




Social media–based interventions for patients with cancer: a meta-analysis and meta-regression of randomised controlled trials

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Abstract

Purpose This review aimed to (1) evaluate the effectiveness of social media–based interventions for improving the quality of life, anxiety and depressive symptoms of patients with cancer at post-intervention and follow-up; (2) identify the essential features of social media–based interventions and (3) explore the covariates of the treatment effect.

Methods All types of randomised controlled trials (RCTs) were included. Ten electronic databases, clinical trial registries and grey literature sources were searched from inception to 15 December 2021. Stata software was used to perform meta-analysis, subgroup analyses and meta-regression analyses. Individual quality assessment and certainty of evidence were assessed using Cochrane risk of bias tool version 1 and Grading of Recommendations Assessments, Development and Evaluation criteria, respectively.

Results This review included 43 RCTs, which comprised 6239 patients with a total mean age of 49.71 years old from across 11 countries. Social media–based interventions significantly improved the quality of life ($g = 0.25$, 95% CI = 0.05–0.45) and anxiety symptoms ($g = -0.41$, 95% CI = -0.76 – 0.07) but not depressive symptoms. The essential features based on the subgroup analysis concluded that using a mobile device with a flexible frequency had a remarkably greater effect on the quality of life and anxiety symptoms than their counterparts. The meta-regression showed the covariate features, where having more social media features in interventions significantly improved the quality of life ($\beta = 0.21$, $p = 0.01$). The certainty of evidence was very low for all outcomes.

Conclusions Participants who received social media–based interventions may experience an increase in quality of life and reduction in anxiety symptoms.

Implications for cancer survivors Social media–based interventions may complement usual care in improving quality of life and anxiety symptoms.

Registration in PROSPERO

CRD42022297956.

Keywords Social media · Cancer · Randomised controlled trials · Meta-analysis · Meta-regression

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Introduction

Cancer is one of the leading causes of disease burden globally. In 2020, 19.3 million new cases of cancer were recorded worldwide [1]. Patients with cancer face social isolation for several reasons. Firstly, the side effects of most cancer treatments, such as fatigue, weight gain, nausea, vomiting and pain, may cause changes in physical appearance and functional status [2–4]. These changes may produce constraints on physical interaction with others and lead to social isolation [5, 6]. Secondly, patients may experience stigmatisation due to discrimination from friends, family, and society, or self-blame [5, 7]. When faced with stigma, patients may

isolate themselves from social circles. Social restrictions due to the coronavirus disease 2019 (COVID-19) pandemic have further limited patients' social interactions, increasing the likelihood of mental health issues and lowering the quality of life [8–10]. Therefore, exploring how patients can interact using remote methods, such as social media, is needed.

Social media usage has soared with the advancement and increased usage of mobile devices and broadband networks. Today, more than half of the global population uses social media platforms [11]. Its extensive usage globally has made it a key tool for communication, information sharing and social support amidst isolation due to the COVID-19 pandemic [12, 13]. Social media are internet-based, mass or personal communication media that allow users to interact, synchronously or asynchronously [14]. Social media interventions may comprise various features, which are used to support communication and information exchange [15]. Features may include, identity representation, communication, peer grouping, data sharing, competition, activity data viewing and online social networking features [15]. The derived value from social media stems from the content generated by users from interactions.

The potential mechanisms of social media-based intervention on quality of life, anxiety symptoms and depressive symptoms using media system dependency [16] and social identity [17] theories are illustrated in Fig. 1. Socially isolated patients need social support, which can be provided through social media. In accordance with the media system dependency theory, patients will have increased dependency on social media when it is aligned with the needs of socially isolated patients [16, 18]. Increased dependency and the usage of social networking sites enhance patients' exposure to information and other individuals online. Thus, patients are enabled to meet peers with similar attributes and form social categories and groups [19]. According to the theory of social identity, patients seek these social categories to help them make sense of changes in their self-context and social identity [17]. An optimally suitable group becomes psychologically salient to the individual's social context and produces strong social and emotional ties [20, 21]. Constant interaction within the group produces in-group norms, which act as attitude and behavioural regulators [19]. This interaction gives patients stability and predictability, which can help reduce negative feeling during challenging times.

Social groups also provide social support in the form of social companionship, esteem, emotional, instrumental or informational support [22]. Traditional forms of support include family, friends and support groups organised by healthcare facilities. Social media has enhanced social networks with the formation of online support groups and communities. Online support groups can help overcome the logistical issues of face-to-face support groups and give patients more control over the choice of peers and

groups that they engage with [23–25]. Through social media, online support groups provide good social support networks, which improves patients' physical and emotional well-being and provides financial support and resources [26–28]. Overall dependency on social media for social support could potentially resolve ambiguities, change attitudes, relieve fear and anxiety, boost morale, reduce alienation and elicit positive health-related offline behaviour for patients [16, 29, 30]. Given that social media is a useful platform for socially isolated patients with cancer, it can improve quality of life, anxiety symptoms and depressive symptoms.

Patients with cancer suffer from poor quality of life, anxiety symptoms and depressive symptoms due to a myriad of reasons. Prolonged social isolation due to the COVID-19 pandemic has aggravated these issues. During the pandemic, the global prevalence of anxiety and depression amongst patients with cancer rose to 38% and 37%, respectively [31]. This increase is worrisome as anxiety and depressive symptoms, such as sleep disturbances, fatigue, nausea and appetite loss, impair daily functioning and worsen quality of life [32]. Poor quality of life affects patients' stress responses, treatment-seeking behaviour and treatment compliance [33–35]. It impacts health outcomes and increases mortality risk [36]. Therefore, quality of life, anxiety symptoms and depressive symptoms are serious issues amongst patients with cancer and should be addressed as part of their care.

Several measurement tools have been developed to assess quality of life in patients with cancer, including European Organisation for Research and Treatment of Cancer Quality of Life Questionnaire [37], Functional Assessment of Cancer Therapy [38] and Paediatric Quality of Life Inventory [39]. State-Trait Anxiety Inventory [40], Beck Anxiety Inventory [41], Hospital Anxiety and Depression Scale-Anxiety [42], Beck Depression Inventory-II [43] and Centre for Epidemiologic Studies Depression Scale [44] are commonly used to measure anxiety and depressive symptoms.

A growing body of systematic reviews illustrate the usage of online interventions [45–47] and social media-based amongst patients with cancer [48–50]. Two scoping reviews on the usage of social media in adolescent and young adult oncology [51] and patients and caregivers [52] were conducted. However, these reviews have different study designs [48, 49] and interventions [47], used few databases [50], lack the inclusion of unpublished trials and grey literature [47, 49], had no information of the methodological quality of selected studies [49, 50] and only reported narrative synthesis [48, 50]. Previous reviews did not perform a meta-analysis, subgroup analysis or meta-regression analysis, and none of them evaluated the certainty of evidence.

The current review aimed to (1) evaluate the effectiveness of social media-based interventions for improving the quality of life, anxiety symptoms and depressive

symptoms amongst patients with cancer at post-intervention and follow-up; (2) identify the essential features of social media-based interventions and (3) explore the covariates of the treatment effect. The findings from this review can help guide the design and implementation of future social media-based interventions for clinical practice and research.

Methods

This systematic review and meta-analysis adopted the Preferred Reporting Items for Systematic Reviews and Meta-Analyses 2020 statement (Table A1). This systematic review was prospectively registered (CRD42022297956) in the International Prospective Register of Systematic Reviews (PROSPERO) database.

Eligibility criteria

This review included RCTs that evaluated the effects of social media intervention on individuals diagnosed with cancer. Social media-based interventions are any form of online medium that allows participants to interact with one another. The media can be self-developed or commercial, such as Facebook, Instagram, TikTok and Twitter. Self-developed interventions have to contain one or a combination of the following features: identity representation, communication, peer grouping, data sharing, competition, activity data viewing or online social networking [15]. Comparators could be usual care, active comparator, placebo or waitlist control group. The outcomes include quality of life, anxiety symptoms and depressive symptoms at post-intervention and follow-up. Considering that quality of life, anxiety and depressive symptoms are widely reported in the extant literature, the current review is able to compare the effects of social media interventions on these outcomes meaningfully. Trials published in the English language were included. No limits on the publication year and publication status were imposed. The details of the eligibility criteria are listed in Table A2.

Search strategy

A scoping search was conducted in Cochrane Database of Systematic Reviews, PubMed Clinical Queries and PROSPERO databases for existing systematic reviews to prevent duplication. Search terms were developed in consultation with the university librarian. Then, an iterative process was used to test the sensitivity and selectivity of the search terms. The final search terms comprising index terms and keywords related to cancer and social media are included in Table A3. A three-step extensive search was conducted from inception till 15 December 2021. Firstly, a systematic search was conducted in 10 electronic databases: Cumulative Index

to Nursing and Allied Health Literature, Cochrane Library, Excerpta Medica Database, Education Resources Information Centre, Institute of Electrical and Electronics Engineers, Institution of Engineering and Technology Xplore, ProQuest Dissertations and Theses Global, PsycINFO, PubMed, Scopus and Web of Science. Secondly, various clinical trial registries and grey literature sources were searched for unpublished trials and grey literature, respectively (Table A4). Lastly, the reference lists of the included studies and existing systematic reviews were handsearched.

Selection process

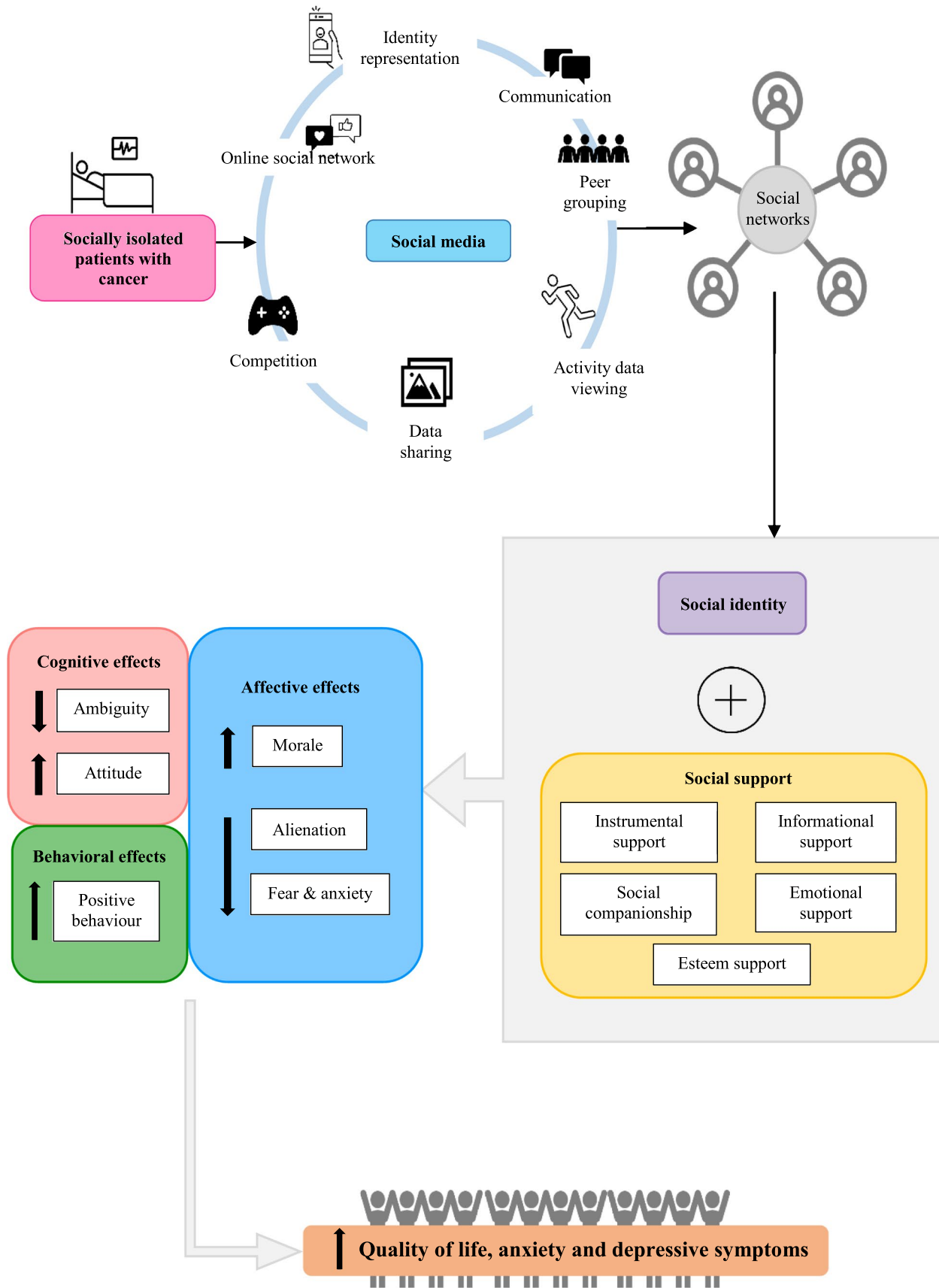
The retrieved articles were exported to EndNote 20 [53]. Articles were organised and duplicates removed using automated and manual functions. Two independent reviewers (DS and RT) screened the articles based on the eligibility criteria. Disagreements were resolved by the third reviewer (LY). The full texts of the included studies were subsequently downloaded. Cohen's Kappa statistic was calculated to ensure inter-rater reliability, and 0.6 was deemed acceptable [54]. This calculation was done for trial selection, data extraction, risk of bias and certainty of evidence.

Data collection process

Data were extracted by two independent researchers (DS and RT) using an adapted version of the Cochrane data extraction form [55]. The form was piloted in six studies to ensure its clarity and comprehensibility. The items extracted included the trial characteristics and intervention description. The trial characteristics included author, year, country, design, mean age, sample size, intervention, control, attrition rate, intention-to-treat analysis, missing data management, publication of protocol, trial registration in various clinical registries and grant support. Intervention description, including the aim of intervention, regime of intervention, components of intervention, interactivity, communication style, device used, features included, presence of co-interventions, theoretical basis and outcome data, were extracted. Authors were contacted up to a maximum of three times for additional information.

Risk of bias

Risk of bias was assessed using the Cochrane Collaboration Risk of Bias Tool version 1 [56]. Risk of bias was assessed by two independent researchers (DS and RT) based on the following domains: random sequence generation, allocation sequence concealment, blinding of participants and personnel, blinding of outcome assessment, incomplete outcome data and selective outcome reporting. Each domain is categorised as 'low', 'high' or 'unclear' risk [55]. Overall risk



◀**Fig. 1** Potential mechanisms of social media-based interventions on quality of life, anxiety and depressive symptoms for patients with cancer using media system dependency (Ball-Rokeach and DeFleur, 1976) and social identity (Tajfel, 1974) theories

was rated using the lowest score of the six domains. Disagreements were resolved by a third reviewer (LY).

Data analysis

Stata version 17 [57] was used to perform the meta-analysis, subgroup analyses and meta-regression analyses. Meta-analysis was performed using inverse-variance method incorporated into random-effects model, which assumes that true intervention effects vary amongst studies [58]. This model measures between- and within-study variances [58]. Z statistics with $p < 0.05$ was used to assess the overall effect. Independent samples were used as the unit of analysis to reduce dependency issues [59]. For studies with multiple treatment groups (e.g. three arm) and compared with the same control group, the number of participants in the control group will be divided by two to ensure independence.

Effect size was measured using the magnitude of difference (e.g. mean and standard deviation) between intervention and comparator groups at the post intervention and follow-up. The effect size of continuous outcomes were expressed using Hedges's g as it provides great precision for studies with small sample sizes [60]. Effect size was interpreted as small (0.2), medium (0.5), large (0.8) and very large (1.2) [61]. A 95% confidence interval (CI) was used to express the precision of the summary estimate and derive a p -value. Z statistic and $p < 0.05$ were used to determine the significance of the intervention effect [55]. Heterogeneity was measured using Cochran's Q with $p < 0.05$ and I^2 . I^2 values were interpreted as low (<40%), moderate (40–60%), substantial (50–90%) and considerable (>75%) [55]. A narrative analysis of the outcomes was conducted if meta-analysis was not possible.

Additional data analysis

Subgroup and meta-regression analyses were performed to address the reasons of heterogeneity. Subgroup analysis was conducted based on the components of the intervention and the characteristics of the studies to examine the essential features of the intervention and population that will most likely benefit from social media-based interventions. The predefined subgroups included country, comparator, frequency, presence of features and usage of mobile devices for the intervention. Chi-square value with $p < 0.1$ was calculated to determine the significance of subgroup differences, whereas I^2 value was used to investigate heterogeneity [62]. Meta-regression with $p < 0.05$ was performed to investigate

whether covariates (year of publication, sample size, attrition rate, mean age, duration of intervention and number of social media features) account for the treatment effect [63]. Regression coefficients (β) were the estimated increase or decrease in the effect size units of the covariates on particular outcomes. $p < 0.05$ was considered significant for random-effects meta-regression analyses [63].

Certainty of evidence

The overall quality of evidence and strength of recommendations were assessed by two independent reviewers (DS and RT) using the Grading of Recommendations Assessments, Development and Evaluation (GRADE) criteria [64]. Risk of bias, imprecision, inconsistency, indirectness and publication bias were rated as high, moderate, low or very low with justifications to support the judgements [64]. Publication bias was measured if 10 or more studies were used in the meta-analysis of each outcome [65]. Its presence was determined by funnel plot symmetry, where inverse standard error was plotted against standardised mean difference [66]. Egger's regression test with $p < 0.05$ was used to evaluate the significance of asymmetry [67, 68].

Results

The initial search yielded a grand total of 13,821 records (Fig. 2). After the duplicates ($n = 6,286$) were removed, two reviewers (DS and RT) independently screened the title and abstract of 7535 articles. A total of 7424 records were excluded on based on the title ($n = 7227$) and abstract ($n = 197$). The full texts of 96 articles were assessed using the eligibility criteria, and 53 articles were excluded. The reasons for exclusion are detailed in Table A5. Only 43 articles were included from this search. In addition, 81 ongoing trials were retrieved from the trial registries, and the details are provided in Table A6. Cohen's kappa was used to measure inter-rater agreement, which indicated strong agreement for study selection ($k = 0.86$) and data extraction ($k = 0.83$), as well as moderate agreement for risk of bias ($k = 0.79$) and certainty of evidence ($k = 0.88$) [54].

Characteristics of randomised controlled trials

The characteristics of the included RCTs are summarised in Table 1. Forty-three RCTs between 2001 [69] and 2021 [70] were included. The included studies across 11 countries had a total of 6239 patients with cancer with a grand mean age of 49.71 years old, ranging from 16.59 years old [71] to 67.20 years old [72]. Five studies are three-arm RCTs [73–77], one study is a four-arm RCT [78], and the rest (86.05%) are two-arm RCTs. The sample sizes ranged from

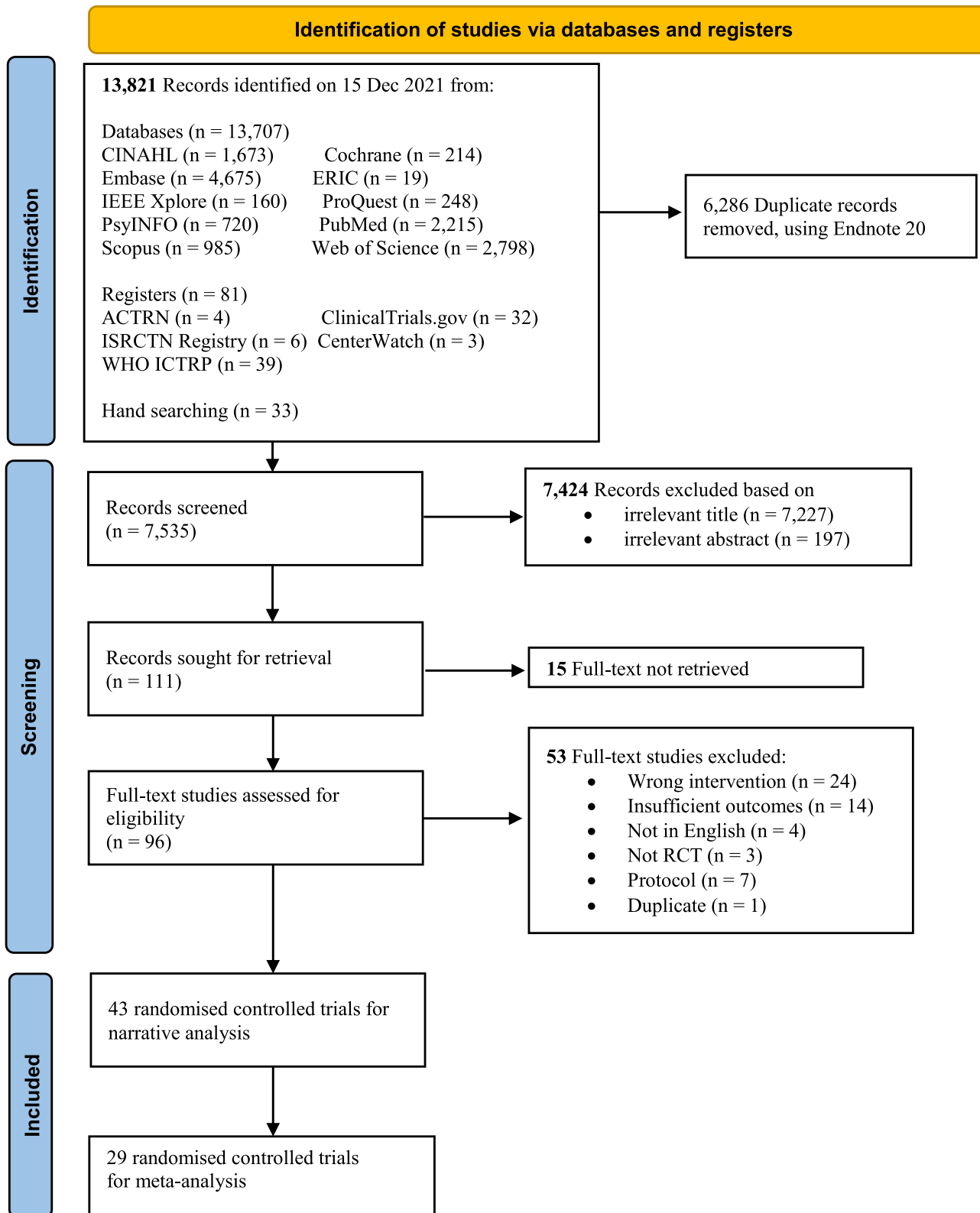


Fig. 2 Flowchart of randomised controlled trials selection

Table 1 Characteristics of 43 selected randomized controlled trials

Author (year)/country	Design	Population	Mean age ± SD	Sample Size	Intervention (name)	Control	Outcomes (Measures)	Attrition Rate	ITT/MDD	Protocol/registration/grant
Baker et al. (2011)/USA	4-arm RCT	Patients with breast cancer	51.52 ± 9.96	T: 450 I ₁ : 118 I ₂ : 109 I ₃ : 111 C: 112	Internet based service (CHESS)	Active	Functional well-being (FACT-B)	5.78%	No/No	No/No/Yes
Børøsund et al. (2014)/Norway	3-arm RCT	Patients with breast cancer	51.43 ± NR, R: 31.00 – 79.00	T: 167 I ₁ : 64 I ₂ : 45 C: 58	Internet-Based communication (WebChoice)	Usual	Anxiety and depressive symptoms (HADS)	14%	No/No	No/Yes/Yes
Changrani et al. (2008)/USA	2-arm RCT	Immigrant women with breast cancer	47.68 ± 12.78	T: 62 I: 42 C: 20	Online support groups (OSG)	Usual	Depressive symptoms (CES-D), quality of life (FACT-B)	12.5%	No/No	No/No/Yes
Chow et al. (2021)/USA	2-arm RCT	Patients with hematologic malignancies	37.0 ± NR, R: 12.0 – 48.8	T: 41 I: 24 C: 17	Social media support group (Facebook)	Active	Health-related quality of life (PROMIS Global 10)	9.8%	No/No	No/Yes/Yes
Classen et al. (2013)/Canada	2-arm RCT	Patients with gynaecological cancer	42.30 ± NR, R: 28.00 – 59.00	T: 27 I: 13 C: 14	Web-based support group (GyneGals)	Wait-list	Anxiety and depressive symptoms (HADS)	14.8%	Yes/No	No/No/Yes
Devine et al. (2020)/USA	2-arm RCT	Patients diagnosed with cancer before 21 years old	18.51 ± 3.73	T: 49 I: 25 C: 24	Group-based program mobile app (FitSurvivor)	Wait-list	Quality of life (PedsQL)	34.7%	No/No	No/Yes/Yes
Dong et al. (2019)/China	2-arm RCT	Patients with breast cancer	49.74 ± 6.73	T: 50 I: 26 C: 24	Exercise and Social media (CEI-BISMS)	Usual	Quality of life (SF-36)	16.7%	Yes/No	Yes/Yes/Yes
Duffeey et al. (2012)/USA	2-arm RCT	Patients with cancer	50.00 ± NR, R: 27.00 – 68.00	T: 31 I: 16 C: 15	Internet Support Groups (Onward)	Active	Depressive symptoms (HADS),	22.6%	Yes/No	No/Yes/Yes
Farnham et al. (2002)/USA	2-arm RCT	Patients who underwent bone marrow transplant	49.00 ± NR	T: 46 I: 21 C: 25	HutchWorld	Active	Quality of life	30%	No/No	No/No/No
Ghanbari et al. (2021)/Iran	2-arm RCT	Patients with breast cancer	46.45 ± 9.28	T: 82 I: 41 C: 41	mHealth phone app (BCSzone)	Usual	Anxiety symptoms (STAI)	6.1%	No/No	No/Yes/Yes
Gnagnarella et al. (2016)/Italy	2-arm RCT	Patients with cancer	49.87 ± 10.34	T: 74 I: 35 C: 39	Website forum	Usual	Anxiety and depression symptoms (PDI), quality of life (EORTC-QLQ C30)	40.8%	No/No	Yes/No/No

Table 1 (continued)

Author (year)/country	Design	Population	Mean age ± SD	Sample Size	Intervention (name)	Control	Outcomes (Measures)	Attrition Rate	ITT/MDD	Protocol/registration/grant
Gustafson et al. (2001)/USA	2-arm RCT	Patients with breast cancer	44.35 ± 6.84	T: 246 I: 121 C: 125	Internet based service (CHESS)	Usual	Quality of life (FACT-B)	16.6%	Yes/No	No/No/Yes
Gustafson et al. (2008)/USA	3-arm RCT	Patients with breast cancer	52.00 ± NR	T: 257 I: 91 C ₁ : 83 C ₂ : 83	Internet based service (CHESS)	Active	Quality of life (FACT-B)	7%	Yes/No	No/No/Yes
Hauflman et al. (2020)/Sweden	2-arm RCT	Patients with cancer	57.15 ± 10.63	T: 245 I: 124 C: 121	Internet-based stepped care (iCAN-DO)	Usual	Anxiety symptoms (HADS, STAI-S), depressive symptoms (EROS, HADS, MADRS-S), quality of life (EORTC QLQ-C30)	42.2%	Yes/Yes	Yes/Yes/Yes
Hou et al. (2020)/Taiwan	2-arm RCT	Patients with stage 0 to III breast cancer	NR	T: 112 I: 53 C: 59	mHealth mobile application (BCMS)	Usual	Quality of life (EORTC-QLQ Core 30 & Breast Cancer-specific)	10.7%	Yes/Yes	No/Yes/Yes
Høybye et al. (2010)/Denmark	2-arm RCT	Cancer survivors	NR	T: 794 I: 361 C: 433	Internet-based peer support	Usual	Anxious and depressive moods (POMS-SF)	18.2%	Yes/No	No/No/Yes
Johnson et al. (2021)/USA	2-arm RCT	Young adult cancer survivors	33.60 ± 4.90	T: 49 I: 26 C: 23	Fitbit Flex and Facebook group	Active	Quality of life (PROMIS, FSI, PSSQI)	2%	Yes/No	No/Yes/Yes
Kim et al. (2018)/Korea	2-arm RCT	Patients with breast cancer	50.90 ± 7.00	T: 72 I: 34 C: 38	Mobile game (ILOVE-BREAST)	Usual	Anxiety symptoms (STAD), depressive symptoms (BDI), quality of life (WHOQL)	5.3%	No/No	No/Yes/Yes
Klemm (2012)/USA	2-arm RCT	Patients with breast cancer	52.20 ± NR, R: 28.00 – 77.00	T: 50 I: 24 C: 26	Moderated online support	Active	Depressive symptoms (CES-D)	18%	No/No	No/No/Yes
Lepore et al. (2014)/USA	2-arm RCT	Patients with breast cancer	52.26 ± 7.70	T: 183 I: 88 C: 95	Online support group (P-ISG)	Active	Anxiety and Depressive symptoms (HADS)	13%	Yes/Yes	No/Yes

Table 1 (continued)

Author (year)/country	Design	Population	Mean age ± SD	Sample Size	Intervention (name)	Control	Outcomes (Measures)	Attrition Rate	ITT/MDD	Protocol/registration/grant
Li et al. (2021)/China	3-arm RCT	Cancer survivors	29.62 ± 6.46	T: 143 I ₁ : 47 I ₂ : 48 C: 48	WeChat group	Usual	Quality of life (FACT-G)	26.8%	Yes/No	No/No/Yes
Mackowski (2018)/USA	2-arm RCT	AYA childhood cancer survivors	18.89 ± 4.18	T: 19 I: 9 C: 10	Multicomponent Intervention (Fit Survivor)	Wait-list	Quality of life (PedsQL)	34.5%	No/No	No/No/No
Mendoza et al. (2017)/USA	2-arm RCT	Childhood cancer survivors	16.59 ± 1.52	T: 59 I: 29 C: 30	Social media support group (Facebook)	Usual	Health-related quality of life (PedsQL)	1.7%	Yes/No	No/No/Yes
Nam (2014)/USA	2-arm RCT	Patients with cancer	38.9 ± 14.6	T: 206 I: 107 C: 99	Twitter support group	Usual	Cancer-related coping skills and quality of life (CACSQL)	38.9%	No/Yes	No/No/Yes
O'Carroll Bantum et al. (2014)/USA	2-arm RCT	Cancer survivors	50.90 ± 11.09	T: 303 I: 156 C: 147	Web-based workshop (STC)	Wait-list	Depressive symptoms (PHQ-8)	13.9%	No/Yes	Yes/Yes/Yes
Omid et al. (2020)/Iran	3-arm RCT	Patients with breast cancer and lymphedema	51.04 ± 9.43	T: 97 I ₁ : 34 I ₂ : 32 C: 31	Social network-based education (SNE)	Usual	Quality of life (LLIS)	7.6%	No/No	No/Yes/Yes
Osei et al. (2013)/USA	2-arm RCT	Patients with prostate cancer	67.20 ± 7.60	T: 40 I: 20 C: 20	Online support group (Us TOO International)	Active	Quality of life (EPIC-26, RSQ, SLS, SF-12)	0%	No/No	No/No/No
Owen et al. (2005)/USA	2-arm-RCT	Patients with stage 0-III breast cancer	51.89 ± 9.54	T: 53 I: 26 C: 27	Online coping group	Wait-list	Health-related quality of life (EuroQL-5D, FACT-B)	14.5%	No/No	No/No/No
Owen et al. (2017)/USA	2-arm RCT	Patients with cancer	53.10 ± 10.90	T: 347 I: 176 C: 171	Distress management (Healthspace)	Wait-list	Depressive symptoms (CED-D), trauma-related anxiety symptoms (IES-revised)	32.3%	Yes/Yes	No/Yes/Yes
Pope et al. (2018)/USA	2-arm RCT	Breast cancer survivors	52.32 ± 9.00	T: 20 I: 12 C: 8	Smartwatch and social media	Active	Quality of life (PROMIS)	33.4%	No/No	No/No/Yes
Ruland et al. (2013)/Norway	2-arm RCT	Patients with breast or prostate cancer	56.65 ± 11.09	T: 325 I: 162 C: 163	Website with forum (WebChoice)	Usual	Depressive symptoms (CES-D), health-related quality of life (15-D HRQL)	24.6%	Yes/No	No/Yes/Yes

Table 1 (continued)

Author (year)/country	Design	Population	Mean age ± SD	Sample Size	Intervention (name)	Control	Outcomes (Measures)	Attrition Rate	ITT/MDD	Protocol/registration/grant
Stanton et al. (2013)/USA	2-arm RCT	Patients with breast cancer	55.47 ± 11.04	T: 88 I: 46 C: 42	Website development (Word-Press)	Wait-list	Depressive symptoms (CES-D)	13.6%	Yes/No	No/No/Yes
Sui et al. (2020)/China	2-arm RCT	Patients with lung cancer	61.86 ± 10.60	T: 200 I: 100 C: 100	WeChat education and rehabilitation program (WERP)	Usual	Anxiety and depressive symptoms (HADS), quality of life (EORTC QLQ-C30)	15%	Yes/No	No/No/Yes
Syrjala et al. (2018)/USA	3-arm RCT	Patients who underwent HCT	51.00 ± 12.00	T: 337 I ₁ : 108 I ₂ : 114 C: 115	Internet-based program (INSPIRE)	Wait-list	Depressive symptoms (SCL-90-R), quality of life (SF-36)	17%	No/No	No/Yes/Yes
Valle et al. (2013)/USA	2-arm RCT	Young adult cancer survivors	31.71 ± 5.10	T: 86 I: 45 C: 41	FITNET (Face-book)	Active	Quality of life (FACT-G)	23.3%	Yes/No	No/Yes/Yes
Wang et al. (2021)/China	2-arm RCT	Patients, above 18 years old, with acute leukaemia	NR	T: 72 I: 36 C: 36	WeChat-based psychoeducational intervention (ICARE)	Usual	Anxiety and depression levels (HADS), quality of life (FACT-Leu)	26.4%	No/No	No/Yes/Yes
Webb et al. (2019)/UK	2-arm RCT	Cancer survivors above 18 years old	56.35 ± 10.76	T: 207 I: 104 C: 103	Health promotion pack (Move More Pack)	Wait-list	Health-related quality of life (FACT-G7)	12.6%	Yes/No	Yes/Yes/Yes
Winzelberg et al. (2002)/USA	2-arm RCT	Patients with breast cancer	49.50 ± 6.20	T: 72 I: 36 C: 36	Web-based support group (Bosom Buddies)	Wait-list	Anxiety symptoms (STAD), depressive symptoms (CES-D)	19.4%	Yes/No	No/No/Yes
Wise et al. (2018)/USA	2-arm RCT	Patients with cancer	57.00 ± 8.71	T: 86 I: 49 C: 37	Website (miLiving-Story)	Active	Angry, anxious and depressed mood (POMS-SF)	22%	No/No	No/Yes/Yes
Wright et al. (2021)/UK	2-arm RCT	Patients with cancer above 18 years old	54.30 ± 11.00	T: 41 I: 21 C: 20	Digital self-management program (HOPE)	Wait-list	Depressive symptoms (PHQ-9), generalized anxiety disorder symptoms (GAD-7)	19.5%	Yes/Yes	Yes/Yes/Yes

Table 1 (continued)

Author (year)/ country	Design	Population	Mean age±SD	Sample Size	Intervention (name)	Control	Outcomes (Meas- ures)	Attrition Rate	ITT/MDD	Protocol/ registration/ grant
Yan et al. (2021)/ China	2-arm RCT	Patients with breast cancer	47.13 ± 7.58	T: 126 I: 63 C: 63	Extended nurs- ing care using WeChat	Usual	Anxiety and depressive symp- toms (HADS), quality of life (GQOLI-74)	0%	No/No	No/No/No
Zhou et al. (2020)/ China	2-arm RCT	Patients with newly diagnosed breast cancer	49.91 ± 9.31	T: 111 I: 56 C: 55	WeChat-based nursing program	Usual	Health-related quality of life (FACT-B)	7.2%	Yes/No	No/Yes/Yes
Zhu et al. (2018)/ China	2-arm RCT	Patients with breast cancer	47.20 ± 8.30	T: 114 I: 57 C: 57	Breast cancer e-support (BCS)	Usual	Anxiety and depressive symp- toms (HADS), quality of life (FACT-B)	8.8%	Yes/No	Yes/Yes/Yes

15-D HRQL, 15-dimensional health-related quality of life; AYA, adolescent and young adult; BDI, Beck Depression Inventory; CACSQL, cancer-related coping skills and quality of life; CES-D, Center for Epidemiological Studies—Depression Scale; EORTC-QLQ, European Organization for Research and Treatment of Cancer – Quality-of-Life Questionnaire; EPIC-26, Extended Prostate Cancer Index Composite; EROS, Environmental Reward Observation Scale; FACT-B, Functional Assessment of Cancer Therapy-Breast; FACT-G, Functional Assessment of Cancer Therapy-General; FACT-Leu, Functional Assessment of Cancer Therapy-leukaemia; FSI, Fatigue Symptom Inventory; GAD-7, Generalized anxiety disorder-7; HADS, Hospital Anxiety and Depression Scale; HCT, haematopoietic cell transplant; IES, Impact of Events scale; LLLS, Lymphedema Life Impact Scale; MADRS-S, Montgomery-Asberg Depression Rating Scale; NR, not reported; PDI, Psychological Distress Inventory; PedsQL, Pediatric Quality of Life Inventory; PHQ, Patient health questionnaire; POMS-SF, short version of the Profile of Mood States; PROMIS, Patient-Reported Outcomes Measurement Information System; PSSQI, Pittsburgh Insomnia Symptom Questionnaire; R, range; RSQ, Relationship satisfaction questionnaire; SCL-90-R, Symptom Checklist-90-R depression scale; SF-36, 36-item Short Form Health Survey; SLS, Satisfaction with Life Scale; STAI, State-trait anxiety inventory; WHOQL, World Health Organization Quality of Life-BREF Scale

19 [79] to 794 [80]. There were different types of comparators used, usual, active or waitlist groups. The attrition rate of the trials was between 0 [81] and 42.2% [82].

Description of social media–based interventions

Table A7 shows the description of the interventions, such as essential component, medium, device, regime, goal setting, communication, interactivity, theoretical basis, reminder and follow-up assessment. The media used to deliver the interventions included websites (39.53%), social media (25.58%), mobile phone applications (20.93%) and other internet-based media (11.63%). Furthermore, most interventions were used on computers and/or mobile or smartphones. Fifteen interventions used unspecified devices with internet access. Intervention regime varied from flexible frequency (62.79%) to fixed frequency, such as weekly (27.91%), twice a week [83], at least thrice a week [72], every day [84] and twice a day [81]. Duration of interventions ranged from 3 h [85] to 24 months [82]. All study interventions contained two-way interactivity with asynchronous and/or synchronous communication. Nineteen studies had theoretical basis for their interventions. The social media features of the included interventions are summarised in Table A8 and Fig. A1. All of them comprised online social network, peer grouping and communication. More than half (53.49%) constitute data sharing, and few of them contain identity representation (39.53%) and activity data viewing (16.28%).

Risk of bias

The summary of the risk of bias assessment is shown in Fig. A2. More than half (52.71%) had low risks across six domains. All the studies used random sequence generation. However, allocation concealment was unclear in 26 studies, which were unable to overcome selection bias. The majority of the studies (81.40%) had high or unclear risk of performance bias. Detection bias was rated high in 34 studies. Most of the studies managed to overcome attrition bias (83.72%) and reporting bias (51.16%). The overall risk of bias was high for most (93.02%) of the studies.

Quality of life

Quality of life was evaluated in 30 RCTs. Seventeen studies were pooled for post-intervention meta-analysis as illustrated in Fig. 3. Statistically significant improvements in quality of life ($Z=2.48$, $p=0.01$) were observed after patients with cancer received social media–based interventions. At 3 months follow-up, meta-analysis also revealed statistically significant improvements in quality of life ($Z=2.07$, $p=0.04$). Considering the moderate to substantial heterogeneity ($I^2=58.28$ – 79.36%), a series of subgroup

and meta-regression analyses were conducted to examine the sources of heterogeneity.

Subgroup analyses for quality of life

A series of subgroup analyses of social media–based interventions on quality of life outcome was conducted to identify the sources for heterogeneity and essential features for social media interventions. Subgroups based on country, frequency, identity representation feature, device and comparator were conducted (Fig. A3). Significant subgroup differences were found amongst different countries ($Q=9.11$, $p<0.01$), types of device ($Q=6.61$, $p=0.01$) and comparator groups ($Q=8.20$, $p=0.02$). Studies conducted in Asia had a larger effect on quality of life ($g=0.70$, 95% CI=0.33–1.08) compared with studies in other regions ($g=0.07$, 95% CI=−0.10–0.23). With regard to devices, interventions delivered in mobile phones had a greater effect ($g=0.50$, 95% CI=0.23–0.78) than other types of devices ($g=0.05$, 95% CI=−0.16–0.26). The type of comparators also affected the quality of life scores with a larger effect size for usual care groups ($g=0.37$, 95% CI=0.11–0.62) than those with active comparators ($g=0.12$, 95% CI=−0.24–0.78) or waitlist control groups ($g=−0.07$, 95% CI=−0.24–0.09). On the basis of effect sizes, a larger effect was observed for trials that comprised an identity representation feature ($g=0.36$, 95% CI=0.02–0.69) than those without ($g=0.15$, 95% CI=−0.07–0.37). The subgroup analyses proposed that the essential features for future interventions include the use of mobile phones and compared with usual care control group.

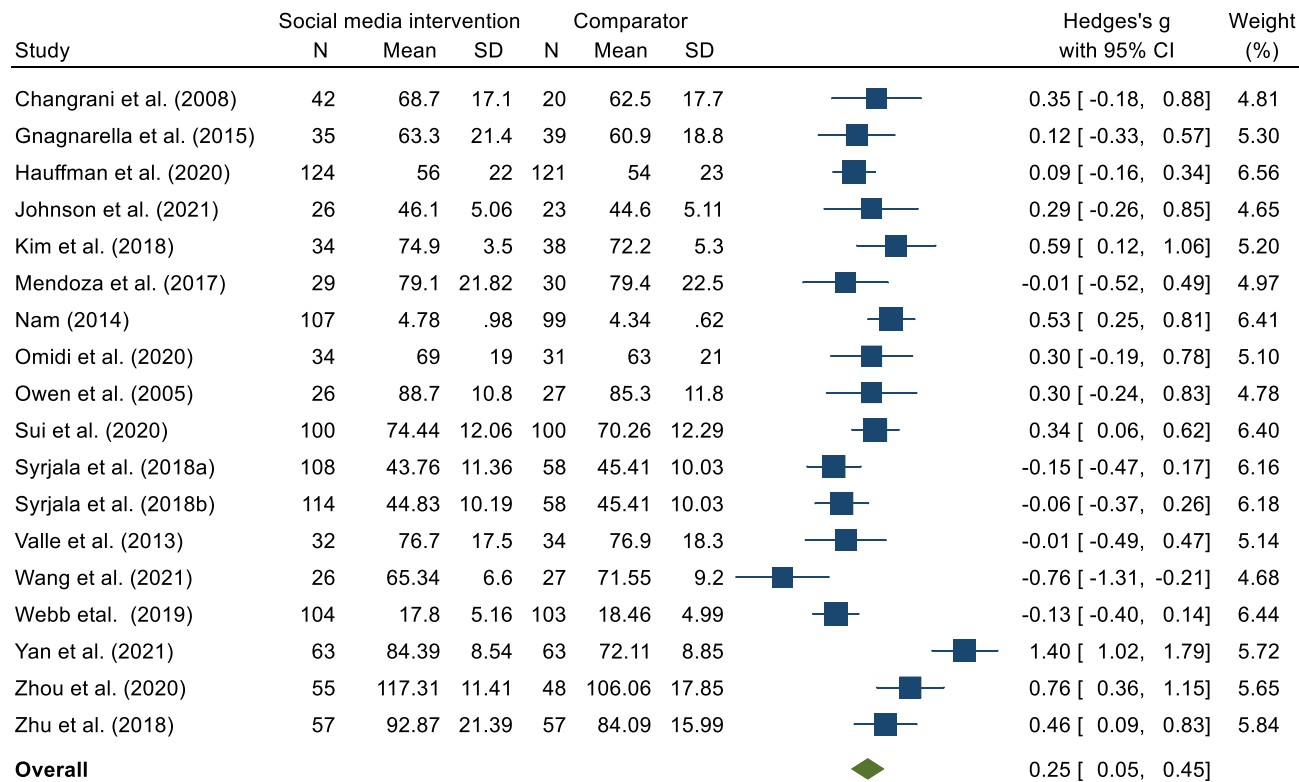
Meta-regression analyses for quality of life

Univariate meta-regression analysis was conducted to examine the effect of the covariates on effect size (Table 2). The number of features ($\beta=0.21$, $p=0.01$) in a social media intervention significantly affected the effect size for quality of life outcome. The bubble plot is provided in Fig. A4. This result indicates that the presence of more social media features results in a better quality of life outcome. The remaining covariates, namely, year of publication ($\beta<0.001$, $p=0.94$), sample size ($\beta<−0.001$, $p=0.87$), attrition rate ($\beta=−1.21$, $p=0.12$), mean age ($\beta<−0.001$, $p=0.95$) and duration of intervention based on weeks ($\beta<−0.001$, $p=0.95$) did not have any effect on the quality of life outcome.

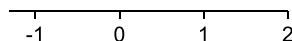
Anxiety symptoms

The effects of social media–based interventions on anxiety symptoms were investigated in 11 studies, amongst which 10 studies were pooled for post-intervention meta-analysis (Fig. 4).

A. Post-intervention

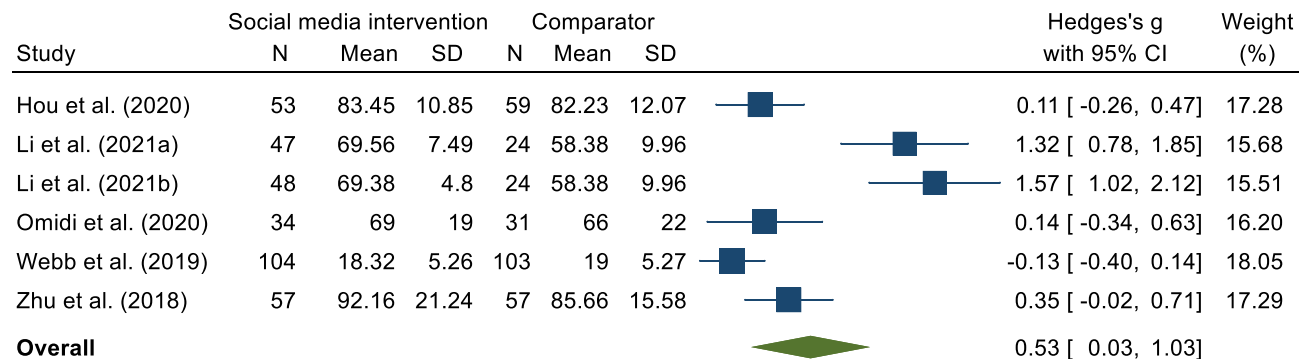


Heterogeneity: $\tau^2 = 0.14$, $I^2 = 79.36\%$, $H^2 = 4.84$
 Test of $\theta_i = \theta_j$: $Q(17) = 82.36$, $p = 0.00$
 Test of $\theta = 0$: $z = 2.48$, $p = 0.01$

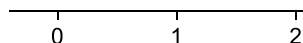


Random-effects DerSimonian–Laird model

B. Follow-up



Heterogeneity: $\tau^2 = 0.34$, $I^2 = 89.06\%$, $H^2 = 9.14$
 Test of $\theta_i = \theta_j$: $Q(5) = 45.70$, $p = 0.00$
 Test of $\theta = 0$: $z = 2.07$, $p = 0.04$



Random-effects DerSimonian–Laird model

Fig. 3 Forest plot of effect size (Hedges's *g*) on quality of life at post-intervention and follow-up for social media-based interventions and comparator group

Table 2 Random-effect univariate meta-regression analyses of covariates on quality of life, anxiety, and depressive symptoms

Outcomes	Covariate	Coefficient	95% CI lower	95% CI higher	<i>p</i>
Quality of life	Year of publication	<0.001	-0.05	0.05	0.94
	Sample size	< -0.001	-0.00	<0.001	0.87
	Attrition rate	-1.21	-2.72	0.32	0.12
	Mean age	<0.001	-0.02	0.02	0.95
	Duration of intervention (weeks)	< -0.001	-0.01	0.01	0.95
	Number of features	0.21	0.05	0.38	0.01*
Anxiety symptoms	Year of publication	-0.04	-0.11	0.02	0.17
	Sample size	<0.001	< -0.001	<0.001	0.50
	Attrition rate	0.87	-2.14	3.89	0.57
	Mean age	< -0.001	-0.09	0.08	0.92
	Duration of intervention (weeks)	<0.001	-0.01	0.01	0.90
	Number of features	0.40	-0.06	0.86	0.09
Depressive symptoms	Year of publication	<0.001	-0.03	0.04	0.78
	Sample size	<0.001	< -0.001	<0.001	0.76
	Attrition rate	-0.09	-1.96	1.76	0.92
	Mean age	-0.03	-0.07	0.02	0.24
	Duration of intervention (weeks)	< -0.001	-0.01	<0.001	0.40
	Number of features	0.24	-0.04	0.51	0.09

CI confidence interval, * $p < 0.05$

The random effects model revealed the statistically significant effects of social media-based interventions in improving anxiety symptom scores ($Z = -2.34$, $p = 0.02$). However, no significant differences were found between the intervention and control groups ($Z = 0.56$, $p = 0.58$) in two trials at 1-month follow-up. A series of subgroup and meta-regression analyses were attempted because of the presence of moderate to substantial heterogeneity ($I^2 = 58.24\text{--}87.58\%$).

Subgroup analyses for anxiety symptoms

The findings of the subgroup analyses to identify the essential features are presented in Fig. A5. Significant subgroup differences in the frequency of intervention ($Q = 7.23$, $p = 0.01$) and the types of comparators ($Q = 12.44$, $p < 0.01$) were found. The social media-based interventions that adopted a flexible frequency had a greater effect ($g = -0.62$, 95% CI = $-1.07\text{--}0.16$) than those with a fixed schedule ($g = 0.06$, 95% CI = $-0.13\text{--}0.24$). In addition, the trials that compared the intervention with usual care had a greater effect ($g = -0.76$, 95% CI = $-1.23\text{--}0.29$) than those with an active control ($g = 0.63$, 95% CI = $-0.25\text{--}1.51$) or waitlist control group ($g = 0.06$, 95% CI = $-0.13\text{--}0.24$). Based on the effect sizes, countries conducted in Asia had a larger effect ($g = -0.84$, 95% CI = $-1.58\text{--}0.10$) than non-Asian countries ($g = -0.17$, 95% CI = $-0.53\text{--}0.19$). Based on the subgroup analyses for anxiety symptoms, flexible schedule should be considered in future trials.

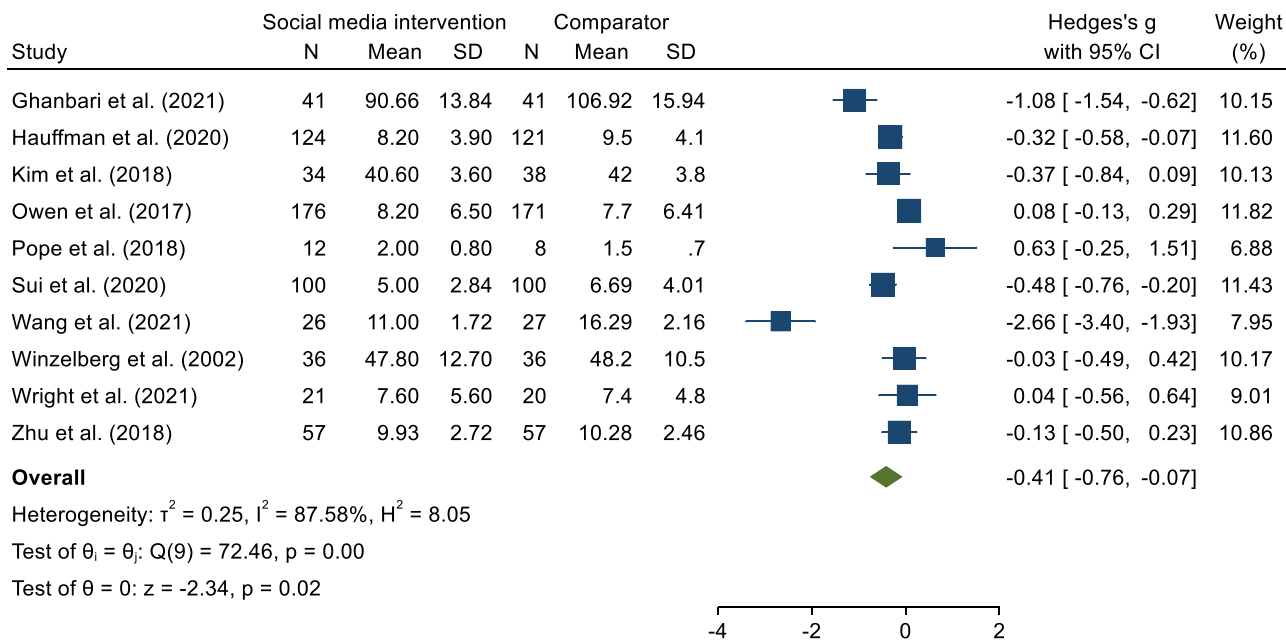
Meta-regression analysis for anxiety symptoms

Univariate meta-regression analysis was conducted to examine the effect of the covariates on effect size (Table 2). The covariates, namely, year of publication ($\beta = -0.04$, $p = 0.17$), sample size ($\beta < 0.001$, $p = 0.50$), attrition rate ($\beta = 0.87$, $p = 0.57$), mean age ($\beta < -0.001$, $p = 0.92$), duration of intervention based on weeks ($\beta < 0.001$, $p = 0.90$) and number of features ($\beta = 0.40$, $p = 0.09$), did not have any effect on anxiety symptoms. Considering that there are only 10 studies included into the meta-regression model, there could be insufficient statistical power to detect any significant differences.

Depressive symptoms

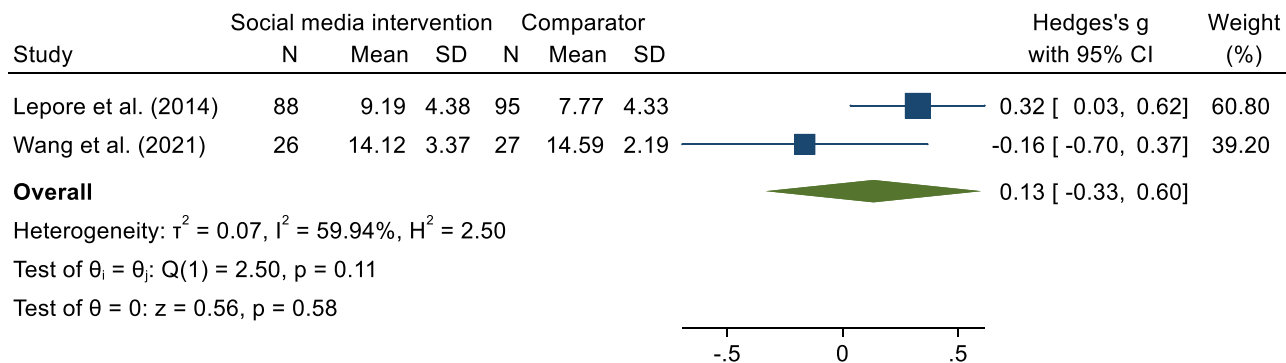
Seventeen RCTs evaluated the effects of social media-based interventions at post-intervention on depressive symptoms as shown in Fig. A6. The meta-analysis revealed no significant differences between the intervention and control groups in improving depressive symptom scores ($Z = -1.28$, $p = 0.20$). Similarly, no significant differences were found at 6-month follow-up ($Z = -1.32$, $p = 0.19$). Moderate to substantial heterogeneity were found ($I^2 = 58.28\text{--}64.17\%$); hence, subgroup and meta-regression analyses were carried out to identify the sources of heterogeneity.

A. Post-intervention



Random-effects DerSimonian–Laird model

B. Follow-up



Random-effects DerSimonian–Laird model

Fig. 4 Forest plot of effect size (Hedges's *g*) on anxiety symptoms at post-intervention and follow-up for social media-based interventions and comparator group

Subgroup analyses for depressive symptoms

The subgroup analysis for depressive symptoms is detailed in Fig. A7. Based on the effect sizes, the studies conducted in Asia had a larger effect ($g = 0.33$, 95% CI = $-0.85-0.19$) compared with other regions ($g = -0.04$, 95% CI = $-0.18-0.10$). In addition, a greater effect was found for interventions that did not comprise an identity representation feature ($g = -0.17$, 95% CI = $-0.39-0.04$) than those that did ($g = 0.05$, 95% CI = $-0.34-0.44$). However, no subgroup differences were found. Hence, there

were no significant recommendations for the features of social media interventions based on depressive symptoms.

Meta-regression analyses for depressive symptoms

The univariate meta-regression analysis (Table 2) concluded that the following covariates, the year of publication ($\beta < 0.001$, $p = 0.78$), sample size ($\beta < 0.001$, $p = 0.76$), attrition rate ($\beta = -0.09$, $p = 0.92$), mean age ($\beta = -0.03$, $p = 0.24$), duration of intervention based on weeks

($\beta < -0.001$, $p = 0.40$) and number of features ($\beta = 0.24$, $p = 0.09$) did not have any effect on depressive symptoms.

Narrative analyses

Fourteen studies were excluded from the meta-analysis as they had insufficient information. Several emails were sent to request additional data from the authors of the trials, but they did not reply; therefore, narrative analyses were performed for these studies. The detail is presented in Table A9. Ten studies reported quality of life outcomes, but only one study found a remarkable improvement ($p = 0.02$) in quality of life at post intervention [74]. In comparison with the meta-analysis findings, nine RCTs found no remarkable differences between the intervention and control groups [69, 70, 72, 78, 79, 84, 86–88]. Out of the four studies that reported anxiety symptoms, one study found that social media–based interventions are substantially effective ($p = 0.03$), similar to the meta-analysis results of [73]. However, three studies found that such interventions have no considerable effect, contradicting the meta-analysis results [80, 89, 90]. Depressive symptoms were reported in five studies, where two studies found that the social media–based interventions have remarkable effects ($p < 0.05$) [73, 80]. In line with the findings of the meta-analysis, no substantial improvement in depressive symptoms was reported in the remaining studies [88–90].

Certainty of evidence

Forty-three studies were evaluated using the GRADE criteria for all outcomes. All domains had very serious concerns due to the high risk of bias, substantial heterogeneity, variations in population and intervention and small sample size with wide confidence interval. Overall, the level of certainty of evidence was downgraded to very low for all outcomes (Table A10). Publication bias was assessed for outcomes if more than 10 trials were included. No visible asymmetry was found in the funnel plots for quality of life, anxiety and depressive symptoms (Fig. A8). Egger's regression tests also revealed no significant asymmetry for quality of life ($p = 0.77$), anxiety symptoms ($p = 0.58$) and depressive symptoms ($p = 0.85$).

Discussion

Summary of findings

This review aimed to analyse the effectiveness of social media–based interventions on quality of life, anxiety symptoms and depressive symptoms amongst patients with cancer. Forty-three RCTs with a total population of 6239

patients with a total mean age of 49.71 years old across 11 countries were included in this review. The meta-analyses demonstrated that social media–based interventions were significantly effective with a small effect size in improving quality of life ($g = 0.25$, 95% CI = 0.05–0.45) and anxiety symptoms ($g = -0.41$, 95% CI = -0.76–0.07). Subgroup analysis showed a greater effect on quality of life than their counterparts when the interventions used mobile devices in Asia compared with usual comparator. A greater effectiveness in improving anxiety symptoms was also found when the interventions used a flexible frequency compared with fixed frequency. The meta-regression results showed that using more social media features for the intervention ($\beta = 0.21$, $p = 0.01$) led to a better quality of life. The certainty of evidence for all outcomes was very low.

Enhancing short- and long-term quality of life

Consistent with a previous systematic review [45], social media–based interventions can remarkably improve short- and long-term quality of life. The incorporation of social media features, namely, peer grouping, group communication and online social network, in all studies enabled the formation of support networks (Fig. 1). Interaction with a community of individuals who are in similar situations gives patients validation to their feelings, opportunities to exchange information and experiences specific to each patients' needs [15]. Companionship and support help decrease the loneliness of socially isolated patients [22]. Given that loneliness can significantly reduce patient's quality of life [91], the findings from this review further highlight the importance of social media. In particular, elements of social media, such as peer support, could be considered in all forms of psychosocial oncology care plans. This phenomenon could be explained by media system dependency theory [16], where satisfying the needs of patients leads to the formation of dependency on social media for social support. This satisfaction elicits positive behaviour, attitude and emotions and thus improves patients' quality of life [16, 18].

Reducing anxiety symptoms at post-intervention

Social media–based interventions also have a remarkable effect on anxiety symptom scores, which is in line with a previous systematic review [51]. Social media provides a platform for patients to discuss their feelings with peers who are more inclined to understand them. The listening ear provides emotional support to patients. Peers could also provide personalised encouragement and thus provide esteem support to each other [92]. As an individual's experience of anxiety could be reactive to the situation or stimulus, the role of peer support could have a more immediate effect and therefore, reduce patient's anxiety symptoms.

Additionally, reading the advices and experiences of peers on the impact of cancer on their everyday lives and mental health could be more personal and less intimidating than information from healthcare professionals. Such informational support could relieve an anticipated worry of the future and help patients navigate through their day-to-day lives. The combination of emotional, esteem and informational support that social media provides can improve the overall social support of patients with cancer [22]. Good social support elicits positive social relationships, which acts as a buffer to the emotional impact of change and stressful events [22]. Therefore, based on the findings that the social support that social media provides can help relieve the anxiety symptoms of patients with cancer, future interventions should include chat room or discussion functions, to promote opportunities for interactions among its users.

Non-significant effect on depressive symptoms

Similar to a previous systematic review [45], the meta-analysis results showed that social media-based interventions have no remarkable effect on depressive symptoms. There are several potential reasons. First, living with cancer can lead to existential crisis among most individuals [93, 94]. Furthermore, cancer is a chronic and life-limiting disease; the experience of depressive symptoms is multifaceted and is prolonged throughout the cancer trajectory [95, 96]. Hence, there are expected difficulties in relieving depressive symptoms [93, 94]. Second, less than half of the included studies consist of psychotherapeutic elements in their intervention, leading to a reduced ability in relieving depressive symptoms. This suggests that future interventions could consider the inclusion of psychotherapeutic elements such as cognitive restructuring and behavioral modification techniques to complement the social media intervention.

Third, this result could be attributed to the lack of between-group significance amongst five studies [97–101]. Two studies [97, 102] also found no remarkable in changes in the baseline scores between the intervention and control groups. Additionally, two studies [83, 103] did not use a power analysis to report their findings. This factor may have led to the lack of statistical power to detect statistical differences between the two groups [104]. Finally, Duffecy et al. (2013) also found a ceiling effect, where participants who had higher depressive symptom scores at baseline demonstrated a greater decrease in scores compared with those with lower scores at baseline [83]. Therefore, the lack of statistical significance in results could have been due to the absence of participant screening.

Use of mobile devices with flexible frequency for social media-based intervention

Using social media on mobile devices increases the accessibility and convenience of social networks for social support [105]. The usage of social media exponentially increases with the high smartphone ownership and internet penetration rates [11]. In the same light, allowing patients the flexibility to access social media gives them the freedom to communicate and seek help from others at any time, especially when they are feeling lonely or worried [106]. This factor could potentially increase their usage of social media; thus, social media-based intervention that are delivered through mobile devices could have a larger effect on quality of life and anxiety symptoms.

More social media features of intervention

Meta-regression analysis showed that having more social media features in interventions improved quality of life scores. Patients have different needs and usage preferences. Some people may prefer sharing data within larger groups, whereas others may prefer to chat in smaller groups or one-to-one with peers [15]. Having a variety of features caters to different preferences and allows social media-based interventions to be more inclusive, which increases the usage of such interventions [107]. Therefore, more patients will benefit from these interventions and have a better quality of life.

Subgroup analysis also showed that interventions with identity representation features have a greater effect on quality of life. Identity representation features involve creating an avatar or the personalisation of online profiles that represents the individual in the community [15]. Being able to identify themselves as patients or survivors of cancer helps patients in accepting and coping with their diagnosis [108]. Furthermore, being able to view the profiles of others gives individuals the control to connect with more like-minded friends, join communities that are more representative of themselves or better able to suit their needs [109]. This factor enables them to form stronger associations and emotional connections within the community and thus have a better quality of life.

Asian countries

Our subgroup analyses showed greater effect sizes on quality of life, anxiety symptoms and depressive symptoms in Asian countries than non-Asian countries. Asian countries are believed to have a collective culture, whereas non-Asian countries lean towards individualistic culture. Cultural differences lead to variations in the usage and preferences of social media platforms [110, 111]. Collective culture leads individuals to prefer using social media to form and deepen

relationships, thus providing social support and sharing data with others [112, 113]. On the flip side, individualistic cultures influence individuals to focus more on self-fulfillment and use social media to seek information and entertainment value [112, 113]. Therefore, Asians may tend to participate more actively and form strong bonds with peers in social media-based interventions. This could possibly be attributed to the greater effect of social media-based intervention on quality of life and anxiety symptoms in studies conducted in Asian countries compared with non-Asian countries as seen in the subgroup analysis.

Use of comparator

Subgroup analysis also showed that the usage of usual care comparator had a larger effect on quality of life and anxiety symptoms scores compared with wait-list or active comparators. Compared with usual care, having an intervention could result in greater between-group effects [114]. Furthermore, although the use of active comparator may be more ethical and helps to overcome performance bias, it could dilute the evidence of the effectiveness of the intervention [115]. Wait-list comparator could also perform as well as or even better than the intervention group and thus lead to the unremarkable between-group effects [116]. However, these findings need to be interpreted with caution due to the uneven number of studies in each comparator conditions. Further investigation is needed to ascertain how each condition (e.g. active, usual or waitlist comparators) could affect the effect size.

Implications for practice and policy

Patients diagnosed with cancer face social isolation at different periods of their treatment journey [6], potentially causing elevated psychological symptoms and lower quality of life. Amidst the isolation due to the social restrictions imposed during the COVID-19 pandemic, having a close group of virtual friends to journey alongside and share experiences can help avert feelings of loneliness [9, 10]. This review supports the implementation of social media-based interventions to improve quality of life and anxiety symptoms. Healthcare institutions can consider integrating such interventions into the care plan of patients with cancer in inpatient and outpatient settings. Based on the findings, mobile devices with flexible frequency and having more social media features are the components of social media-based interventions that showed greater improvement in quality of life and anxiety symptoms. Incorporating multiple features, such as blog posting, messaging and photo sharing features on smartphones, can provide diversified social support and drive positive attitude and behavioural change [51]. Therefore, these components can be considered when designing

and implementing such interventions for clinical practice and research.

Strengths and limitations

To our knowledge, this systematic review is the first to evaluate the effectiveness of social media-based interventions on the quality of life and psychological outcomes of patients with cancer using meta-analytic methods. An extensive search strategy was used across a large number of databases to ensure a comprehensive search outcome. The risks of bias of the studies were assessed to appraise their quality. This review included a sizeable total number of RCTs across 11 countries. GRADE assessment was undertaken to provide holistic recommendations to other healthcare professionals and researchers. Using subgroup analysis and meta-regression analyses provided information on essential elements that could be used in the future development and research of social media-based interventions.

However, this review has several limitations. Firstly, all outcomes are subjective and were measured using self-reported surveys, which may have led to the social desirability bias of respondents and affected the reliability of the results [117]. Secondly, restricting the language of included studies to English may have limited the generalisation of findings. Thirdly, the population had a wide age group and varied in cancer type, stage and treatment. Furthermore, the design of interventions varied between studies. Substantial heterogeneity and high risk of bias were also found in the majority of the studies. Fourthly, the long-term effect of intervention is based on limited trials that restrict the generalisation of the findings. Next, this review largely focused on social media interventions, and it will be challenging to compare them with traditional psychosocial interventions that are not based on social media. In addition, due to the uneven number of studies in each type of comparators (Figures S3, S5, S7), it will be difficult to conclude which control or comparison conditions can be recommended. Nevertheless, it is recommended that future trials adopt a rigorous approach in the development of their interventions such as the medical research council framework for development of complex interventions [118]. This will ensure that the interventions are suitable to the context, easily implementable and effective for its target audience. Finally, the very low grade of evidence may also reduce the internal validity of the findings.

Conclusion

We conclude that social media-based interventions are effective for improving the quality of life and anxiety symptoms of patients with cancer. Social media-based

interventions should contain a mixture of features and be delivered through mobile devices with a flexible frequency to maximise effects. Social media-based interventions enhance the interaction of patients to form social support groups and communities. The results need to be interpreted with caution because of the substantial heterogeneity, high overall risk of bias and low certainty of evidence. As such, future trials should use comprehensive research techniques to enhance the quality of trials. The use of masking, allocation concealment and protocols are recommended. Further investigations into the use of specific social media features for particular cancer types and stages are needed.

Directors for future research

The findings from this review provided some considerations for future research. Firstly, future trials should include elements of a well-designed RCT. This encompasses the use of allocation concealment methods, active control group, blinded researchers, intention-to-treat analysis, missing data management strategies, protocols or trial registries. Most importantly, trials need to be explicit when reporting methods to reduce risks of bias. Trials should also be conducted in accordance with recommendations from the consolidated standards of reporting trials statement [119]. Secondly, future trials can screen participants based on their quality of life, anxiety symptom score or depressive symptom score at baseline, allowing those with poorer outcomes to benefit from the intervention. This is due to the ceiling effect [83]. Thirdly, future trials can consider examining the effectiveness of individual social media feature for improving the quality of life and psychological outcomes of patients with a particular cancer type and stage from different cultures. Lastly, investigation into the inconsistency between meta-analysis and narrative analysis findings with a larger sample of studies can be considered in future research.

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Declarations

Ethical approval Not required.

Conflict of interest The authors declare no competing interests.

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