medline, Embase, Cochrane Central Register of Controlled Trials (CENTRAL), PsycINFO, Web of Science, Cochrane Central Register of Controlled Trials, Proquest Digital Dissertations, Foreign Medical Retrieval System, China National Knowledge Infrastructure, VIP Journal Integration Platform, China Wanfang Database, and Taiwanese Airiti Library, from their inception to March 2019. We also reviewed the bibliographies of relevant review articles to identify additional publications. Search strategies were tailored for each database (see Additional file 1).

### Inclusion criteria

The inclusion criteria were as follows:

(a) *Study designs*: randomized controlled trials or clinical controlled trials in English or Chinese;
(b) *Participants*: patients with confirmed diagnosis of any cancer, with no restriction on the age, sex, or ethnicity;

(c) *Interventions*: Internet-based instruments such as websites, smartphone applications, online games, and online video for conducting psycho-education interventions. Meanwhile, interventions were required to meet the definition of psycho-education or use material related to psycho-education or as a component of psycho-education;
(d) *Controls*: eligible controls were required to receive standard care or usual care, or be a conditional control group;
(e) *Outcomes*: studies were eligible if a mental health outcome (e.g., QoL, depression, anxiety, distress, life satisfaction) was assessed.

### Exclusion criteria

(a) *Study designs*: other types of studies (e.g., observational, review, protocol, case reported) were excluded;
(b) *Participants*: patients who could not use internet by themselves or had cognitive disorders;
(c) *Interventions*: participants who were receiving other types of interventions (e.g., music therapy, life review therapy, or group-based or family involvement cognitive therapy);
(d) Studies without available full-text articles were excluded.

### Search outcomes

After analyzing the characteristics of the selected studies, two reviewers codified and organized the articles. The extracted data included publication details, study designs, participants, sample sizes, interventions, facilitators, settings, outcomes, measuring instruments, and results. Data were independently extracted by two reviewers, and a consensus was reached by consulting with a senior researcher. The reliability (kappa value) between the two reviewers was 0.830 ($p < 0.001$). If any information was missing or unclear, the original authors were contacted by e-mail for more information.

### Quality appraisal

The tool provided by the Cochrane Collaboration was used to assess the risk of bias based on the adequacy of sequence generation, allocation concealment, blinding of patients and personnel, blinding of outcome assessment, reporting of incomplete outcome data, selective outcome reporting, and other sources of bias [45]. The risk of bias for each outcome was categorized into three levels: low, high, and unclear. The quality of included studies was independently assessed by the two researchers. Disagreements were resolved by discussion, or if unsuccessful, by consulting the senior researcher. The inter-rater reliability (kappa value) was 0.874 ($p < 0.001$).

### Data abstraction

The data extraction forms for each publication included in the review were independently completed by the two reviewers. They read each article and recorded information regarding the study design, participants, intervention characteristics, and outcomes. Data extraction forms were used to complete a narrative synthesis of the results. Additionally, evidence regarding the effects of Internet-based psycho-educational interventions on the mental health and QoL of cancer patients was synthesized by collating the publication details, study designs, participants, interventions, samples, primary outcomes, measuring instruments, and results, in a narrative manner. Any discrepancy or uncertainties were resolved through regular meetings and discussion among the research team.

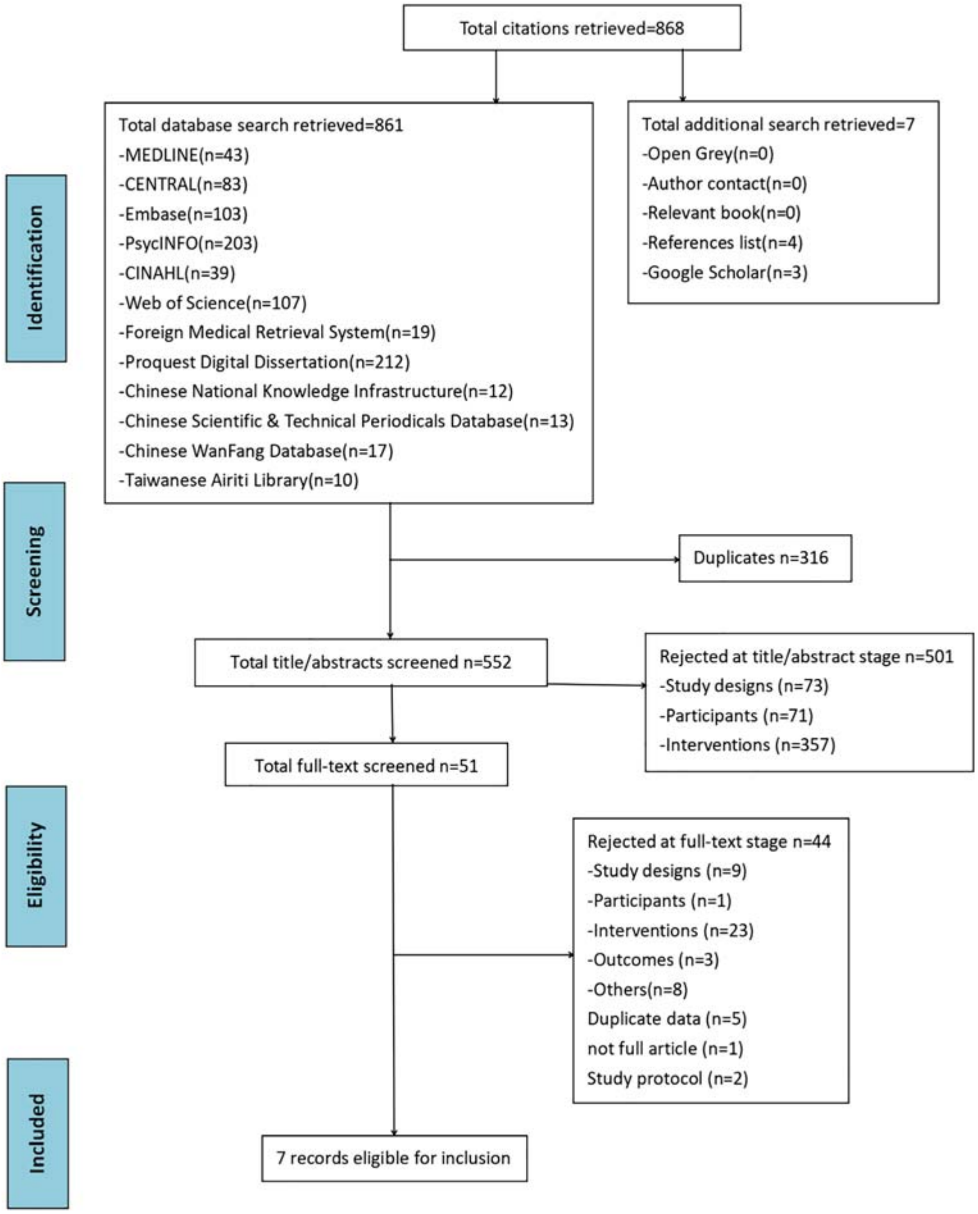
### Data synthesis

Data synthesis was performed using Revman Manager 5.3, and all numeric outcome data were double entered to prevent data entry errors. Heterogeneity was quantified using $I^2$ statistics. When $I^2 < 50\%$, a fixed effects model was used. Where there was evidence of a significant heterogeneity ($I^2 \geq 50\%$), a random effects model was applied. A narrative overview was taken when $I^2 > 75\%$. For continuous data that used the same scale, the mean difference (MD) was chosen as the summary measure. When the same outcome was measured by different scales, the standardized mean difference (SMD) was used. Outcomes were pooled and presented in a narrative form and in tables.

## Results

### Description of the studies

After systematically searching 12 electronic databases, a total of 868 studies were selected. After removal of duplicates, 552 studies remained. Following the screening of titles and abstracts, 51 studies were identified for further assessment. After reading the full articles, 7 studies were finally identified for inclusion in this review. The flow of selection is described in Fig. 1. All seven eligible studies were randomized controlled trials. Four studies were performed in the Netherlands, while the others were conducted in Germany ($n = 1$), Korea ($n = 1$), and Switzerland ($n = 1$). The studies were published from 2011 to 2018 ($n = 7$). Two studies were performed in hospitals, whereas the settings for the remaining five studies were unclear. Although these included studies have reported intervention components (e.g., CBT, PST), only one study mentioned the theoretical intervention [28] (Table 1).



Note: n=number of citations

**Fig. 1** Literature search flowchart. *n*, number of citations

## Participants and professionals

The seven studies included a total of 1220 participants, of which 1034 (84.8%) were female. The range of sample sizes was 36–518 participants, with 6 having > 50 participants. Studies recruited participants with breast cancer ($n$ = 3), with glioma ($n$ = 1), with several types of cancer ($n$ = 2), or who were unclear regarding cancer type ($n$ = 1). Interventions were primarily performed by trained professionals ($n$ = 6) including clinical psychologists, trained and supervised psychology students, and registered nurses. One study [37] did not provide a specific description of the practitioners who conducted the intervention (Table 1).

## Characteristics of interventions

There were no uniform standards or commonalities across all included studies. Interventions were diverse in terms of the instrument, duration, frequency, setting, and facilitator. The tools used for Internet-based psycho-educational interventions included websites ($n$ = 5), tablet personal computers (PCs) ($n$ = 1), and e-mail ($n$ = 1). The range of study duration was 3–16 weeks, including 3 weeks ($n$ = 1), 5 weeks ($n$ = 1), and 8–12 weeks ($n$ = 5). The frequencies of interventions were reported as at least once per week ($n$ = 3) or unclear ($n$ = 4). The facilitators of Internet-based psycho-educational interventions included clinical psychologists or nurses, supervised psychology students ($n$ = 6) who had been well trained in the

**Table 1** Characteristics of included studies

| No. | Author (year) | Country | Design | Patients | Sample size ($n$ per group) | Sex, % | Groups |
|---|---|---|---|---|---|---|---|
| 1 | Niklas et al. (2011) | Germany | RCT | Breast cancer | 133 (C = 64, I = 69) | Female, 100 | 2 |
| 2 | Admiraal et al. (2017) | The Netherlands | RCT | Breast cancer | 139 (C = 69, I = 70) | Female, 100 | 2 |
| 3 | Lee et al. (2014) | Korea | Quasi-RCT | Several types of cancer | 36 (C = 17, I = 19) | Female, 55.6 | 2 |
| 4 | Boele et al. (2018) | The Netherlands | RCT | Glioma | 115 (C = 44, I = 45, non-CNS control group = 26) | Female, 60<br>Male, 40 | 3 |
| 5 | van den Berg et al. (2015) | The Netherlands | RCT | Breast cancer | 150 (C = 80, I = 70) | Female, 100 | 2 |
| 6 | Urech et al. (2018) | Switzerland | RCT | Unclear type of cancer | 129 (C = 64, I = 65) | Female, 84.5<br>Male, 15.5 | 2 |
| 7 | Willems et al. (2017) | The Netherlands | RCT | Several types of cancer | 518 (C = 253, I = 265) | Female, 79.9 | 2 |

| No. | Time and sample size for each group at the end of follow-up (dropout rate) | Interventions | Facilitators | Settings | Outcomes (measuring instrument) | Results |
|---|---|---|---|---|---|---|
| 1 | At registration and at a 2-month follow-up<br>C: 38 (40.6%)<br>I: 32 (53.6%) | **Intervention group**<br>Method: online counseling via e-mail<br>Duration: 2 months<br>Frequency: immediate counseling whenever capacities permitted<br>Components: CBT/PST/rational emotive therapy/solution-focus brief therapy<br>**Control group**<br>Usual care | Clinical psychologist | Unclear | 1. Psychological<br>2. Distress (BSI)<br>3. QOL (EORTC QLQ-C30) | No significant improvements in distress or QOL ($p > 0.05$) |
| 2 | At 6 and 12 weeks<br>C: 63 (8.7%)<br>I: 64 (8.6%) | **Intervention group**<br>Method: web-based automated information; problem-solving strategies; resources and services for reported problems<br>Duration: 12 weeks<br>Frequency: access to the psycho-educational material at any time<br>Components: PST<br>**Control group**<br>Standard care | Psychologist | Hospital | 1. Distress (DT/PL)<br>2. QOL (EORTC QLQ-C30) | No differences between the control and intervention groups for distress or QOL ($p > 0.05$) |
| 3 | At baseline and 3 weeks later<br>C: 16 (5.8%)<br>I: 19 (0.0%) | **Intervention group**<br>Method: a single-session psycho-education intervention on distress management on a tablet PC<br>Duration: 3 weeks<br>Frequency: 20 min per day for psycho-education material<br>Components: (1) distress education; (2) cancer survivor inter- view; (3) coping strategies and stress management; (4) psychosocial services<br>**Control group**<br>A sham-control movie clip | RN | Hospital | 1. Depression (HADS)<br>2. QOL (SF-8) | Significant in depression and QOL ($p < 0.05$) |

**Table 1** (continued)

| | | | | | | |
|---|---|---|---|---|---|---|
| 4 | At baseline, after 6 and 12 weeks, and after 6 and 12 months<br>C1: 18 (59.1%)<br>I: 17 (62.2%)<br>Non-CNS control group: 8 (69.2%) | **Intervention group** Method: online guided self-help course; disease-specific information and examples<br>Duration: 5 weeks<br>Frequency: at least 2 h per week<br>Components: CBT/PST<br>**Control group**<br>Usual care | Psychologist psychology student, RN | Unclear | 1. Depressive (CES-D)<br>2. QOL (SF-36)<br>3. Fatigue (CIS) | No significant improvements in distress or QOL ($p > 0.05$) |
| 5 | At baseline and after 4 (T1), 6 (T2), and 10 months (T3) of follow-up<br>C: 72 (10.0%)<br>I: 63 (10.0%) | **Intervention group**<br>Method: usual care + BREATH<br>BREATH includes information, assignment, assessment, and video<br>Duration: 10 months<br>Frequency: no limit<br>Components: CBT/PST<br>**Control group**: Usual care | Without therapist | Unclear | 1. Distress (SCL-90) | Significant for distress ($p < 0.05$) |
| 6 | At baseline, after the intervention or waiting period (control group), 2-month follow-up<br>C: 51 (20.3%)<br>I: 52 (20.0%) | **Intervention group**<br>Method: web-based intervention STREAM includes audio files with relaxation and guided imagery exercise<br>Duration: 8 weeks<br>Frequency: at least once per week<br>Components: CBT/mindfulness-based stress reduction techniques<br>**Control group**<br>Usual care | Psychologist | Unclear | 1. QOL (FACIT-F)<br>2. Distress (DT)<br>3. Anxiety and depression (HADS) | Significant in distress and QOL ($p < 0.05$) |
| 7 | At baseline and 6 and 12 months later<br>C: 212 (16.2%)<br>I: 169 (36.2%) | **Intervention group**<br>Method: stand-alone web-based intervention includes self-management training modules and general information on common residual symptoms<br>Duration: 12 months<br>Frequency: Unclear<br>Components: CBT/PST<br>**Control group**<br>Usual care | Psychologist | Unclear | 1. Emotion/social function (EORTC QLQ-C30)<br>2. Distress (HADS)<br>3. Fatigue (CIS) | Reducing depression for participants who received chemotherapy ($d = 0.36$) |

*BIS*, The Brief Symptom Inventory; *CAU*, care as usual; *CES-D*, Center for Epidemiological Studies-Depression Scale; *CIS*, the Checklist Individual Strength; *Dutch DT/PL*, Dutch Distress Thermometer/Problem List; *EORTC QLQC30*, European Organization for Research and Treatment of Cancer Quality of Life Questionnaire Version 3.0; *FACIT-F*, Functional Assessment of Chronic Illness Therapy-Fatigue; *HADS*, Hospital Anxiety and Depression Scale; *MRA*, a program called *My Road Ahead*; *QOL*, quality of life; *RCT*, randomized controlled trials; *SCL-90*, Symptom Checklist-90; *SF-8*, Short-form 8 Health Survey; *Short-36*, The Short-Form Health Survey; *CBT*, cognitive behavioral therapy; *PST*, problem solving therapy use of psycho-educational interventions, or the patients themselves ($n = 1$). The psycho-educational interventions could be divided into four types, including counseling, education, behavioral therapy, and social support that can be used individually or in combination. In this review, most studies were conducted using single or mixed modules. The modules for each study differed considerably. For example, the ENCOURAGE [40] program included four modules: (a) distress education, (b) cancer survivor interview, (c) coping strategies and stress management, and (d) psychosocial services. Conversely, the BREATH components were based on cognitive behavioral therapy and included information, assignment, assessment, and videos [37]. The KNW program included eight modules, the majority of which were self-management training modules covering topics such as returning to work, fatigue, anxiety and depression, social relationships and intimacy issues, physical activity, diet, and smoking cessation [46]. Another study was implemented by online consultation [39]. Five studies have published study protocols [37, 39, 41, 42, 46].

## Control interventions

Control groups received usual care ($n = 5$), standard care ($n = 1$), or other control therapy (e.g., a single-session movie clip) ($n = 1$). Usual care included routine nursing and health education. In this review, standard care involved regular visits to a medical specialist (medical, surgical, or radiation oncologist, and/or oncology nurse) every 3 or 4 months during the first year of follow-up.

## Variables, instruments, and results

Ten outcome variables measured using 16 scales were identified. Most studies used validated (self-rating) questionnaires or scales. In the selected studies, QoL was assessed using various scales as follows: EORTC QLQ-C30 [39, 40, 46], Short-form 8 Health Survey [47], The Short-Form Health Survey [48], and Functional Assessment of Chronic Illness Therapy-Fatigue [49]. Mental health (e.g., distress) was assessed using The Brief Symptom Inventory [50], Dutch Distress Thermometer/Problem List [51], the Hospital Anxiety and Depression Scale (HADS) [52], and Symptom Checklist-90 [53].

## Outcomes

### Distress

Five studies [28, 37, 39–41] assessed the effect of Internet-based psycho-educational interventions on distress. However, just four studies [28, 37, 39, 40] including 355 participants were evaluated in the meta-analysis for the reason that one study [41] only reported the interquartile range and median of outcomes (no mean values and standard deviation were reported). The pooled data of the four studies showed no significant difference in improvement between the intervention and control groups (SMD − 1.03, 95% confidence interval (CI) (− 2.63, 0.57), $p = 0.21$) (Fig. 2a).

### Depression

Four studies [28, 41, 42, 46] investigated the effects of Internet-based psycho-educational interventions on depression. Three studies [28, 42, 46] including 462 participants were evaluated in the meta-analysis. The data from one study [41] was not pooled because the mean values and standard deviation of outcomes were not reported. Meta-analysis showed a significant difference in improvement between the intervention and control groups (SMD − 0.58, 95% CI (− 1.12, − 0.03), $p = 0.04$) (Fig. 2b).

### QoL

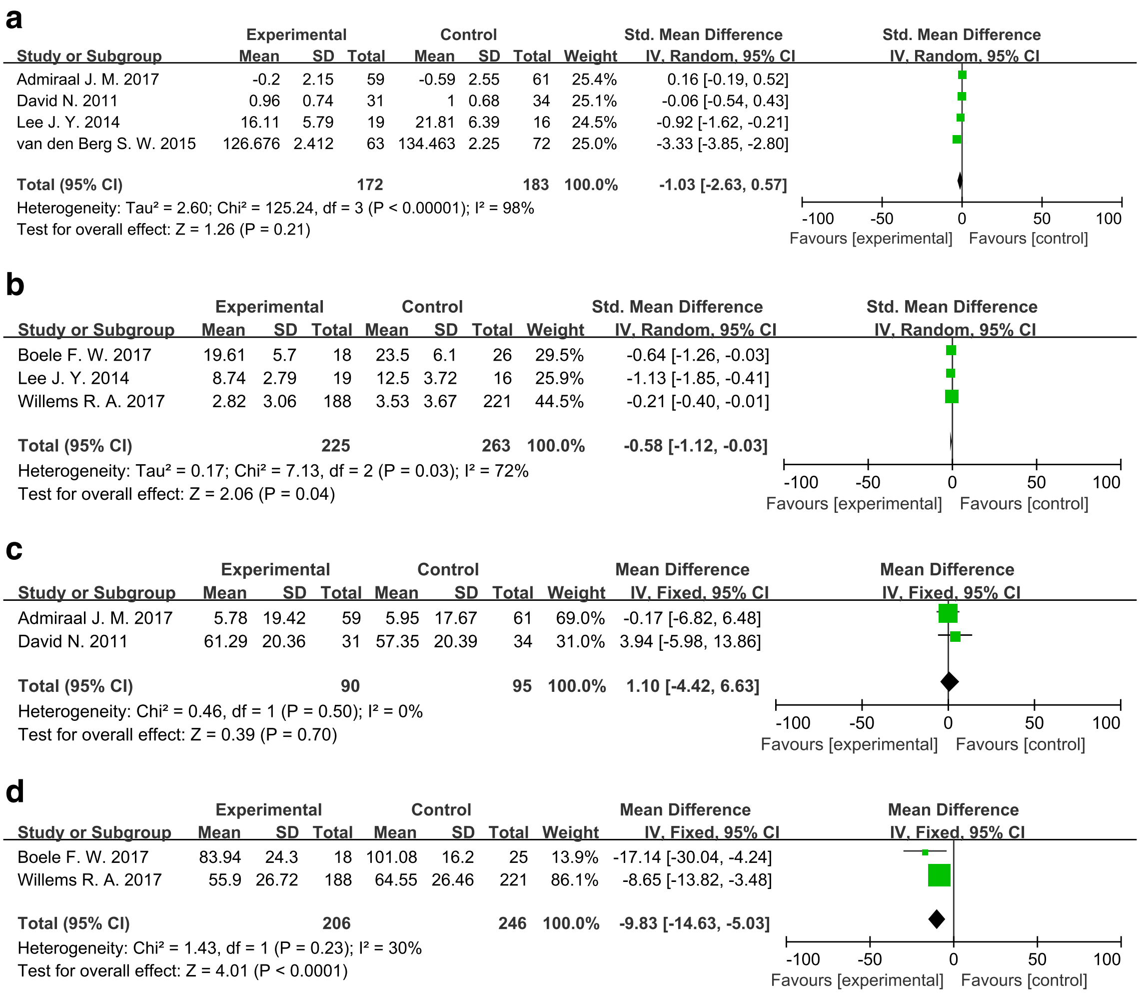
A total of six studies [28, 39–42, 46] reported the effects of Internet-based psycho-educational interventions on QoL among cancer patients. Different scales were used to measure QoL. Two studies including 185 participants that provided sufficient data were combined in the meta-analysis [39, 40]. The result showed no significant difference in improvement between the intervention and control groups (MD 1.10, 95% CI (− 4.42, 6.63), $p = 0.70$) (Fig. 2c).

### Fatigue

Two studies assessed the effect of Internet-based psycho-educational interventions on fatigue [42, 46]. The pooled data included 427 participants and showed a significant difference in improvement between the intervention and control groups (MD − 9.83, 95% CI (− 14.63, − 5.03), $p < 0.01$) (Fig. 2d).

### Additional outcomes

Other outcomes were only described in one study. They reported that for cancer patients, empowerment was not affected by the Internet-based psycho-educational interventions (− 1.71; 95% CI, 5.2 to − 1.79; $p = 0.34$). One study showed a significant effect on anxiety using HADS ($U = 69.0$; $p = 0.006$) [28]. One of these studies reported that for breast cancer patient, online counseling via e-mail for breast cancer patients can increase their satisfaction [39]. One reported that using of the ENCOURAGE program had improvement in optimism and control more than inpatients in the control group (Cohen's $d = 0.65$) [40].



**a**

| Study or Subgroup | Experimental Mean | SD | Total | Control Mean | SD | Total | Weight | Std. Mean Difference IV, Random, 95% CI |
|---|---|---|---|---|---|---|---|---|
| Admiraal J. M. 2017 | -0.2 | 2.15 | 59 | -0.59 | 2.55 | 61 | 25.4% | 0.16 [-0.19, 0.52] |
| David N. 2011 | 0.96 | 0.74 | 31 | 1 | 0.68 | 34 | 25.1% | -0.06 [-0.54, 0.43] |
| Lee J. Y. 2014 | 16.11 | 5.79 | 19 | 21.81 | 6.39 | 16 | 24.5% | -0.92 [-1.62, -0.21] |
| van den Berg S. W. 2015 | 126.676 | 2.412 | 63 | 134.463 | 2.25 | 72 | 25.0% | -3.33 [-3.85, -2.80] |
| **Total (95% CI)** | | | **172** | | | **183** | **100.0%** | **-1.03 [-2.63, 0.57]** |

Heterogeneity: Tau² = 2.60; Chi² = 125.24, df = 3 (P < 0.00001); I² = 98%
Test for overall effect: Z = 1.26 (P = 0.21)

**b**

| Study or Subgroup | Experimental Mean | SD | Total | Control Mean | SD | Total | Weight | Std. Mean Difference IV, Random, 95% CI |
|---|---|---|---|---|---|---|---|---|
| Boele F. W. 2017 | 19.61 | 5.7 | 18 | 23.5 | 6.1 | 26 | 29.5% | -0.64 [-1.26, -0.03] |
| Lee J. Y. 2014 | 8.74 | 2.79 | 19 | 12.5 | 3.72 | 16 | 25.9% | -1.13 [-1.85, -0.41] |
| Willems R. A. 2017 | 2.82 | 3.06 | 188 | 3.53 | 3.67 | 221 | 44.5% | -0.21 [-0.40, -0.01] |
| **Total (95% CI)** | | | **225** | | | **263** | **100.0%** | **-0.58 [-1.12, -0.03]** |

Heterogeneity: Tau² = 0.17; Chi² = 7.13, df = 2 (P = 0.03); I² = 72%
Test for overall effect: Z = 2.06 (P = 0.04)

**c**

| Study or Subgroup | Experimental Mean | SD | Total | Control Mean | SD | Total | Weight | Mean Difference IV, Fixed, 95% CI |
|---|---|---|---|---|---|---|---|---|
| Admiraal J. M. 2017 | 5.78 | 19.42 | 59 | 5.95 | 17.67 | 61 | 69.0% | -0.17 [-6.82, 6.48] |
| David N. 2011 | 61.29 | 20.36 | 31 | 57.35 | 20.39 | 34 | 31.0% | 3.94 [-5.98, 13.86] |
| **Total (95% CI)** | | | **90** | | | **95** | **100.0%** | **1.10 [-4.42, 6.63]** |

Heterogeneity: Chi² = 0.46, df = 1 (P = 0.50); I² = 0%
Test for overall effect: Z = 0.39 (P = 0.70)

**d**

| Study or Subgroup | Experimental Mean | SD | Total | Control Mean | SD | Total | Weight | Mean Difference IV, Fixed, 95% CI |
|---|---|---|---|---|---|---|---|---|
| Boele F. W. 2017 | 83.94 | 24.3 | 18 | 101.08 | 16.2 | 25 | 13.9% | -17.14 [-30.04, -4.24] |
| Willems R. A. 2017 | 55.9 | 26.72 | 188 | 64.55 | 26.46 | 221 | 86.1% | -8.65 [-13.82, -3.48] |
| **Total (95% CI)** | | | **206** | | | **246** | **100.0%** | **-9.83 [-14.63, -5.03]** |

Heterogeneity: Chi² = 1.43, df = 1 (P = 0.23); I² = 30%
Test for overall effect: Z = 4.01 (P < 0.0001)

**Fig. 2** Effect sizes of the Internet-based psycho-educational intervention group versus the control group on (a) distress rating scores, (b) depression rating scores, (c) quality of life rating scores, and (d) fatigue rating scores

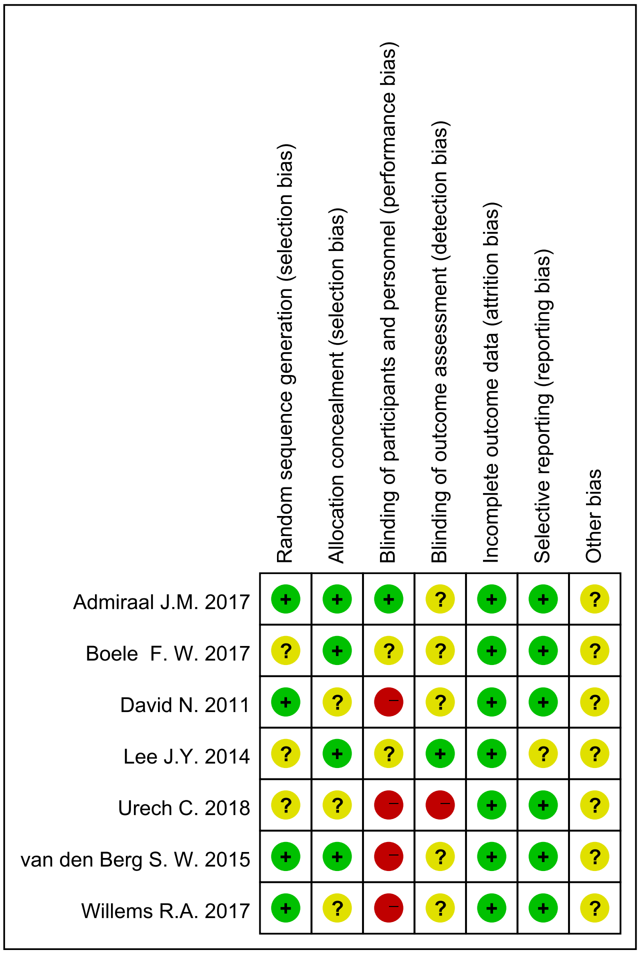
## Quality of evidence

The Cochrane Risk of Bias Tool was used to assess the risk of bias. All studies were rated "B," suggesting a moderate risk of bias. Although all included studies used randomization, only four described the generation of the random sequence. Four studies reported allocation concealment. In most studies, patients or researchers were not blinded because of the nature of Internet-based psycho-educational interventions. Only one study reported that outcome assessors were blinded to the intervention groups. All studies reported discontinuation rates and provided detailed reasons (Figs. 3 and 4).

## Discussion

To the best of our knowledge, this is the first review to explore the effects of Internet-based psycho-educational interventions on mental health and QoL among cancer patients. Seven RCTs, with a total sample of 1220 participants, were identified for inclusion in the review. The meta-analysis showed that Internet-based psycho-educational interventions significantly reduced depression and fatigue, but there was no evidence for effects on distress and QoL among cancer patients.

Previous studies indicate that online interventions have the potential to improve mental health in cancer patients, including the amelioration of depression and fatigue [54, 55]. A systematic review reported that Internet-based interventions conducted by healthcare professionals have elicited positive effects on distress among cancer patients [56]. Although only two of the included studies have reported significant improvements in QoL among cancer patients [28, 41], the results of the present meta-analysis did not indicate significant differences in QoL outcomes between the intervention and comparison groups (or the conditional control groups), which is contrary to the results of a previous study [57]. For some important outcomes (e.g., anxiety, empowerment, and satisfaction) that were only reported in one study, it was not appropriate to draw



| | Random sequence generation (selection bias) | Allocation concealment (selection bias) | Blinding of participants and personnel (performance bias) | Blinding of outcome assessment (detection bias) | Incomplete outcome data (attrition bias) | Selective reporting (reporting bias) | Other bias |
|---|---|---|---|---|---|---|---|
| Admiraal J.M. 2017 | + | + | + | ? | + | + | ? |
| Boele F. W. 2017 | ? | + | ? | ? | + | + | ? |
| David N. 2011 | + | ? | − | ? | + | + | ? |
| Lee J.Y. 2014 | ? | + | ? | + | + | ? | ? |
| Urech C. 2018 | ? | ? | − | − | + | + | ? |
| van den Berg S. W. 2015 | + | + | − | ? | + | + | ? |
| Willems R.A. 2017 | + | ? | − | ? | + | + | ? |

**Fig. 3** Risk of bias summary: a review of authors' judgments regarding each risk of bias item for each included study

a conclusion because the evidence was insufficient. Caution is warranted when interpreting the outcomes, considering the limited number of studies.

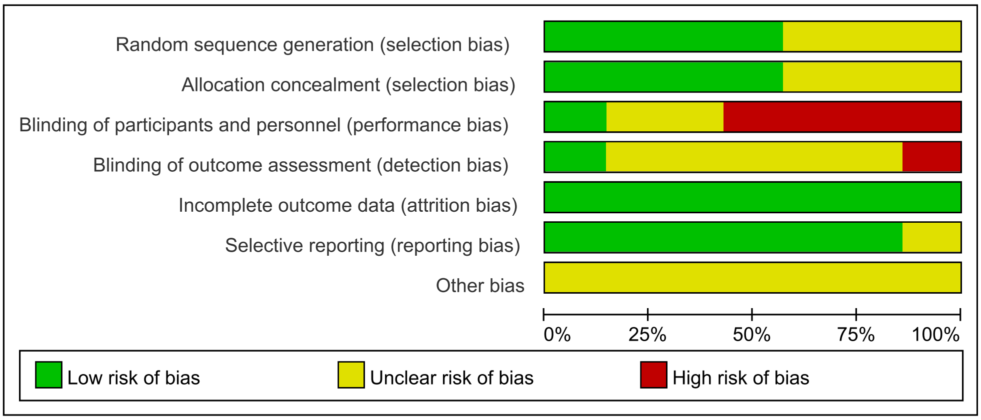
Internet-based interventions incorporate multiple behavior change techniques and are increasingly being used as an efficient method to improve support for cancer patients, overcoming obstacles such as time, mobility, and geography [58, 59]. Our review found that Internet-based psycho-educational interventions usually include various components (e.g., CBT and PST), which might have short-term effects on mental health among cancer patients. The intervention schedules, intensity, and duration were not described in detail. The relative value and importance of intervention elements and frequency for cancer patient outcomes remain unclear. Therefore, the effectiveness of specific components should be further studied.

In our review, evidence for the long-term effects of Internet-based psycho-educational interventions among cancer patients was limited. One study reported that during a 12-month measurement period to assess long-term effects of interventions on QoL among cancer patients, no significant difference was found between the intervention and control groups [46]. In comparison, a review reported that telepsychology interventions ameliorated patient distress and decreased depression symptoms over time [57]. More trials are needed to appropriately explore the long-term effects of Internet-based psycho-educational interventions among cancer patients and survivors.

In the seven studies covered by this review, the Internet-based psycho-educational interventions were conducted by various individuals, including clinical psychologists, nurses, a researcher-psychologist, a trained and supervised psychology student, or the patients themselves. Although the benefits from having psychologists versus RNs remain unclear because of the limited evidence, a previous study has indicated that patients tend to rely on professionals when receiving online support [60]. Healthcare professionals are often involved in conducting Internet-based interventions that would be expected to have a positive impact on patients' health [59]. It is therefore important that these professionals receive appropriate psychological counseling training, so that they can better serve as counselors or therapists on online platforms to resolve psychological issues among cancer patients [59, 60].

In this review, the majority of participants who accessed Internet-based psycho-educational interventions were women. Gender differences may play a role in the effectiveness of Internet-based psycho-educational interventions. Previous

**Fig. 4** Risk of bias graph: a review of authors' judgments regarding each risk of bias item presented as percentages across all included studies



studies have reported that cancer patients who are female have a higher tendency to participate in online interventions [19, 32]. This may be because women have higher levels of interest in Internet-based solutions for coping with health problems and are more likely to complete online programs [61]. This review indicated that women may potentially benefit more from Internet-based psycho-educational interventions compared with men.

Participants who were lost to follow-up or those who discontinued the intervention were considered dropouts. In this review, the main reasons for discontinuation included the individual patient circumstances (e.g., unwillingness, exhaustion, finding the interventions excessively burdensome, or lack of satisfaction with the interventions) and disease progression. Additionally, patient expectations from the intervention, the timing of the intervention node, and the duration of intervention may also affect withdrawal from the interventions or lack of engagement. The rate of discontinuation is an issue worthy of investigation, and a particularly common problem for Internet-based psychological interventions, which are typically associated with low adherence [62, 63]. Previous study indicates that several strategies (e.g., e-mail reminders, individualized feedback) may have a positive influence on adherence for online-based interventions [64]. The present findings should serve as a reminder for healthcare professionals that specific intervention procedures and the individual characteristics of the participants should be fully considered to minimize attrition rates when implementing Internet-based psycho-educational interventions.

## Limitations

This systematic review was characterized by some limitations. Firstly, the review was limited to published studies, which may have introduced publication bias. Secondly, this review included only English or Chinese studies, potentially introducing publication and language biases. Thirdly, the measurement instruments varied in most included studies, resulting in heterogeneity for important outcomes. Therefore, it was difficult to pool all the data and conduct subgroup analyses. Finally, it was necessary to combine and compare results due to the heterogeneity between studies.

## Implications and recommendations

Our findings have implications whereby Internet-based psycho-educational interventions may be effective in improving depression and fatigue and can be used as a part of stepped care in clinical practice. Future studies can be conducted to investigate the effectiveness of different components from Internet-based psycho-educational interventions among cancer patients/survivors. Intervention manuals or protocols guided by related conceptual framework should be provided to monitor the treatment fidelity of these interventions. There is insufficient evidence regarding the efficacy of Internet-based psycho-educational interventions in improving QoL; more rigorously designed studies that generate high-quality data are warranted to investigate the effects of Internet-based psycho-educational interventions on the QoL of patients with cancer in the future.

# Conclusions

This review demonstrated that Internet-based psycho-educational interventions may be effective in improving mental health symptoms such as depression and fatigue among patients with cancer. As such, Internet-based psycho-educational interventions with various components can be used to complement usual care so that cancer patients and survivors can gain psychological support and better manage health-related symptoms.

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## Compliance with ethical standards

**Conflict of interest** The authors declare that they have no conflict of interest.

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