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Research Paper

A comparison of electronically-delivered and face to face cognitive behavioural therapies in depressive disorders: A systematic review and meta-analysis

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ABSTRACT

Background: Cognitive behavioural therapy (CBT) is a widely used treatment for depression. However, limited resource availability poses several barriers to patients seeking access to care, including lengthy wait times and geographical limitations. This has prompted health care services to introduce electronically delivered CBT (eCBT) to facilitate access. Although previous reviews have compared the effects of eCBT to face-to-face CBT, there is an overall lack of adequately powered and up-to-date evidence in the literature to provide a reliable comparison between the two modes of administration. The purpose of this study is to evaluate the effects of eCBT compared to face-to-face CBT through a systematic review of the literature.

Methods: To be eligible for this review, studies needed to be randomized controlled trials evaluating the clinical effectiveness of any form of eCBT compared to face-to-face CBT. These encompassed studies evaluating a wide range of outcomes including severity of symptoms, adverse outcomes, clinically relevant outcomes, global functionality, participant satisfaction, quality of life, and affordability. There were no restrictions on participant age or sex.
We searched MEDLINE, EMBASE, Psych Info, Cochrane CENTRAL and CINAHL databases from inception to February 20th, 2020 using a comprehensive search strategy. All stages of literature screening and data extraction were completed independently in duplicate. Data extraction and risk of bias analyses, including GRADE ratings, were conducted on studies meeting inclusion criteria. Qualitative measures are reported in a narrative summary. We pooled quantitative data in meta-analyses to provide an estimated summary effect. This review adheres to PRISMA reporting guidelines.

Findings: In total, we included 17 studies in our analyses. Our results demonstrated that eCBT was more effective than face-to-face CBT at reducing depression symptom severity (Standardized mean difference [SMD]: −1.73; 95% confidence interval [CI]: −2.72, −0.74; GRADE: moderate quality of evidence). There were no significant differences between the two interventions on participant satisfaction (SMD 0.13 95%; CI −0.32, 0.59; GRADE: low quality of evidence). One RCT reported eCBT to be less costly than face-to-face CBT (GRADE: low quality of evidence). Results did not differ when stratified by subgroups such as participant age and study location.

Interpretation: Although we found eCBT to have moderate evidence of effectiveness in reducing symptoms of depression, high heterogeneity among studies precludes definitive conclusions for all outcomes. With the current

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reliance and accessibility of technology to increasing number of people worldwide, serious consideration in utilizing technology should be given to maximize accessibility for depression treatments. Our results found eCBT is at least as effective as face to face CBT, thus eCBT should be offered if preferred by patients and therapists.
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Research in context

Evidence before this study

Previous studies have shown positive results of eCBT in treating depression when compared to no treatment or face-to-face CBT. Although, this body of literature was based on modestly sized studies with methodological challenges making the comparison inconclusive. We believe that updating the literature on the effectiveness of eCBT would be beneficial for policy-makers involved in designing service delivery models as well as clinicians seeking to maximize their treatment capacity.

Added value of this study

This study is the latest systematic review that culminates recent research to examine the effectiveness of eCBT for depression treatment. Our results found eCBT to be as effective as face-to-face CBT for depression, and its' utility as a valid option for treating depression that is more accessible, flexible and potentially cost-saving.

Implications of all the available evidence

eCBT could increase access to more patients to life-saving therapies. By providing access to remote areas and areas with less service, it will save the system exponentially more by reducing missed productivity, travel time, child care, and more.

1. Introduction

With rise in mental health awareness and advocacy, mental health services are being increasingly sought after. To meet high demands, health-care systems must adapt and innovate. With increasingly long waits for mental health services, this prevents individuals from being productive in society thus increasing system costs. eCBT was in it's infancy near 20 years ago, and as technology progresses, it is developing into a promising new method of mental health care provision. However, there existed a lack of new and up-to-date evidence on the usefulness of eCBT compared to traditional CBT. Therefore, we searched MEDLINE, EMBASE, Cumulative Index to Nursing and Allied Health Literature (CINAHL), PsychINFO and Cochrane CENTRAL from inception to September 28th, 2018 using a comprehensive search strategy for English-language publications using key words such as "depression", "eCBT", "randomized controlled trials", and "treatment". We identified 17 studies meeting the study inclusion criteria.

With increasing prevalence of technology use (15% of all households in 1989 to 78.9% in 2012), technology is an ever more apparent resource in health-care provision, particularly for mood disorders [1].

Major depressive disorder (MDD), as defined by Diagnostic and Statistical Manual of Mental Disorders (DSM-5), is characterized by a depressed mood or loss of interest or pleasure in everyday activities for at least two weeks associated with other features including changes in appetite, energy and cognitive function [2]. According to the World Health Organization, 300 million people worldwide are affected by depression with substantive economic impacts [3]. In Canada, for example, the estimated total cost of depression is $32.3 billion annually [4]. Taking into consideration the negative consequences of depression on individuals' wellbeing and broader societal economic interests, all individuals with depression should have access to effective treatment.

Typically, first-line treatment for moderate to severe depression are antidepressant medications [5]. However, previous studies found medications to only be effective in approximately one third of patients, and half experience substantial decreases in their depressive symptoms [6]. New research demonstrates that comprehensive treatments include psychotherapy in addition to pharmacotherapy [7,8]. Specifically, studies have demonstrated that CBT is as effective as antidepressants for the treatment of acute phase MDD [9]. As a result of emerging evidence, the American College of Physicians view CBT to be an equivalent first-line treatment for MDD [9].

CBT helps individuals identify maladaptive or inaccurate cognitions [10,11]. Patients learn new skills to counter their inaccurate thoughts and beliefs, inducing modified thinking and behavior [11]. Typically, CBT is delivered weekly with a qualified therapist [11]. Several studies have found face-to-face CBT as an effective depression treatment [12–15]. However, face-to-face therapy can be costly and inaccessible—particularly in resource-limited settings [16].

Electronically delivered CBT (eCBT) uses platforms such as cellphone apps and the internet to deliver CBT, presenting a viable option to increase access [17–24]. Accessing CBT may include numerous barriers such as travel time and costs that prevent patients from accessing treatment sessions. Therefore, reducing barriers is imperative to improving entrance and adherence to treatment.

The primary objective of this review is to compare the effectiveness of eCBT to face-to-face CBT in individuals with depression by assessing symptom severity changes and adverse outcomes. Secondary objectives are to assess differences in global functionality, participant satisfaction, quality of life, affordability, and participant study dropout between eCBT and face-to-face CBT.

2. Methods

2.1. Protocol

There is an unpublished protocol available upon request from the authors.

2.2. Eligibility criteria

2.2.1. Types of studies

Only randomized controlled trials that compared face-to-face CBT to *therapist supported* eCBT for treating depression were included in this review. We included English-language human studies with no age, sex, or ethnicity restrictions.

2.2.2. Information sources and search

Full search strategies can be found in Tables 1 to 5 in Appendix II with a sample search strategy shown in Table 1. We searched Medline, EMBASE, CINAHL, PsychINFO and Cochrane CENTRAL from inception until February 20th, 2020. Keywords and phrases used included "cognitive behavioural therapy", "clinical trial", "randomised controlled trial",

Table 1
Search strategy for CENTRAL cochrane database.

ID	Search	Hits
#1	MeSH descriptor: [Behavior Therapy] explode all trees	10,972
#2	"Cognit* Behavio* Therap*" or "Cognit* Therap*" or "Behavio* Therap*" or CBT or "Dialect* Behavio* Therap*" or "Metacogniti* Therap*" or "Mind Training" or "Behavio* Activation" or "Cognitive Restructur*" or "Mindfulness" or Cognit* Training* or "Behavi* Training"	19,665
#3	{or #1-#2}	21,533
#4	MeSH descriptor: [Computers] explode all trees	1059
#5	MeSH descriptor: [Software] explode all trees	2028
#6	MeSH descriptor: [Telecommunications] explode all trees	3724
#7	MeSH descriptor: [Computer Communication Networks] explode all trees	2041
#8	MeSH descriptor: [Therapy, Computer-Assisted] this term only	781
#9	MeSH descriptor: [Audiovisual Aids] explode all trees	2578
#10	MeSH descriptor: [Telemedicine] explode all trees	1365
#11	MeSH descriptor: [Computer Simulation] explode all trees	1527
#12	"Internet*" or "web*" or "World Wide Web" or WWW or "CD-ROM*" or "DVD*" or "iphone*" or "i-phone*" or "ipad*" or "i-pad*" or "ipod*" or "i-pod*" or "Tablet*" or "Phone*" or "Telephone*" or "Smartphone*" or "Video*" or "Audio*" or "Chatroom*" or "Chat Room*" or "Text Messag*" or "Texting" or "Blog*" or "Forum*" or "Electronic-mail" or "Email*" or "E-mail*" or "Virtual" or "Webinar*" or "Web-Conferenc*" or "Skype" or "Podcast*" or "Social* Media*" or "Facebook" or "Snapchat" or "Twitter" or "Tumblr" or "Instagram" or "Interapy*" or "e-health" or "Ehealth" or "Electronic Health" or "emed*" or "e-Med" or "Electronic Medicine" or "telepsych*" or "Technolog*" or "Tech" or "telemedicine" or "teletherap*" or "Computer*" or "Software*" or "Application*" or "Apps" or "Online"	219,779
#13	{or #4-#12}	220,584
#14	"iCBT" or "I-CBT" or "eCBT" or "e-CBT" or "cCBT" or "c-CBT"	214
#15	#13 and #3	7694
#16	#14 or #15	7753
#17	MeSH descriptor: [Depression] explode all trees	5651
#22	#16 and #17	1062

"major depressive disorder", "internet-based", and "computer". We did not search gray literature nor ClinicalTrials.gov for unpublished trials.

We conducted a calibration exercise where all team members screened an identical 50 studies, allowing for pilot testing and amending of the extraction form before finalizing inclusion criteria.

2.2.3. Study selection

Eight reviewer pairs independently screened titles and abstracts for inclusion of relevant studies from the search and coded them as 'retrieve' (eligible, potentially relevant, or unclear) or 'do not retrieve'. The eight pairs were JS:JL, HS: NB, IS:PH, NS:MP, NS:PL, SS: KN, and SS:SK. We retrieved full-text studies, and review authors independently screened them to identify for inclusion and to record reasons for exclusion for ineligible studies. Data extraction pairs were CL:SH, HS:PH, JL:JS, NS:MP, NS:PL, SK:SS, and SS:KN. We resolved disagreements through discussion—if required, a third author was consulted. Inclusion and exclusion criteria were determined *a priori*. The kappa agreement score is the percent agreement between two raters that screened, rated, or extracted the same studies for inclusion, quality, or data extraction respectively. Kappa statistics were utilized to determine inter-rater variability in the screening process. We identified and excluded duplicated reports, and collated multiple reports of the same study. Risk of bias was assessed by CL, NS, KP, and NS.

2.2.4. Study design considerations

In parallel-group randomized controlled trials, only data from participants before crossing from control to intervention group were analyzed. If several independent comparisons existed within a study, only groups with interventions and comparisons relevant to this review were included. Therefore, if a study included multiple correlated comparisons and the intervention of interest was in the first trial, it was included in the meta-analysis.

2.2.5. Data collection process

Two reviewers independently extracted data from selected studies using a digital full-text extraction form before the review. The data extraction form and data items were created by the authors and is available in Appendix III. The reviewers attempted to resolve disagreements through discussion, and a third reviewer was consulted if necessary. Results from the selection and data abstraction process are presented in a Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) flow diagram (Fig. 1) [25].

2.2.6. Data items

A piloted data extraction form was used to collect the following information: authors, journal year of publication, demographics, primary diagnosis, details on intervention, details on outcome and outcome measurement, and data quality. We contacted study authors to retrieve missing information, though we did not receive any responses. Data were then transferred from extraction forms into Review Manager 5.3 file for meta-analyses.

2.2.7. Risk of bias in individual studies

Two reviewers independently assessed the risk of bias of each included study using the domain-based evaluation criteria from the Cochrane Handbook for Systematic Reviews of Interventions [26]. Each rater evaluated studies in each of the domains as shown in Tables 1–18, Appendix IV.

Reviewers rated each study as either low, unclear, or high risk of bias for each domain and provided explanations to justify. The risk of bias assessment was summarized across studies and presented in Tables 1–18 in Appendix IV and Fig. 2 (Risk of Bias within Studies).

2.2.8. Grading strength of evidence

Studies eligible for statistical analysis were evaluated based on the Grading of Recommendations, Assessment, Development and Evaluation (GRADE) guidelines to assess the level of confidence in effect estimates for each outcome. Results from the GRADE approach are presented per outcome in Table 2 in the manuscript.

2.2.9. Types of intervention

2.2.9.1. Therapist-supported electronically-delivered CBT (eCBT). eCBT was defined a type of CBT using an electronic medium of delivery which also provided participants with opportunities to contact the therapist(s) electronically. We considered this intervention to be therapist-supported eCBT. Acceptable modalities included web-based, applications, e-mail, texting, computerized, video conferencing, and more. Eligible studies were therapist-supported, with the therapist connecting with participants at least once throughout the duration of the trial, with no restrictions placed on the number of therapy sessions or duration of follow-up.

2.2.9.2. Face-to-face CBT. Face-to-face CBT included any form of CBT treatment where the therapist delivered CBT in person to the participants at a designated treatment facility. This could include group-based CBT. There were no restrictions placed on the number of sessions, location, or duration of follow-up.

2.2.10. Types of participants

2.2.10.3. Participant characteristics. No restrictions were placed on age, sex, or ethnic background. No restrictions were placed on inpatient or outpatient treatment. However, we only included studies published in English.

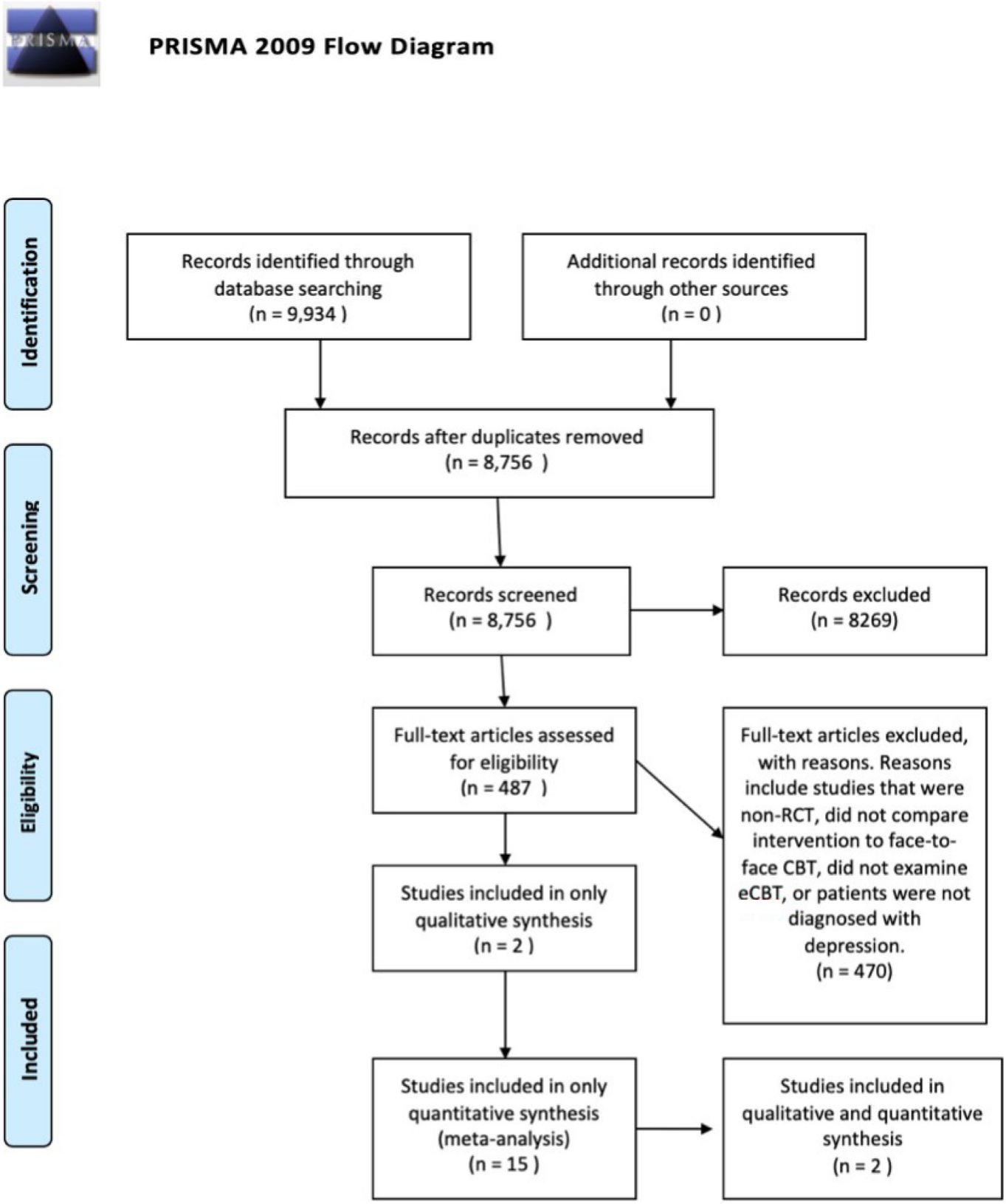

Fig. 1. PRISMA Flowchart of study screening and inclusion.

2.2.10.4. Diagnosis. Eligible studies included participants with a primary diagnosis of a depressive disorder as defined by either the American Psychiatric Association Diagnostic and Statistical Manual of Mental Disorders (DSM)[2], the WHO international Classification of Diseases (ICD)[27], clinician referral or diagnosis, or other screening questionnaires which have been previously validated to measure depressive symptoms. For the full list, please refer to Appendix II. No restrictions were placed on edition or version of the classification

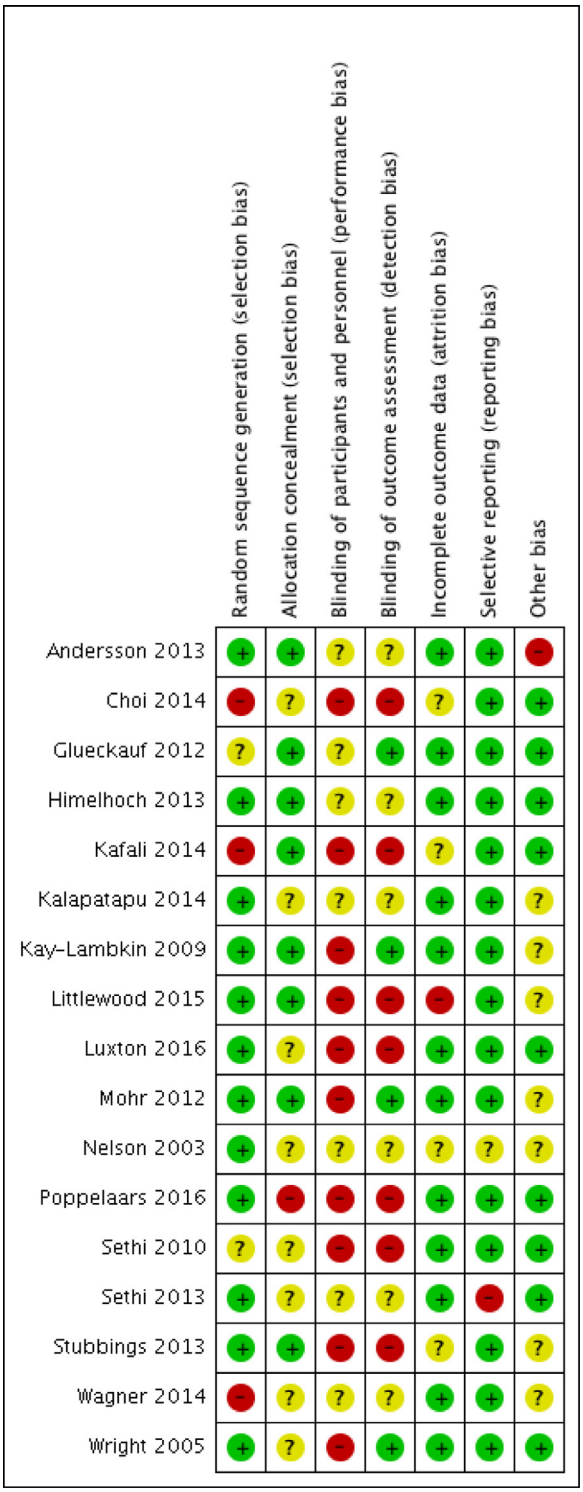

Fig. 2. Risk of Bias within Studies. *other biases include self-report biases and niche study populations.

system used. No restrictions were placed on symptom severity, subtype, comorbidities, or phase of disorder.

2.3. Summary measures

2.3.1. Primary outcome

2.3.1.5. Depressive symptom severity outcome. Symptom severity is defined as the level of deviation from a normal, healthy state perceived by the patient. No restrictions were placed on tool to measure symptom severity.

2.4. Secondary outcomes

2.4.1. Global functionality

Global functionality refers to functional impairments in various domains including employment, education, social situations, and independence in daily life activities.

2.4.2. Quality of life

Quality of life refers to broad aspects of well-being and cover domains such as functionality (e.g., frequency of social contacts), subjective well-being, access to resources, and psychiatric symptoms. No restrictions were applied on the type of measurement tool used.

2.4.3. Participant satisfaction

Participant satisfaction measures are often study-specific, ranging from validated scales such as the Service Satisfaction Scale (SSS-30) to unstructured patient interviews. No restrictions were placed on type of measurement tool used.

2.4.4. Economic outcomes

The economic outcome included in this review was costs associated with administering either face-to-face or electronically-based CBT. We recognize that resource costs are sensitive to variability across settings, limiting the generalizability of cost estimates. Results are presented in a narrative summary comparing the total cost of face-to-face CBT to eCBT.

2.4.5. Adverse events outcome

Participant dropout rates from the studies were recorded and presented narratively. We considered participant dropout as any participant whom did not complete full follow-up.

2.5. Outcome measures

2.5.1. Continuous outcomes

We recognize that studies include different measurement scales for a single outcome. Therefore, we expressed continuous outcomes as standardized mean differences (SMD) with 95% confidence intervals. Before calculating the SMDs, mean scores for each study were presented with a direction of effect.

2.5.2. Endpoint versus change-from-baseline data

Data from all studies were presented as change-from-baseline data, which is the difference between pre- and post-intervention/comparator scores. Change-from-baseline data was chosen as it reduces between-participant variation. Studies presenting only endpoint data were only summarized qualitatively if they measured outcomes of interest.

2.5.3. Dealing with missing data

In cases of missing outcome measures, we tried contacting authors of the primary studies to retrieve the missing data or calculating missing data with relevant information presented in studies. For instance, we would calculate SD with Review Manager calculators imputing necessary values such as the SMD. All correspondence with trial investigators was documented. We were able to compute values for 17 studies. If we were unable to obtain missing data through either means, we excluded the study from our meta-analysis. However, these studies were still included in our narrative summaries.

2.5.4. Assessment of heterogeneity

The impact of heterogeneity on the meta-analysis was assessed using I^2 statistics [26]. The degree of heterogeneity was represented

Table 2
Summary of Findings Question: Electronic CBT compared to face-to-face CBT for depression Bibliography: Electronic cognitive behavioural therapy versus face-to-face cognitive behavioural therapy for depression.

Certainty assessment							№ of patients		Effect		Certainty	Importance
№ of studies	Study design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Electronic CBT	face-to-face CBT	Relative (95% CI)	Absolute (95% CI)		
Symptom Severity with Depression Diagnosis (follow up: mean 2.4 months)												
14	randomised trials	not serious	very serious [a]	not serious	not serious	all plausible residual confounding would reduce the demonstrated effect	563	573	-	SMD 1.73 SD lower (2.72 lower to 0.74 lower)	⊕⊕⊕x̂ MODERATE	CRITICAL
Global Functionality (follow up: mean 12.8 months)												
2	randomised trials	not serious	very serious [b]	serious [c]	very serious [b]	strong association all plausible residual confounding would reduce the demonstrated effect	298	302	-	SMD 36.28 SD higher (28.62 lower to 101.18 higher)	⊕x̂x̂x̂ VERY LOW	IMPORTANT
Quality of Life (follow up: mean 9.7 months)												
3	randomised trials	not serious	very serious [d]	serious [e]	serious [f]	all plausible residual confounding would reduce the demonstrated effect	1 study reported that the intervention resulted in greater differences in quality of life compared to face-to-face CBT. 2 studies reported that both intervention and control resulted in the same mean difference.				⊕x̂x̂x̂ VERY LOW	IMPORTANT
Participant Satisfaction (follow up: mean 2.4 months)												
3	randomised trials	not serious	very serious [g]	serious [h]	not serious	all plausible residual confounding would reduce the demonstrated effect	170	171	-	SMD 0.19 SD lower (0.88 lower to 0.49 higher)	⊕⊕x̂x̂ LOW	CRITICAL
Economical Evaluation (follow up: mean 9.2 months)												
1	randomised trials	not serious	very serious [i]	not serious	very serious [j]	strong association all plausible residual confounding would reduce the demonstrated effect	1 study reported eCBT was less costlier than face-to-face CBT.				⊕⊕x̂x̂ LOW	IMPORTANT

CI: Confidence interval; SMD: Standardised mean difference.
Explanations.
[a] Studies had high variation across measures of symptom severity, as well as study design leading to inconsistent results.
[b] Inconsistent due to high heterogeneity and large variation across study characteristics, including population, sample size, eCBT method of delivery and assessment.
[c] Studies used validated and unvalidated measures to measure global functionality. There was also a large variation across studies.
[d] High heterogeneity was present across study characteristics. The main inconsistency was in the measurement tool to measure quality of life outcomes.
[e] Studies did not include direct measures of quality of life, and used various surrogate measures instead.
[f] Pooled estimates not precise due to high heterogeneity across studies including study characteristics and study results.
[g] There was large variation across studies in measures of participant satisfaction leading to high inconsistency in results.
[h] Studies used surrogate measures.
[i] There was a high variation in the economic evaluation measures, and studies had varying study characteristics.
[j] There were high variation across results in terms of results, outcomes measured, and tools used to measure outcome.

in random-effects meta-analysis as an estimation of between-study variance known as the Tau value.

2.5.5. Synthesis of results

We conducted a meta-analysis if the clinical question, interventions, and population of participants were similar across studies for a pooled estimate to be meaningful. A random-effects meta-analysis was conducted to create an overall summary statistic of treatment effect by direct comparisons of intervention with control. Random effect models do not require the assumption that all studies estimate the same treatment effect. Continuous outcomes were weighted by inverse of variance [28], thereby granting studies with high variance a lower weight in pooled estimate and vice versa. This method was chosen because we assumed heterogeneity among the included studies therefore using a random effect model is a more conservative estimate of the total effect [29]. All pool standard mean deviations were calculated using baseline scores. All statistical analyses were performed using Review Manager Version 5.3 [30]. Results from meta-analysis are presented in forest plots (Figs. 3–5).

2.5.6. Risk of bias across studies

To assess potential reporting bias, a funnel plot was generated in Review Manager Version 5.3 for analyses with 10 or more studies as well as completing an Egger's Test for publication bias by using normalized effect estimates and standard errors [30]. Funnels have been shown to be an inadequate assessment of publication bias for meta-analyses of under 10 studies [31]. We have included the funnel plot for the analysis with more than 10 studies in Appendix I.

2.5.7. Presentation of data and 'Summary of findings' table

Results of our search and the process of screening studies for inclusion are presented in a PRISMA Flow Diagram (Fig. 1) [32]. A 'Characteristics of Included Studies Table' (Table 3) presents information about methods, participants, interventions, and outcomes for included studies.

A summary of findings table (Table 2) was created for comparisons between eCBT and face-to-face CBT for each outcome as mentioned above.

2.5.8. Additional analyses

A subgroup analysis was conducted to investigate differences between two or more sub-groups, as described by Borenstein et al. [29]. We conducted the subgroup analyses (Appendix I) on age group (under 18 vs. adults, location (US which was the most common setting for studies, vs other) and type of eCBT (computer-based vs. telephone-based). We performed a sensitivity analyses to measure if removing the outlier (Choi et al., 2014) changed the direction of effect (Appendix I).

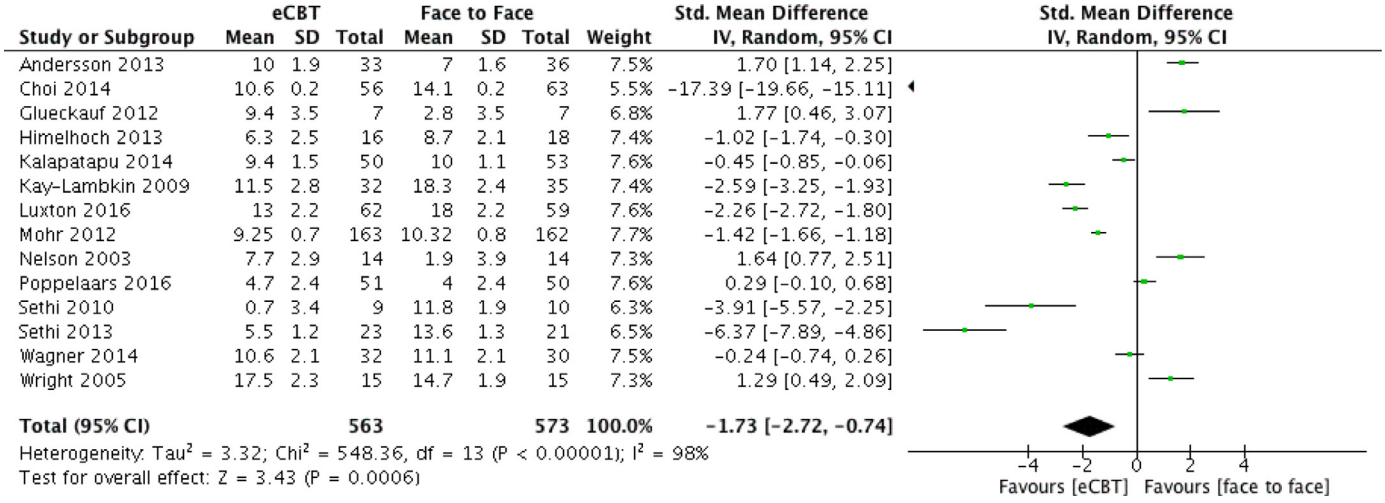

Fig. 3. Forest plot for symptom severity ($k = 14$).

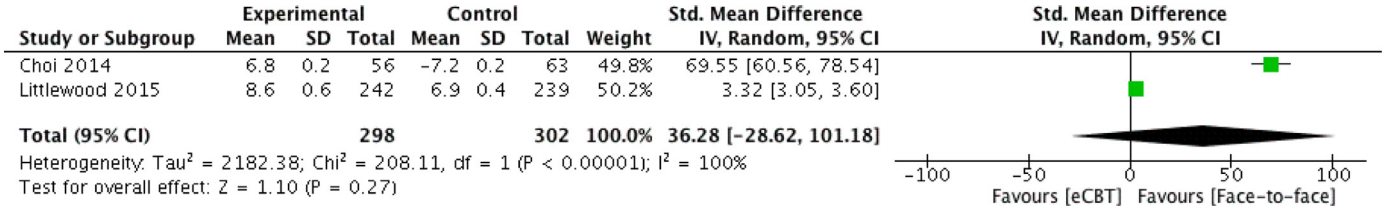

Fig. 4. Forest plot for global functionality ($k = 2$).

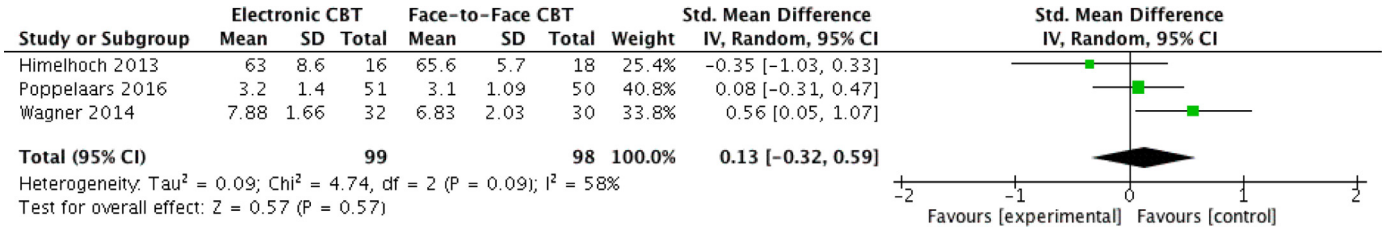

Fig. 5. Forest plot for participants' satisfaction ($k = 3$).

Table 3
Summary of study characteristics.

Study Name and Year (Ex. Smith 2001)	Methods (type of RCT, type of eCBT, blinds, analysis, sample size)	Participants (age range, sex, exclusion criteria, primary diagnosis)	Interventions (Brief description of the CBT separated by study arms)	Outcomes (Tools they use to measure it)
Andersson 2013	RCT, guided Internet-delivered CBT and live group CBT. Intention-to-treat analysis. Sample size: Internet CBT 33; group CBT 36.	*N* = 69; Internet mean age (SD) 42.8 years (14.9); group 41.8 years (12.2). Gender: 78.3% female; ethnicity not specified; community sample - major depression with or without dysthymia. Exclusion criteria: recent change in depression medication; participating in other treatment for depression; other primary disorder that could be negatively affected by treatment.	Intervention: Manual-based, therapist-guided Internet-delivered CBT with 7 text modules over 8 weeks Control: manual-based live group CBT 8 * 2 h over 8 weeks.	MADRS-S. BDI. BAI. QOLI. CGI-I. HAM-D.
Choi 2014	Triple arm RCT comparing tele-CBT via Skype versus in-person CBT and telephone support calls; Effects analyzed using mixed-effects regression with random effects with random intercept models; Intention-to-treat analysis conducted; no blinding; Sample size: face-to-face 63, intervention 56, (third arm 39)	*N* = 158; Sex: 124 females, 34 males Primary Diagnosis: Major Depressive Disorder Exclusion Criteria: High suicide risk, possible dementia, bipolar disorder, and psychotic disorder	Intervention: Participants received 1 face-to-face and 5 Skype teleconferencing problem-solving therapy (PST) Control: participants received 6 individual face-to-face PST in the control group. Both groups had Masters level social workers to deliver the CBT.	Ham-D WHODAS
Glueckauf 2012	RCT comparing telephone-based versus face-to-face CBT on treatment of depression (n = 14). Student t tests and ANOVAs were conducted to assess post-test change.	African American caregivers of patients with Alzheimer's and dementia who also met the PHQ-9 criteria for depression (mean age= 58.09).	Intervention: 12 weekly 1-hour e-CBT sessions. Control: 12 weekly 1-hour face-to-face individual CBT sessions	CES-D, RMBPC, ISEL, CAI, Caregiver Health and Health Behaviour Inventory.
Himelhoch 2013	Pilot RCT, face-to-face and telephone- based CBT; blind assessment. Intention-to-treat analysis. Sample size: face-to-face CBT 18; telephone based 16;	*N* = 34; face-to-face mean age (SD) 46.78 years (8.87); telephone-based 42.47 years (7.95) Sex: 9 males, 25 females; Primary Diagnosis: HIV; Exclusion Criteria: receiving con-current psychotherapy, life expectancy < 6 months as determined by their HIV clinician, having HIV related dementia, initiating antidepressant treatment targeting depression or having an antidepressant medication dose change within 6 weeks of the consent process, and/or having current drug or alcohol dependence. The MINI was also used to rule out anyone with more severe psychiatric pathology for whom participation in the study might be considered dangerous or unethical	Intervention: 11-session manualized telephone CBT intervention targeting depression. The intervention included one initial evaluation session, five sessions of behavioral activation and five sessions of cognitive restructuring delivered over a 14-week period. Included a patient workbook and a linked therapist manual. Control: Non-manualized 11 sessions of CBT provided by clinic therapist without study supervision. Sessions were scheduled for 60 min blocks.	HAM-D QIDS-SR WAI SIMH
Kafali 2014	RCT, usual care versus telephone CBT versus face-to-face CBT. Sample size: usual care 86; telephone CBT 87; face-to-face CBT 84.	*N* = 257; 71.2% aged 35–64; 81.7% female; 100% Latino; primary care patients with depression. Exclusion criteria: psychosis; suicidal thoughts; specialty mental health treatment within last 3 months.	Intervention: 6–8 sessions of Engagement and counseling for Latinos (ECLA) by telephone or face-to-face. Control: typical standard of care potentially including antidepressant medication or brief counseling.	PHQ-9. HSCL.
Kalapatapu 2014	RCT comparing telephone-based versus face-to-face CBT for treatment of depression with co-occurring problematic alcohol use (*N* = 103). The chi-squared test was used to analyze changes in categorical variables and Wilcoxon	Patients with a HAM-D score > 16 and met AUDIT screening criteria (mean age: 41.9 face-to-face; 45.6-telephone).	Intervention: Individual 18 * 14 min eCBT sessions were delivered: 2 sessions for the first 2 weeks, followed by 12 weekly sessions and 2 final sessions in the last 4 weeks. Control: Individual 18 * 14-minute CBT sessions were delivered: 2 sessions for the first 2	PHQ-9, HAM-D, AUDIT.

(*continued*)

Table 3 (*Continued*)

Study Name and Year (Ex. Smith 2001)	Methods (type of RCT, type of eCBT, blinds, analysis, sample size)	Participants (age range, sex, exclusion criteria, primary diagnosis)	Interventions (Brief description of the CBT separated by study arms)	Outcomes (Tools they use to measure it)
	signed-rank test was used for AUDIT scores.		weeks, followed by 12 weekly sessions and 2 final sessions in the last 4 weeks.	
Kay-Lambkin 2009	RCT, brief intervention alone versus computer-delivered CBT versus therapist-delivered CBT; blind assessment. Intention-to-treat analysis. Sample size: brief intervention alone 30; computer-delivered CBT 32; therapist-delivered CBT 35.	*N* = 97; age range 18–61; 54% female; 93% Australian-born; community sample - comorbid major depression and alcohol/cannabis misuse. Exclusion criteria: brain injury; organic brain disease; significant cognitive impairment.	Intervention: All participants received manualized face-to-face brief intervention (one session). Participants then randomized to no further treatment or 9 sessions of manualized SHADE intensive therapy (Self-Help for Alcohol and other drug use and Depression), either computer- or live therapist-delivered. Control: Live therapist delivered manualized and individual face-to-face SHADE intensive therapy for 9 sessions	BDI-II. OTI.
Littlewood 2015	Triple arm RCT comparing a combination of either Beating the Blues and Usual Care, MoodGYM and Usual Care, or just Usual Care; blinding of outcome assessors; Intention-to-treat-analysis; ANOVA analysis; Sample Size: face-to-face 239, 242 in MoodGYM, and 210 in Beating the Blues	*N* = 691; Mean age (SD) of intervention 39.43 (12.96), mean age (SD) of control 40.52 (12.640 Sex: 229 males, 462 females Primary Diagnosis: depression Exclusion Criteria: suicidal, suffering from a psychotic illness, recently suffered bereavement, depressed in postnatal care, suffering from psychotic depression, primary diagnosis of drug or alcohol abuse, not able to read or write English	Intervention: Moodgym is a free, internet-based interactive CBT program for depression with 5 interactive modules for approximately 30–45 min; Beating the Blues is an interactive, multimedia, computer based CBT with 8 therapy sessions consisting of 50 min each and homework exercises between sessions Control: usual care was determined by GP	PHQ-9, CIS-R, CORE-OM, EQ-5D, SF-36v2, CSRI
Luxton 2016	Cluster RCT with participants recruited from two large regional military treatment facilities in the USA; linear mixed-effects regression model analysis; Intention-to-treat analysis conducted; no blinding; Sample size: Face-to-face 59, intervention 62	*N* = 121; Sex: 22 females, 99 males Primary Diagnosis: Minor and major depressive disorder DSM-IV-TR Exclusion Criteria: Currently undergoing psychotherapy for depression, less than 18 or older than 65 years in age, active psychotic symptoms/disorder as determined by SCID-I/P, dysthymic disorder, suicidal ideations, history of organic mental disorder, substance dependence, history of violence or poor impulse control, significant ongoing stressors, having a living arrangement that does not permit the use of private space to participate in the study	Intervention: Behavioural-activation treatment for depression was delivered through videoconferencing in the intervention condition. Intervention groups received eight 50–60 min sessions every week for 8 weeks from doctoral-level mental health providers. Control: Behavioural-activation treatment delivered through face-to-face 50–60 min sessions every week for 8 weeks from doctoral-level mental health providers.	BHS; BDI-II; SCID-I/P; BAI; PTSD Checklist-Military Version; IASMHS; CSQ; Treatment sessions checklist
Mohr 2012	Parallel arm RCT comparing telephone based CBT to face-to-face CBT; Repeated measures linear regression model analysis; intention-to-treat analysis conducted; no blinding; Sample size: face-to-face 162, intervention 163	*N* = 325; Sex: 252 females, 73 males Primary Diagnosis: major depressive disorder Exclusion Criteria: Visual or hearing impairments, met diagnostic criteria for severe psychiatric disorder for which psychotherapy is inappropriate, severe use of alcohol or other drugs, met criteria for dementia, severe suicidality, receiving or planning to receive psychotherapy, or on antidepressant pharmacotherapy	Intervention: Telephone based CBT was delivered by therapist, with 18 45 min sessions in total. Control: Face-to-face was provided in the Preventive Medicine clinic at Northwestern University.	PHQ-9 HAM-D

(*continued*)

Table 3 (*Continued*)

Study Name and Year (Ex. Smith 2001)	Methods (type of RCT, type of eCBT, blinds, analysis, sample size)	Participants (age range, sex, exclusion criteria, primary diagnosis)	Interventions (Brief description of the CBT separated by study arms)	Outcomes (Tools they use to measure it)
Nelson 2003	RCT comparing CBT delivered either face-to-face or over videoconferencing (*N* = 28). Analysis was completed using a two-way within-subjects ANOVA.	Children who met the DSM-IV criteria for depression (avg. age= 10.3), excluding individuals with thought disorders or suicidal ideation.	Intervention: 8 weekly CBT sessions were delivered through videoconferencing. The first session was 90 min. and all subsequent sessions were 60 min.; time was divided between the child and parent. Control: Face-to-face individual weekly 90 min. CBT sessions for 8 weeks. Time was divided between child and parent.	CDI, K-SADS-P, Telemedicine Satisfaction Questionnaire.
Poppelaars 2016	RCT comparing a school-based CBT and a computerized CBT program (*N* = 208). Changes in depressive symptoms were compared using a repeated measures factorial ANOVA design	Participants included Dutch female adolescents (mean age= 13.35), who were within the 70th percentile or greater on the (RADS-2) compared to their peers. Exclusion criteria included suicidal ideation, and currently receiving mental health care.	Intervention: The school-based program was modelled after the Penn Resiliency program and provided 16 1-hour sessions; 8 focused on CBT and 8 focused on social problem solving. Control: Same as intervention but through face-to-face modality.	Depressive symptoms were measured using the RADS 2. Suicide ideation was measuring using item 9 of the (CDI).
Sethi 2010	Quadruple arm RCT comparing face-to-face, conjunction of online and face-to-face, online, and wait list control; Analysis of data using MANOVA; Unclear if intention-to-treat analysis conducted; no blinding; Sample size: 10 face-to-face, 9 intervention	*N* = 19; mean age N/A; Sex: 14 females, 5 males; Primary diagnosis: adolescent depression and anxiety; Exclusion criteria: Those seeking treatment elsewhere, had extreme levels of depression or anxiety	Intervention: The intervention group used MoodGYM for 8 40−50 min sessions; Control: Face-to-face CBT comprised of 8 sessions with registered psychologists.	DASS-21 K10 ATQ 30
Sethi 2013	Quadruple arm RCT comparing MoodGYM, face-to-face CBT, wait-list control, and in-conjunction treatment of both MoodGYM and face-to-face CBT; Analysis of data using ANOVA; intention-to-treat analysis conducted; no blinding; sample size: face-to-face 21, intervention 23	*N* = 44; Sex: females 32, males 12 Primary Diagnosis: Depression and/or GAD Exclusion Criteria: Do not meet age criteria of 18−25, seeking treatment elsewhere, being on medication	Intervention: MoodGYM is a free online CBT intervention with 5 sessions over five weeks Control**:** Face-to-face CBT contained individual 5 sessions over 5 weeks. Both groups were supported by a registered psychologist.	K10 DASS 21
Stubbings 2013	Parallel arm RCT with randomized, active control group with a mixed diagnostic cohort; Multilevel mixed effects linear regression analysis; no intention-to-treat analysis; no blinding; sample size: face-to-face 12, intervention 14	*N* = 26; Mean age in intervention group 31.93, mean age of control 29.67; Sex: 15 females, 11 males Primary Diagnosis: DSM-IV Axis I Disorder Exclusion Criteria: DSM-IV diagnosis of anorexia, psychosis, personality disorder, self-harm or suicidal behaviors currently receiving psychotherapy, and/or involvement in legal proceedings	Intervention: 12 week, 1 h long video conferencing sessions with individualized CBT formulations for patients; Control: Standard condition involved in person standard CBT techniques for 12 weekly sessions.	DASS depression subscale, DASS anxiety subscale, DASS stress subscale, QLES
Wagner 2014	Parallel-arm RCT comparing therapist supported online computer CBT versus face-to-face treatment; Mixed-design ANOVA analysis; intention-to-treat analysis; no blinding; Sample size: face-to-face 30, intervention 32	*N* = 62; Sex: 40 females, 22 males Primary diagnosis: depression Exclusion Criteria: Currently receiving treatment elsewhere, suffering from substance abuse or dependence, had been on antidepressant medication for less than 4 weeks, not fluent in German, high risk of suicide, psychotic symptoms, post-traumatic stress disorder, anxiety, phobia and bipolar disorder	Intervention: Both groups received 8 week intervention; Intervention group had intensive therapist support through weekly online intervention. Control: Face-to-Face met a psychologist one-hour per week with homework assignments;	BDI SCL-Anxiety ATQ

(*continued*)

Table 3 (*Continued*)

Study Name and Year (Ex. Smith 2001)	Methods (type of RCT, type of eCBT, blinds, analysis, sample size)	Participants (age range, sex, exclusion criteria, primary diagnosis)	Interventions (Brief description of the CBT separated by study arms)	Outcomes (Tools they use to measure it)
Wright 2005	3-parallel arm RCT, face-to-face, computer-assisted CBT and control; blind assessment. Intention-to-treat analysis. Sample size: face-to-face CBT 15; computer-based 15; control 15.	*N* = 45; face-to-face mean age (SD) 41.9 years (9.0); computer-based 38.2 years (9.8); control 40.6 years (10.7). Gender: 11 males, 34 females; Primary diagnosis: Nonpsychotic MDD; Exclusion criteria:diagnosis of schizophrenia or other psychotic disorder, bipolar disorder, depression secondary to substance abuse or medical condition, chronic major depression, obsessive-compulsive disorder, anorexia nervosa or bulimia nervosa, borderline personality disorder, dementia or other cognitive disorders, any substance use disorder other than nicotine, or anxiety disorder of greater severity than depression; Current suicidal ideation or plan or a history of two suicide attempts or episodes of self-mutilation; Previous felony conviction, two arrests as a juvenile, or currently on probation;Past treatment with cognitive therapy; A medical condition that would interfere with participation in therapy	Intervention: Treatment with computer-assisted cognitive therapy included nine sessions with a therapist (first session=50 min, subsequent sessions=25 min) and eight computer sessions (20−30 min) that followed immediately after sessions 1−9. Control: Individual standard cognitive therapy was delivered in nine sessions with a therapist that were 50 min long. Patients assigned to the waitlist received no treatment during the 8-week waiting period.	HAM-D BDI&&&&& &ATQ DAS&&& &&&CTA

Abbreviations: ATQ- Automatic Thoughts Questionnaire; AUDIT: Alcohol Use Disorders Identification Test; BAI: Beck Anxiety Interview; BDI: Beck Depression Inventory; BDI-II: Beck Depression Inventory-II; BHS: Beck Hopelessness Scale; CAI: Caregiver Appraisal Inventory; CDI: Children's Depression Inventory; CES-D: Center for Epidemiological Studies-Depression Scale; CGI-I: Clinical Global Impression Improvement scale; CSQ-8: Client Satisfaction Questionnaire; CSRI: Client Service Receipt Inventory; DAS-Dysfunctional Attitude Scale; DASS- Depression, anxiety, stress scales; EQ-5D: Health State Utility; HADS-A: Hospital Anxiety and Depression Scale-anxiety subscale; HAM-A: Hamilton Anxiety Rating Scale; HAM-D: Hamilton Depression Rating Scale; HAMD-17: 17-item Hamilton Depression Rating Scale; HSCL: Hopkins Symptom Checklist; ISEL: Interpersonal Support Evaluation List; ISI: Insomnia Severity Index; K10: Kessler Psychological Distress Scale; LEC: Life Events Checklist; MADRS: Montgomery-Asberg Depression Rating Scale; OTI: Opiate Treatment Index; OQ-45: Outcome questionnaire 45; PHQ-9: Patient Health Questionnaire 9; QIDS-SR- Quick inventory of depressive symptomology; QOLI: Quality of Life Inventory; RADS: Reynolds Adolescent Depression Scale; RMBPC: Revised Memory and Behaviour Problem Checklist; SCID-IV-RV-Structured Clinical Interview for DSM-IV, Research Version; SCL-A: Symptom Checklist-Anxiety; SDQ: Strengths and Difficulties Questinnaire; SF-36: 36-Item Short Form Survey; SIMH- satisfaction index-mental health; WAI- Working Alliance Inventory; WHO-DAS: World Health Organization Disability Assessment Schedule.

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3. Results

3.1. Study selection

The search process was performed from inception until February 20th, 2020. Upon applying the search strategies defined in Appendix II to Medline, CINAHL, EMBASE, PsychINFO, and Cochrane CENTRAL databases, we retrieved 8756 studies after removing duplicates. Of the 487 studies eligible for full-text screening, 17 were eligible for data extraction. In the excluded cases after full-text screening, 11 were duplicates, and 13 lacked information on the outcome measures for this review.

The mean kappa agreement between pairs of reviewers was 0.96 for title and abstract reviews. Kappa agreement variables were not calculated for full-text screening and data extraction review processes. A more detailed outline of the article screening process is included in Fig. 1 and a list of the selected studies is available in Table 3.

3.2. Study characteristics

All 17 included studies were RCTs by design. The trial participants were predominantly female (n = 1642), amounting to 71% of the study total population. Out of the 17 studies, 10 reported ethnicity of their participants. Eight of these studies reported a majority Caucasian population, one reported a majority Black population, and one with a majority Latino population. The mean age (k = 14) across intervention groups was 27.0 years, and mean age across control groups (k = 14) was 27 years. There were 3 studies that did not report the mean age for their intervention and control groups [33−35].

Combined, 17 studies were utilized to compare eCBT effectiveness to face-to-face CBT (Table 3) [33−49]. Among the 17 trials, seven included internet-based eCBT programs, six included telephone-based eCBT programs, two included eCBT offered through video-conferencing, and two included eCBT offered through CD-ROM media. Nine studies were conducted in the USA, four in Australia, one in the Netherlands, one in Switzerland, one in Sweden, and one in the UK. More details about individual studies can be found in Table 3.

3.3. Risk of bias within studies

The quality of the studies included in the meta-analysis is shown in Table 2 (Summary of Findings). Justifications for individual study assessments are presented in Appendix IV. The Cochrane Risk of Bias tool was used to rate the internal validity of the studies shown in Fig. 2.

The overall quality between studies was highly variable. Some of the common issues were not surprising. Specifically, 11 out of 17

studies did not include blinding of participants or personnel. Although blinding in behavioural studies would be impossible for personnel and participants, it is possible for outcome assessors. In our review, few studies had any blinding of the outcome assessors. In contrast, only two out of 17 studies did not report their intended outcomes and five out of 17 studies did not utilize a random sequence during randomization. Numerous studies were missing key information required to evaluate the risk of bias of their results.

3.4. Results of individual studies

We report results of individual studies in forest plots for the outcomes of symptom severity, global functionality, and participant satisfaction respectfully (Figs. 3–5). For quality of life and economic evaluations, we have provided the mean differences, confidence intervals, p-values, and intervention as well as control group costs if available for each study in the narrative summaries below.

3.5. Synthesis of results

3.5.1. Depressive symptom severity

Our meta-analysis (Fig. 3) pooled the results of 14 studies comparing the effects of eCBT to those of face-to-face CBT based on outcome measures of depression symptom severity. The total sample size consisted of 1136 participants. We used the SMD between pre-treatment and post-treatment results to compare the effects of both interventions, and is defined as the difference in mean effects between groups divided by the pooled standard deviation (SD). The effect of the SMD may be estimated using Cohen's statistical criteria [50]. The criteria states that a SMD of 0.2 represents a small effect, 0.5 a moderate effect, and 0.8 a large effect. In our meta-analysis, we found an estimated SMD of −1.73 (95% CI −2.72, −0.74), favouring eCBT with a large effect. However, we observed high amounts of heterogeneity (I^2=98%) among the pooled results. We provided this outcome with a GRADE rating of moderate.

3.5.2. Global functionality

Our meta-analysis (Fig. 4) pooled 2 studies to compare the results of both the intervention and the control group on changes in global functionality. The total sample size in this meta-analysis was 600. The pooled SMD was 36.28 (95% CI −28.62, 101.18), demonstrating no statistically significant difference between face-to-face and eCBT in improving global functionality. We also observed high heterogeneity of 99%, introducing further uncertainty to our results. We provided this outcome with a GRADE rating of very low.

3.5.3. Quality of life

Three RCTs reported on quality of life outcomes with a sum of 576 participants (289 in intervention group, 287 in control group). The first study included by Littlewood et al. [42]. demonstrated no difference in improvement in quality of life outcomes between intervention and control with statistically insignificant results (mean difference [MD] 0.0028, 95%CI −0.0436, 0.0491) using the SF-6D at 4-, 12- and 24-month followups. The second study, Stubbings et al. [47], used the QLES questionnaire at pre- and post-treatment (12 weeks). Results demonstrated superior quality of life outcomes with eCBT. However, the mean difference nor confidence intervals were reported and results were statistically insignificant (P = 0.65). Lastly, Andersson et al. [36] reported outcomes using the QOLI questionnaire before and after the 8-week intervention. Results showed eCBT to be superior to the control group (MD 0.32, p<0.001). In summary, there lies inconclusive evidence regarding eCBT compared to face-to-face in quality of life outcomes. We provided this outcome with a GRADE rating of very low.

3.5.4. Participant satisfaction

Out of 17 studies, three reported participants' satisfaction outcomes with a total of 197 participants (Fig. 5). The pooled SMD was 0.13 (95% CI −0.32, 0.59) showing no statistically significant difference between face-to-face CBT and eCBT in participant satisfaction. We provided this outcome with a GRADE rating of low.

3.5.5. Economic evaluations

Out of 17 studies, one evaluated the total cost of eCBT compared to face-to-face CBT with a total of 171 participants. Results from Kafali et al. [39] demonstrated that the total costs of eCBT were $501.18 USD less expensive per patient compared to face-to-face. This value includes the costs of administering the services as well as non-intervention mental health care services used including primary care visits related to mental health, psychologist visits, psychiatrist visits, emergency department visits, and medications. We provided this outcome with a GRADE rating of low.

3.6. Adverse outcomes

Of the 17 studies included in the analysis, one study did not report adverse outcomes. In total, there were 177 participants' drop outs from all 16 studies that reported on participant drop-outs. The mean dropout rate in the intervention group was 0.21 and the mean dropout rate in the control group was 0.20.

3.7. Risk of bias across studies

When assessing risk of bias across studies (Fig. 6), we noticed several trends. First, most studies were low risk for reporting bias, attrition bias, or selection bias. However, numerous studies were high risk for performance bias and detection bias. Lack of methodological reporting was also common. As mentioned previously, blinding of personnel and participants is challenging in behavioural studies—therefore, it is expected to observe high risks of performance bias. We also conducted a funnel plot for Severity of Depressive Symptoms outcome, finding more publications that demonstrated face-to-face superiority (Fig. 7). Our Egger's Test for publication bias also demonstrated a result of −0.918 (SE:0.410) leaning towards eCBT. Overall, this suggests that publication bias is inconclusive in this study.

3.8. Additional analyses

To assess causes of heterogeneity, we performed subgroup analyses on studies assessing depressive symptom severity. Due to the small number of studies in other outcomes, subgroup analyses within those outcomes were not feasible. Only one included study compared eCBT with group face-to-face CBT, thus a sensitivity analyses was not feasible. From our analyses, we found that the heterogeneity was not caused by age groups (Fig. 2 and 3, Appendix I), the studies' country of origin (Fig. 4 and 5, Appendix I), or the modality of the eCBT (Fig. 6 and 7, Appendix I). We also found that removing outliers did not change the direction of the result's effect (Fig. 8, Appendix I).

4. Discussion

CBT is a common form of psychotherapy for depression. In our study, we identified 17 RCTs comparing eCBT with face-to-face CBT measuring improvements in patients' depressive symptoms. All studies were conducted between 2003 and 2018; thus, our study is the most recent to meta-analyze the results of these RCTs to measure the effectiveness of eCBT compared to face-to-face CBT.

Our results demonstrated a relatively large effect size, favouring the electronically-delivered modalities for depressive symptom severity with a GRADE rating of "moderate". For quality of life and participants' satisfaction, eCBT was found to be as effective as face-

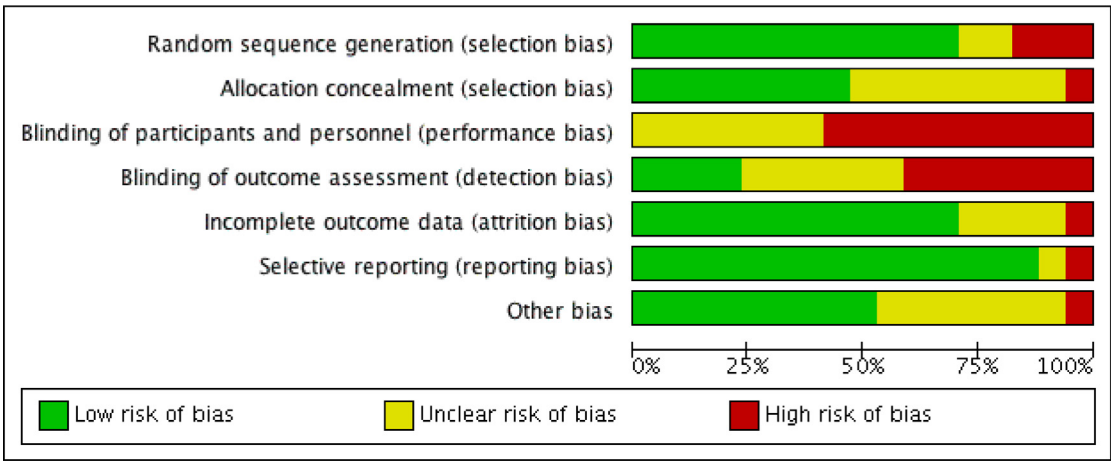

Fig. 6. Risk of bias across studies.

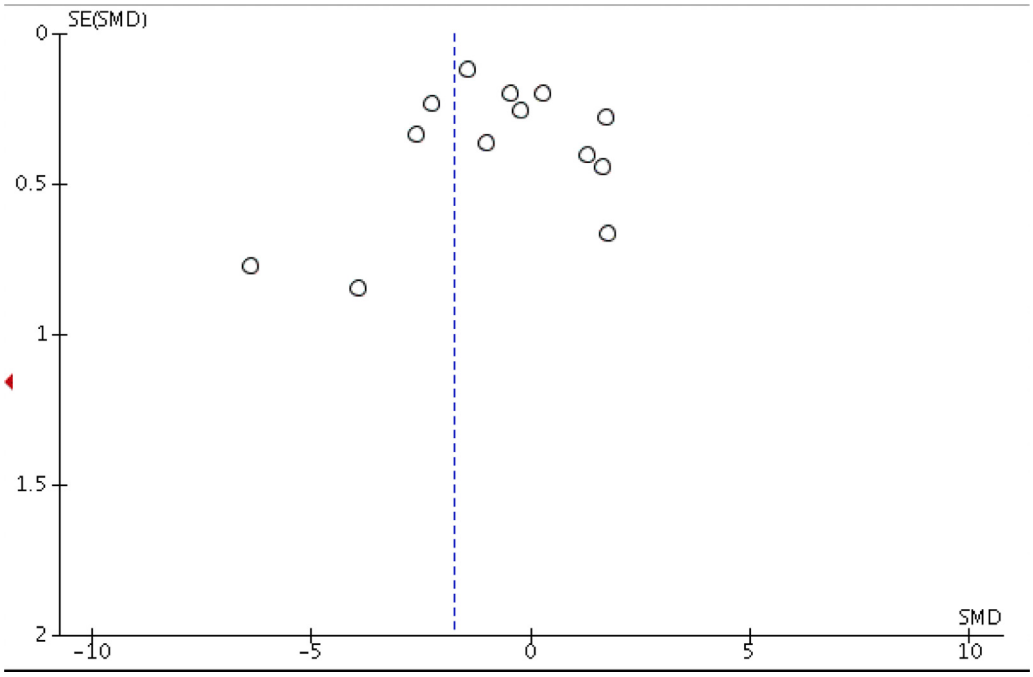

Fig. 7. Symptom severity funnel plot.

to-face CBT. We were only able to pool results from two studies for global functionality, therefore there lies vast uncertainty regarding the pooled result. One study that included an economic analysis found eCBT to be less expensive than face-to-face CBT. There were similar dropout rates in the eCBT groups and 2the face-to-face CBT. Taken together, these results demonstrate that eCBT should be considered as a treatment modality to reduce depressive symptoms if preferred by patients and therapist because it is at least as effective as traditional face to face CBT.

The results of this review are consistent with previous literature on eCBT. Previous studies demonstrated eCBT to be efficacious [51–55]. More recently, Karyotaki et al. [53], also found self-guided internet-CBT to be effective at reducing depressive symptoms compared to controls such as wait-list, treatment-as-usual, or attention control. There lies little evidence against eCBT. [56] Our study included new additional research along with attempts to explain the causes of heterogeneity that is noticeably absent in previous research. Furthermore, our study shows a vast lack of research in this area as exemplified by the few studies we were able to pool for our meta-analysis for global functionality and economic evaluations.

Previous studies have discussed the effectiveness of eCBT for treating depression.[58, 59]A previous meta-regression demonstrated that factors that make eCBT statistically significantly effective in a general population include recruiting patients from non-clinical settings, participants who have existing depression as well as the use of CBT techniques with only guided self-help [57]. Another study also found that electronic therapy was reported to be effective especially when combined with face to face contact than electronic alone [58]. Electronic therapy may have the advantages of easy access by removing physical barriers to access therapy such as transport, cost of travel, finding the time for the therapy and travel to clinic sites, having to arrange time off work, childcare arrangements and other practical challenges that are associated with attending regularly face to face at a clinic location to receive therapy. In addition, time flexibility of electronic interventions may also have the advantage over face to face where participants may be able to use the electronic interventions in their own time and not restricted to usual working hours.

Our study has several methodological strengths that should be noted. To our knowledge, it is one of the only studies that specifically compares eCBT to face-to-face CBT for patients with a primary

diagnosis of depression covering several clinical outcomes providing a comprehensive overview of the effectiveness and utility of eCBT in comparison to face-to-face CBT. More recent systematic reviews evaluating eCBT did not do so in a broad context such as ours thus making our study more generalizable to the population [56,59]. We also included a large number of trials (k = 17) and provided a rigorous methodological evaluation of the included studies and the level of confidence in our results. The results of the current synthesis may also be impacted by the quality of the included trials as described under limitations below [60]. As well, eCBT provides users the ability to have therapy without worrying about stigma associated with psychiatric disorders and being seen attending psychiatric service.

There are limitations in this study that must be mentioned, including small studies with inordinate outcomes, and high heterogeneity in the meta-analysis that cannot be explained by our subgroup analyses. Heterogeneity is a prominent issue in many systematic reviews, and in meta-analyses it can cause the final statistics to be difficult to interpret [61]. Overall, the results should be analyzed with caution due to the risk of bias present.

It can be argued that because of the high heterogeneity, quantitative analyses should not be conducted. However, we decided a *priori* to summarize the evidence and made efforts to minimize heterogeneity such as selecting single study methodology, namely RCT, standardizing outcome measures, using a random effects model, subgroup analyses, and sensitivity analyses. The I^2 values in the meta-analysis reflect the statistical heterogeneity that could not be minimized by the above measures suggesting other sources of clinical and methodological heterogeneity in the included studies adding to the complexity of addressing heterogeneity [62]. The included trials had various durations of intervention, components of CBT, number of sessions offered, levels of engagement with therapists and levels of skills of therapists inherent to psychotherapy studies. We can argue that qualitative summary alone is less informative with subjective bias. In addition, with modest sample sizes and limited number of trials, features common in behavioural interventions, the power of test to detect heterogeneity is low [63]. Hence, we kept the meta-analyses to show the estimates and dispersion of the effects of the intervention for each study. The advantages of having a remotely administered and flexible option of therapy cannot be underestimated. Therefore, electronically based psychotherapy can be considered to reduce the barriers to access, costly and lengthy training of therapists, and elimination of wait times because there exists little difference between eCBT and face-to-face CBT.

Lastly, our study has a large SMD magnitude with large confidence intervals. However, we believe that the true estimate does lie between the limits of the confidence interval. The majority of the individual trials included in our study had a large mean difference between the two interventions. Previous systematic reviews of behavioural interventions also reported large SDM [64,65]. For instance, Ekers et al. had a SMD of −0.70 with a 95% CI of −1.00 to −0.39. [64] A commonality between our studies is the variation in types of therapies and comparators in the studies included in our reviews due to the nature of psychosocial interventions. Additionally, the different studies varied by types of populations, from treatment resistant populations to community-based participants which are likely main contributors to a large SMD magnitude.

Our meta-analysis provides moderate evidence that eCBT is more effective than face-to-face CBT at reducing symptom severity in patients. Due to the associated risk of bias, high heterogeneity, and the lack of between-group difference in global functionality our conclusions are not definitive. With current accessibility of technology internationally, serious consideration should be given as to how to diversify healthcare provision to meet patient needs in treating depression. If eCBT is at least as effective as face to face CBT, then eCBT should be offered if preferred by patients and therapists.

This review is reported following PRISMA Guidelines [25]. The PRISMA checklist is included as supplementary material in Appendix I, Table 1.

Authors contributions

Candice Luo: contributed to the conception and design of the study, search strategy, screening and data extraction, analysis of results manuscript writing and final review of the manuscript.

Nitika Sanger, Nikhita Singhal, Kaitlin Pattrick: contributed to the design of the study, screening and data extraction, analysis of results and critical revision and final review. Ieta Shams, Hamnah Shahid, Peter Hoang, Joel Schmidt, Janice Lee, Sean Haber, Megan Puckering, Nicole Buchanan, Patsy Lee, Kim Ng, Sunny Sun, Sasha Kheyson, Douglas Cho-Yan Chung: contributed to screening, data extraction, critical revision and final review of the manuscript. Stephanie Sanger: contributed to the development of the search strategy and final review of the manuscript. Lehana Thabane: contributed to the methodological design, critical revision and final review of the manuscript. Zainab Samaan: contributed to the conception and design of the study, critical revision and final approval of the manuscript.

Declaration of Competing Interest

The authors have no conflicts of interest to report.

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Supplementary materials

Supplementary material associated with this article can be found in the online version at doi:10.1016/j.eclinm.2020.100442.

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