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E-therapy in the treatment and prevention of eating disorders: A systematic review and meta-analysis

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ABSTRACT

The widespread availability of the Internet and mobile-device applications (apps) is changing the treatment of mental health problems. The aim of the present study was to review the research on the effectiveness of e-therapy for eating disorders, using the methodology employed by the UK's National Institute for Health and Care Excellence (NICE). Electronic databases were searched for published randomised controlled trials of e-therapies, designed to prevent or treat any eating disorder in all age groups. Studies were meta-analysed where possible, and effect sizes with confidence intervals were calculated. The GRADE approach was used to determine the confidence in the effect estimates. Twenty trials met the inclusion criteria. For prevention, a CBT-based e-intervention was associated with small reductions in eating disorder psychopathology, weight concern and drive for thinness, with moderate confidence in the effect estimates. For treatment and relapse prevention, various e-therapies showed some beneficial effects, but for most outcomes, evidence came from single studies and confidence in the effect estimates was low. Overall, although some positive findings were identified, the value of e-therapy for eating disorders must be viewed as uncertain. Further research, with improved methods, is needed to establish the effectiveness of e-therapy for people with eating disorders.

Introduction

The treatment of mental health problems is likely to change markedly over the next 10–20 years, as a result of the widespread availability of the Internet and of mobile-device applications (apps), and their ability to deliver direct to the user certain psychological treatments. This change will greatly increase the availability of these treatments, but it will be associated with risks, a major one being the promulgation of ineffective or even harmful interventions. Clinicians and the public alike will therefore need access to authoritative and up-to-date guidance regarding the empirical status and clinical utility of the many online and app-based interventions (referred to here as e-therapy).

Research on the effectiveness of e-therapy is still at an early stage. The number of outcome studies is modest but it is increasing rapidly and has been the focus of several systematic reviews and meta-analyses (Aardoom, Dingemans, Spinhoven, & Van Furth, 2013; Andersson & Cuijpers, 2009; Andrews, Cuijpers, Craske, McEvoy, & Titov, 2010; Bauer & Moessner, 2013; Dölemeyer, Tietjen, Kersting, & Wagner, 2013). In general, the conclusions drawn have been strikingly positive with the effectiveness and acceptability of e-therapy being highlighted.

E-therapy should be evaluated no differently from other therapeutic interventions. The relevant studies and their data should be subject to the same independent and rigorous scrutiny as those from studies of drug treatments and surgical interventions. The UK's National Institute for Health and Care Excellence (NICE) specialises in conducting such evaluations.[1] This paper describes the application of NICE systematic review methodology[2] to the studies of e-therapy, focusing in particular on interventions designed to prevent or treat eating disorders. Previous reviews of this research (Aardoom et al., 2013; Dölemeyer et al., 2013) have been narrower in focus than the present study and did not use NICE methodology.

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[1] http://www.nice.org.uk/About/What-we-do/Our-Programmes/NICE-guidance/NICE-guidelines/NICE-clinical-guidelines.
[2] http://www.nice.org.uk/article/PMG6/chapter/1%20Introduction.

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Methods

This systematic review and meta-analysis was conducted by staff from the National Collaborating Centre for Mental Health (NCCMH), a centre established by NICE for the evaluation of mental health interventions. The presentation of the findings follows the Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA; Moher, Liberati, Tetzlaff, & Altman, 2009).

Eligibility criteria

All published randomised controlled trials (RCTs) of e-therapies designed to prevent or treat eating disorders, compared with a control condition or any other active intervention, were eligible for inclusion in the review. No restrictions were placed on the type of sample recruited. The samples included participants from the general population, high risk groups, and full cases. E-therapies were defined as interventions that were primarily delivered via a computer, mobile phone or tablet, although there could be limited additional therapist contact. The means of delivery included the Internet, downloadable software, CD-ROMs and mobile-device apps.

Studies were excluded if the therapist was the primary means of delivering the intervention, as in face-to-face treatments augmented with an e-therapy component. Interventions that were delivered entirely by a therapist but transmitted electronically (e.g. CBT delivered via videoconferencing) were also excluded. Studies presented solely in conference abstracts or dissertations/theses were also excluded, as were those reported in languages other than English.

Search strategy

The main strategy involved a search for published studies in the following electronic databases: Embase, Medline, PreMedline, PsycINFO, Sociological Abstracts, Cochrane Central Database of Controlled Trials (CENTRAL), Cumulative Index to Nursing and Allied Health Literature (CINAHL), Applied Social Sciences Index and Abstracts (ASSIA), British Education Index (BEI), British Humanities Index (BHI), International Bibliography of Social Science (IBSS), Education Resources Information Centre (ERIC), Public Affairs Information Service International (PAIS International) and Social Services Abstracts (SSA) from database inception to 10th July 2014 (see Supplementary Appendix A for the search strategy containing a full list of the search terms used). Citations were screened by one reviewer (CEL) and checked by a research assistant. Hard-copies of studies that were judged to be potentially relevant to the review were obtained. Two reviewers (MEP and CGF) confirmed the eligibility of all the identified studies with disagreements being resolved by discussion.

The electronic search was supplemented by manual searches on www.clinicaltrials.gov for unpublished trials of relevance to the review. Where eligible trials were found, unpublished data were requested from the investigators. Finally, the reference lists of the included studies and of previous reviews of relevance to the topic were checked for additional studies.

Data extraction

Study characteristics and outcome data were captured using electronic data extraction forms by one reviewer (CEL) and checked for accuracy by a second reviewer (MEP). Where studies met inclusion criteria but did not report outcome data in a form that could be used in the analysis, authors were contacted to obtain data in an alternative form.

The following outcomes were examined at the end of the intervention and at follow-up: a) weight concern, shape concern, dietary restraint, bulimia, drive for thinness and global eating disorder psychopathology; b) binge eating and inappropriate weight control behaviour including, vomiting, laxative/diuretic misuse and excessive exercising; c) cessation of binge eating and inappropriate weight control behaviour, and remission from the eating disorder in question (i.e., no longer meeting diagnostic criteria).

Quality assessment

The Cochrane risk of bias tool was used to make an assessment of the potential for bias in each individual study (Higgins & Green, 2011). Studies were rated in terms of six domains: sequence generation; allocation concealment; blinding of participants, assessors, and providers; selective outcome reporting; and incomplete data. An overall risk of bias rating was provided for each study based on the probability of any source of bias having a significant influence on the study results (not as a sum of the number of sources of bias).

The GRADE approach was used to assess the confidence in the effect estimates (quality of evidence) for each outcome (Balshem et al., 2011; Guyatt et al., 2011). This approach is a structured method that takes into consideration five separate factors: 1) risk of bias; 2) inconsistency ($I^2 > 50\%$, $p < 0.05$); 3) indirectness of the population, intervention, control or outcomes; 4) imprecision (number of participants less than the optimal information size, assumed to be $N = 400$); 5) publication bias. Confidence in the effect estimates was categorised as 1) 'high' (very confident that the true effect lies close to that of the estimate of the effect); 2) 'moderate' (moderately confident in the effect estimate and the true effect is likely to be close to the estimate of the effect, but there is a possibility that it is substantially different); 3) 'low' (confidence in the effect estimate is limited and the true effect may be substantially different from the estimate of the effect); or 4) 'very low' (very little confidence in the effect estimate and the true effect is likely to be substantially different from the estimate of effect) (Balshem et al., 2011). Evidence from RCTs is initially classed as 'high', but confidence in the evidence may decrease on the basis of the five factors listed above.

Data analysis

Data were synthesised using RevMan Version 5.2 (Cochrane Collaboration, 2012). All effect sizes are reported with 95% confidence intervals (CI). For continuous outcomes, means (M) and standard deviations (SD) were used to calculate the effect size, expressed as a standardised mean difference (SMD), using the Hedges g (Hedges, 1994) correction for small sample size. A SMD of less than 0.20 was considered to be a very small effect, 0.20 a small effect, 0.50 a medium effect and 0.80 a large effect. For trials where M and SD were not provided, if p values for the net effect were reported, these were used to calculate the SMD and associated standard error (SE). For dichotomous outcomes, the risk ratio (RR) was calculated, and used as the effect size. Dichotomous outcomes were weighted using the Mantel-Haenszel method (Mantel & Haenszel, 1959) and continuous outcomes were weighted by the inverse of variance (Greenland & Robins, 1985). Where trials used methods to adjust for attrition bias, these data were used in preference to data from completers. Where individual trial data could be combined, random-effects meta-analysis was conducted. Statistical heterogeneity (variation in study effect sizes) was determined using the I^2 statistic, which provides the percentage of total variation in the estimates of effect that is due to heterogeneity between studies (Higgins & Thompson, 2002; Higgins, Thompson, Deeks, & Altman, 2003). Where I^2 was

Table 1
Characteristics of the 20 included studies.

Study	Study population	Intervention	Control/Comparison intervention(s)	End of intervention (weeks)	Follow-up (weeks)
Prevention studies					
Winzelberg et al. (1998)	57 unselected women (*M* age 19.7, SD 1.13)	'Student Bodies'[a,b] – CD-ROM-delivered CBT program	Waitlist	13	26
Jacobi et al. (2007)	100 unselected women (*M* age 22.3, SD 2.6)	'Student Bodies'[a,b] (Translated into German) – Internet-delivered CBT program	Waitlist	8	22
Low et al. (2006)	72 unselected 1st and 2nd year college students (100% women)	'Student Bodies'[a,b] – Internet-delivered CBT program	Waitlist	8	35
Celio et al. (2000)	76 unselected women (*M* age 19.6, SD 2.2). Although unselected, participants had high body dissatisfaction (BSQ *M* score 109.6, SD 30.4)	'Student Bodies'[a,b] – Internet-delivered CBT program Support: Also included 1–2 h face-to-face sessions with moderator on 3 out of 8 sessions aimed at familiarising participants with the program and encouraging adherence	1. Waitlist 2. 'Body Traps' – Classroom body image education	8	26
Winzelberg et al. (2000)	60 unselected women (*M* age 20.0, SD 2.8). 23 out of 60 participants had high body dissatisfaction (BSQ $\geq$ 110)	'Student Bodies'[a,b] – Internet-delivered CBT program	Waitlist	8	22
Zabinski et al. (2001)	62 women at risk of an ED (BSQ $\geq$ 110) (*M* age 19.3, SD 1.4)	'Student Bodies'[b,c] – Internet-delivered CBT program	Waitlist	8	18
Taylor et al. (2006)	480 women at risk of an ED (WCS $\geq$ 50) (*M* age 20.8, SD 2.6)	'Student Bodies'[b,c] – Internet-delivered CBT program	Waitlist	8	60
Jacobi et al. (2012)	126 women at risk of an ED (17.5 < BMI < 33; >42 on WCS; behavioural symptoms DSM-IV) (*M* age 22.3, SD 2.9)	'Student Bodies+'[b,d] – Internet-delivered CBT program	Waitlist	8	34
Franko et al. (2005)	120 women at risk of an ED (symptomatic on Q-EDD) (*M* age 18.2, SD 0.4)	'Food, Mood and Attitude' (FMA) – CD-ROM delivered psychoeducation program based on the dual-pathway model of ED development (Stice, Nemeroff, & Shaw, 1996) Support: None	Control – generic videos concerning women's issues	2–3	16
Stice et al. (2012)	107 women at risk of an ED (self-reported body dissatisfaction – no measure used) (*M* age 21.6, SD 6.6)	'eBody project' – Internet-delivered cognitive dissonance program Support: None	1. Control – educational video on eating disorders 2. 'Body project' – Face-to-face group cognitive dissonance intervention	4–6	None
Hötzel et al. (2014)	212 women with symptoms of AN and BN (as measured by the SEED) (*M* age 27, SD 7.7)	'ESS-KIMO' – Internet-delivered program. Informed by the transtheoretical model of change (Prochaska & DiClemente, 1992) and motivational interviewing techniques (Miller & Rollnick, 2002) Support: Therapist-provided individualised feedback (~80 min in total)	Waitlist	6	None
Doyle et al. (2008)	83 adolescents at risk of BED ($\geq$85th percentile BMI) (*M* age 14.5, SD 1.7; 63% female)	'Student Bodies' (SB2-BED)[b,e] – Internet-delivered CBT program	Waitlist	16	33
Jones et al. (2008)	105 adolescents at risk of BED ($\geq$85th percentile BMI; binge/overeating behaviours > once a week for 3 months) (*M* age 15.1, SD 1.0; 70% female)	'Student Bodies' (SB2-BED)[b,e] – Internet-delivered CBT program	Waitlist	16	39
Treatment studies					
Schmidt et al. (2008)	97 adults with diagnosed BN or EDNOS (DSM-IV) (97% women; *M* age 27.1, SD 7.6)	'Overcoming bulimia' – CD-ROM-delivered CBT program Support: None	Waitlist	13	None
Sánchez-Ortiz et al. (2011)	76 adults with diagnosed BN or EDNOS (DSM-IV) (99% women; *M* age 23.9, SD 5.9)	'Overcoming bulimia online' – Internet-delivered CBT program Support: Emails sent to participants once every 1–2 weeks by therapists and any emails received were responded to	Waitlist	13	26
Ruwaard et al. (2013)	105 adults with BN (self-reported binge eating,	Internet-delivered CBT program. No name provided.	1. Waitlist 2. Bibliotherapy – CBT self-help	20	72

Table 1 (*continued*)

Study	Study population	Intervention	Control/Comparison intervention(s)	End of intervention (weeks)	Follow-up (weeks)
	inappropriate weight-control behaviour, shape and weight concern – no formal diagnosis) (99% women; *M* age 31, SD 10)	Support: Included 25 scheduled therapist feedback moments (~13 h in total)	workbook. Support: None.		
Wagner et al. (2013)	155 women with diagnosed BN or EDNOS (DSM-IV) (*M* age 24.5, SD 4.2)	'Salut BN' – Internet-delivered CBT program Support: Weekly email support from psychologist/ psychotherapist	Bibliotherapy – 'Getting better Bit(e) by Bit(e)' – CBT self-help workbook	30	78
Carrard et al. (2011)	74 women with diagnosed or subthreshold BED (DSM-IV) (*M* age 36.0, SD 11.4)	'Salut BED' – Internet-delivered CBT program Support: Weekly email contact by psychologists acting as coaches	Waitlist	26	52
Shapiro et al. (2007)	66 adults with diagnosed BED or subthreshold BED (DSM-IV) (92% women; *M* age 39.6, SD 11.7)	CD-ROM-delivered CBT program. No name provided Support: No therapeutic contact. One weekly telephone contact with the research assistant to address technical difficulties	1. Waitlist 2. Face-to-Face CBT group intervention, facilitated by a clinical psychologist	10	18
Relapse prevention studies					
Fichter et al. (2012) Fichter et al. (2013)	258 women with diagnosed or subthreshold AN (DSM-IV) who had been previously hospitalised for AN (*M* age 24.0, SD 6.1)	'VIA' – Internet-delivered CBT program Support: Included therapist-moderated online discussion board, monthly therapist-facilitated group chat-room sessions and the opportunity to contact therapists via email at any time within the program	Treatment-as-usual (TAU) – Included psychotropic medication, in- and out-patient treatment	39	78

Note: End of intervention = post-treatment assessment time point (weeks from baseline); Follow-up = Follow-up assessment time point (weeks from baseline); *M* = mean; SD = standard deviation; CBT = cognitive behavioural therapy; BSQ = body shape questionnaire; ED = eating disorder; BMI = body mass index; WCS = weight concern scale; DSM-IV = diagnostic and statistical manual of mental disorders, 4th edition; Q-EDD = questionnaire for eating disorder diagnoses; SEED = short evaluation of eating disorders; BED = binge eating disorder; BN = bulimia nervosa; EDNOS = eating disorder not otherwise specified; AN = anorexia nervosa.

[a] Content tailored towards improving body image.

[b] Support: Weekly group discussion via email or online discussion board, moderated by a clinical psychologist, graduate psychology student or research assistant.

[c] Content tailored for women at risk of an ED.

[d] Content tailored for women with disordered eating and/or subthreshold ED.

[e] Content tailored for adolescents at risk of developing BED.

greater than 50% and statistically significant based on the Chi-squared test, heterogeneity was defined as substantial. In the event of heterogeneity, an a priori subgroup analysis was used to explore whether sample type (general versus at risk population) explained the variance. For this purpose, *general population* was defined as participants who were unselected for entry into a trial (i.e. study authors did not employ any specific criteria for inclusion in relation to eating disorder psychopathology, this includes participants who enrolled into a trial on the basis of a desire to increase body satisfaction, provided that this was not a criterion imposed by study authors). An *at risk population* was defined as participants who were selected for entry into a trial on the basis of meeting criteria on a pre-determined measure or self-identification of eating disorder psychopathology.

Results

Study selection

Once duplicate records were removed, the main search strategy identified 1240 papers, of which 71 were retrieved for full-text screening (see Supplementary Fig. 1 for trial flow). One additional study was obtained through manual searches of the reference lists of included trials and was screened for eligibility. Fifty trials were excluded (see Supplementary Appendix B for excluded studies with reasons for exclusion). In total, 20 RCTs (published in 21 papers) met all eligibility criteria, and were included in the review. Outcomes in 14 of the 20 studies could be appropriately combined in a meta-analysis.

The characteristics of the trials are shown in Table 1. Seventeen of the 20 studies evaluated cognitive behavioural interventions. Sixteen studies used the internet as the primary means of delivering the intervention. The remaining four used CD-ROMs. None of the studies evaluated the use of mobile-device app-delivered interventions. Thirteen studies focused on preventing an eating disorder from developing, six investigated treatment interventions, and one (reported in two publications) focused on an intervention designed to prevent relapse. Accordingly, the results have been subdivided into prevention, treatment and relapse prevention studies (see Tables 2–4 for a summary of the findings with details of the confidence in the effect estimates).

Quality of evidence

Based on the GRADE approach (Guyatt et al., 2011), confidence in the effect estimates were graded as moderate to very low, often because of high risk of bias (see Supplementary Fig. 2 for risk of bias assessments for each study), but also because of inconsistency, indirectness and imprecision in certain outcomes (see Tables 2–4). Due to the small number of studies, publication bias could not be assessed statistically.

Table 2
Summary of findings and confidence in effect estimates for the prevention studies.

Outcome	*k*	*N*	Effect size (95% CI)	Heterogeneity (% I^2)	Confidence in effect estimates (GRADE)
CBT-based e-intervention ('Student Bodies' program) for the prevention of any eating disorder versus waitlist control					
Weight concern					
End of intervention	8	836	SMD −0.30 (−0.61 to 0.01)	75	Low[a,b,c]
Subgroup analysis					
General population	5	269	SMD −0.21 (−0.45 to 0.03)	0	Low[a,c,d]
At risk population	3	567	SMD −0.37 (−0.96 to 0.21)	88	Low[a,b,c]
Follow-up	8	819	SMD −0.30 (−0.47 to −0.13)*	20	Moderate[a,c]
Shape concern					
End of intervention	6	425	SMD −0.08 (−0.27 to 0.12)	3	Moderate[a,c]
Follow-up	6	400	SMD −0.17 (−0.37 to 0.03)	0	Moderate[a,c]
Dietary restraint					
End of intervention	4	316	SMD −0.27 (−0.64 to 0.09)	60	Low[a,c,d]
Follow-up	4	299	SMD −0.37 (−0.61 to −0.14)*	5	Low[a,c,d]
Drive for thinness					
End of intervention	8	841	SMD −0.37 (−0.59 to −0.15)*	50	Moderate[a,b,c]
Subgroup analysis					
General population	5	277	SMD −0.33 (−0.64 to −0.02)*	38	Low[a,c,d]
At risk population	3	564	SMD −0.40 (−0.74 to −0.06)*	66	Low[a,b,c]
Follow-up	8	816	SMD −0.37 (−0.51 to −0.22)*	2	Moderate[a,c]
Bulimia					
End of intervention	7	739	SMD −0.01 (−0.24 to 0.22)	44	Moderate[a,c]
Follow-up	7	722	SMD −0.13 (−0.36 to 0.09)	41	Moderate[a,c]
Global eating disorder psychopathology					
End of intervention	3	573	SMD −0.23 (−0.79 to 0.32)	87	Low[a,b,c]
Follow-up	3	556	SMD −0.33 (−0.58 to −0.07)*	39	Moderate[a,c]
Binge eating					
End of intervention	1	115	SMD −0.28 (−0.65 to 0.08)	NA	Low[c,d]
Follow-up	1	103	SMD −0.43 (−0.82 to −0.04)*	NA	Low[c,d]
Vomiting and/or diuretic/laxative misuse					
End of intervention	1	115	SMD −0.21 (−0.57 to 0.16)	NA	Low[c,d]
Follow-up	1	103	SMD −0.33 (−0.72 to 0.06)	NA	Low[c,d]
Remission from subthreshold eating disorders					
End of intervention	1	115	RR 0.75 (0.25 to 2.23)	NA	Low[c,d]
Follow-up	1	103	RR 0.29 (0.06 to 1.34)	NA	Low[c,d]
Cessation from binge eating, vomiting, laxative/diuretic misuse and restrictive eating					
End of intervention	1	115	RR 2.42 (1.27 to 4.62)*	NA	Low[c,d]
Follow-up	1	103	RR 1.68 (0.98 to 2.88)	NA	Low[c,d]
CBT-based e-intervention ('Student Bodies' program) for the prevention of any eating disorder versus classroom education					
Weight concern					
End of intervention	1	39	SMD 0.22 (−0.42 to 0.87)	NA	Low[a,d]
Follow-up	1	39	SMD 0.20 (−0.44 to 0.85)	NA	Low[a,d]
Shape concern					
End of intervention	1	39	SMD 0.25 (−0.40 to 0.90)	NA	Low[a,d]
Follow-up	1	39	SMD 0.56 (−0.09 to 1.22)	NA	Low[a,d]
Dietary restraint					
End of intervention	1	39	SMD 0.07 (−0.58 to 0.71)	NA	Low[a,d]
Follow-up	1	39	SMD 0.07 (−0.58 to 0.71)	NA	Low[a,d]
Drive for thinness					
End of intervention	1	39	SMD 0.21 (−0.44 to 0.86)	NA	Low[a,d]
Follow-up	1	39	SMD −0.05 (−0.69 to 0.60)	NA	Low[a,d]
Bulimia					
End of intervention	1	39	SMD 0.13 (−0.52 to 0.78)	NA	Low[a,d]
Follow-up	1	39	SMD 0.04 (−0.60 to 0.69)	NA	Low[a,d]
Psychoeducation-based e-intervention for the prevention of any eating disorder versus control					
Global eating disorder psychopathology					
Follow-up[#]	1	112	SMD −0.28 (−0.66 to 0.09)	NA	Low[a,d]
Weight concern					
Follow-up[#]	1	112	SMD −0.28 (−0.66 to 0.09)	NA	Low[a,d]
Shape concern					
Follow-up[#]	1	112	SMD −0.34 (−0.71 to 0.03)	NA	Low[a,d]
Dietary restraint					
Follow-up[#]	1	112	SMD −0.26 (−0.64 to 0.11)	NA	Low[a,d]
Cognitive dissonance based e-intervention for the prevention of any eating disorder versus control					
Global eating disorder psychopathology					
End of intervention	1	48	SMD 0.05 (−0.53 to 0.63)	NA	Moderate[d]
Dietary restraint					
End of intervention	1	48	SMD −0.27 (−0.85 to 0.31)	NA	Moderate[d]
Cognitive dissonance based e-intervention for the prevention of any eating disorder versus face-to-face group-based cognitive dissonance intervention					
Global eating disorder psychopathology					
End of intervention	1	58	SMD −0.13 (−0.68 to 0.42)	NA	Moderate[d]

Table 2 (*continued*)

Outcome	*k*	*N*	Effect size (95% CI)	Heterogeneity (% I^2)	Confidence in effect estimates (GRADE)
Dietary restraint					
End of intervention	1	58	SMD −0.14 (−0.69 to 0.41)	NA	Moderate[d]
Motivational interviewing based e-intervention for the prevention of any eating disorder versus control					
Weight concern					
End of intervention	1	212	SMD −0.18 (−0.45 to 0.09)	NA	Low[a,d]
Shape concern					
End of intervention	1	212	SMD −0.33 (−0.60 to −0.06)*	NA	Low[a,d]
Dietary restraint					
End of intervention	1	212	SMD −0.38 (−0.66 to −0.11)*	NA	Low[a,d]
Vomiting					
End of intervention	1	212	SMD −0.56 (−0.83 to −0.28)*	NA	Low[a,d]
CBT-based e-intervention ('Student Bodies' program) for the prevention of binge eating disorder versus waitlist control					
Binge eating					
End of intervention	1	105	SMD 0.07 (−0.31 to 0.46)	NA	Low[a,c,d]
Follow-up	1	105	SMD 0.38 (0.00 to 0.77)*	NA	Low[a,c,d]
Weight concern					
End of intervention	1	66	SMD −0.28 (−0.77 to 0.20)	NA	Low[a,c,d]
Follow-up	1	66	SMD 0.01 (−0.48 to 0.49)	NA	Low[a,c,d]
Shape concern					
End of intervention	1	66	SMD −0.17 (−0.65 to 0.32)	NA	Low[a,c,d]
Follow-up	1	66	SMD 0.13 (−0.35 to 0.61)	NA	Low[a,c,d]
Dietary restraint					
End of intervention	1	66	SMD 0.45 (−0.04 to 0.94)	NA	Low[a,c,d]
Follow-up	1	66	SMD 0.26 (−0.23 to 0.74)	NA	Low[a,c,d]
Remission (BMI < 85th percentile, no longer at risk of BED)					
End of intervention	1	87	RR 2.35 (0.90 to 6.09)	NA	Low[a,c,d]

Note.
BED = binge eating disorder; BMI = body mass index; *k* = number of studies; *N* = number of participants; NA = not applicable; SMD = standardised mean difference; RR = risk ratio; CI = confidence interval.
*$p < 0.05$.
#Outcomes of relevance to the review were only reported at follow-up.
Reasons for downgrading, based on the GRADE approach:
[a] Risk of bias (one or more of the following: selection bias, performance bias, detection bias, attrition bias, selective outcome reporting bias).
[b] Inconsistency ($I^2 > 50\%$, $p < 0.05$).
[c] Indirectness (comparison: waitlist control).
[d] Imprecision (optimal information size for dichotomous outcomes = 300 events, and for continuous outcomes = 400 participants).

Findings

Prevention studies

Eight of the 20 RCTs were concerned with the efficacy of the 'Student Bodies' program, a CBT-based intervention designed to reduce body dissatisfaction (Celio et al., 2000; Jacobi et al., 2007; Jacobi, Völker, Trockel, & Taylor, 2012; Low et al., 2006; Taylor et al., 2006; Winzelberg et al., 1998, 2000; Zabinski et al., 2001). Meta-analyses were performed for all outcomes. These showed that when compared with a waitlist control, Student Bodies was associated with small improvements in drive for thinness and weight concern at the end of the intervention and at follow-up, although for weight concern the effect estimate was imprecise at the end of the intervention. Small effects were also observed for shape concern, dietary restraint and global eating disorder psychopathology at follow-up only, however for shape concern the estimate was imprecise. The evidence was inconclusive for bulimia. Confidence in the effect estimates was moderate for the majority of the outcomes.

One study of Student Bodies included participants with disordered eating attitudes and behaviour, and it reported additional outcome variables (Jacobi et al., 2012). For frequency of binge eating the evidence was inconclusive at the end of the intervention, although a small effect was found at follow-up. There were large improvements in combined cessation rates of binge eating, vomiting, laxative/diuretic misuse and restrictive eating at the end of the intervention (41% of participants in the intervention group versus 17% in the control group). This was supported by the results at follow-up, although the estimate was imprecise. The evidence was inconclusive for vomiting and/or diuretic/laxative misuse, and rates of remission from subthreshold eating disorders.

Substantial heterogeneity was observed across these studies in the meta-analyses of the weight concern and drive for thinness outcomes. To investigate this, findings were subgrouped by population type (general population versus at risk population). The size of the effect did not differ between the two groups, and for both outcomes all of the difference between groups could be explained by random variation (I^2 for subgroup differences = 0%).

In one study, Student Bodies was compared with a classroom-based body image education intervention (Celio et al., 2000). In this comparison, the evidence was inconclusive across all outcomes and confidence in the effect estimates was low.

Of the remaining studies one was concerned with a CD-ROM delivered psychoeducation program entitled 'Food, Mood and Attitude' (FMA), designed to reduce the risk of developing an eating disorder in young adult women who were rated at high or low risk (Franko et al., 2005). For the purpose of this review, only the high risk participants were included in the analysis. There were no conclusive differences between the intervention and a control across all outcomes. Confidence in the effect estimates was low.

Another study investigated an internet-delivered intervention based on cognitive dissonance theory, designed to prevent the development of an eating disorder in women with body image concerns (Stice, Rohde, Durant, & Shaw, 2012). The intervention was compared with a control and with a face-to-face intervention based on cognitive dissonance theory. In both comparisons, the

Table 3
Summary of findings and confidence in effect estimates for the treatment studies.

Outcome	*k*	*N*	Effect size (95% CI)	Heterogeneity (% I^2)	Confidence in effect estimates (GRADE)
CBT-based e-therapy for the treatment of bulimia nervosa versus waitlist control					
Binge eating					
End of intervention	2	146	SMD −0.44 (−0.77 to −0.11)*	0	Low[a,c,d]
Follow-up	1	76	SMD −0.57 (−1.03 to −0.11)*	NA	Low[a,c,d]
Vomiting and/or laxative misuse					
End of intervention	2	146	SMD −0.43 (−0.75 to −0.10)*	0	Low[a,c,d]
Follow-up	1	76	SMD −0.56 (−1.02 to −0.10)*	NA	Low[a,c,d]
Global eating disorder psychopathology					
End of intervention	3	220	SMD −0.54 (−1.28 to 0.20)	86	Very low[a,b,c,d]
Follow-up	1	76	SMD −0.94 (−1.42 to −0.47)*	NA	Low[b,d]
Weight concern					
End of intervention	2	151	SMD −0.37 (−1.36 to 0.63)	89	Very low[a,b,c,d]
Follow-up	1	76	SMD −0.57 (−1.03 to −0.12)*	NA	Low[b,d]
Shape concern					
End of intervention	2	150	SMD −0.67 (−1.67 to 0.33)	89	Very low[a,b,c,d]
Follow-up	1	76	SMD −1.02 (−1.50 to −0.54)*	NA	Low[b,d]
Dietary restraint					
End of intervention	2	151	SMD −0.46 (−1.28 to 0.35)	84	Very low[a,b,c,d]
Follow-up	1	76	SMD −0.64 (−1.10 to −0.17)*	NA	Low[b,d]
Remission from BN/EDNOS diagnosis					
End of intervention	2	150	RR 2.82 (0.54 to 14.85)	62	Low[b,d]
Cessation of binge eating, vomiting and/or laxative misuse					
End of intervention	3	218	RR 1.94 (1.07 to 3.52)*	0	Low[b,d]
CBT-based e-therapy for the treatment of bulimia nervosa versus bibliotherapy					
Binge eating					
End of intervention	1	122	SMD −0.03 (−0.39 to 0.33)	NA	Low[a,d]
Follow-up	1	122	SMD −0.13 (−0.49 to 0.23)	NA	Low[a,d]
Vomiting					
End of intervention	1	122	SMD 0.14 (−0.22 to 0.50)	NA	Low[a,d]
Follow-up	1	122	SMD −0.04 (−0.40 to 0.32)	NA	Low[a,d]
Laxative misuse					
End of intervention	1	122	SMD 0.16 (−0.20 to 0.52)	NA	Low[a,d]
Follow-up	1	122	SMD 0.18 (−0.18 to 0.54)	NA	Low[a,d]
Excessive exercise					
End of intervention	1	122	SMD 0.08 (−0.28 to 0.44)	NA	Low[a,d]
Follow-up	1	122	SMD −0.01 (−0.37 to 0.35)	NA	Low[a,d]
Global eating disorder psychopathology					
End of intervention	2	193	SMD −0.21 (−0.50 to 0.07)	0	Low[a,d]
Follow-up	2	193	SMD 0.01 (−0.27 to 0.30)	0	Low[a,d]
Dietary restraint					
End of intervention	1	122	SMD 0.12 (−0.24 to 0.48)	NA	Low[a,d]
Follow-up	1	122	SMD −0.27 (−0.63 to 0.09)	NA	Low[a,d]
Drive for thinness					
End of intervention	1	123	SMD −0.07 (−0.42 to 0.29)	NA	Low[a,d]
Follow-up	1	123	SMD 0.02 (−0.34 to 0.38)	NA	Low[a,d]
Bulimia					
End of intervention	1	123	SMD −0.14 (−0.50 to 0.22)	NA	Low[a,d]
Follow-up	1	123	SMD −0.12 (−0.48 to 0.23)	NA	Low[a,d]
Cessation of binge eating and other inappropriate weight control behaviours					
End of intervention	2	150	RR 1.60 (0.62 to 4.15)	54	Low[a,d]
Follow-up	2	146	RR 0.91 (0.47 to 1.75)	33	Low[a,d]
Remission from BN diagnosis					
End of intervention	1	80	RR 0.94 (0.47 to 1.87)	NA	Low[a,d]
Follow-up	1	76	RR 1.11 (0.64 to 1.95)	NA	Low[a,d]
CBT-based e-therapy for the treatment of binge eating disorder versus waitlist control					
Binge eating					
End of intervention	2	158	SMD −0.23 (−0.71 to 0.25)	40	Low[a,c,d]
Follow-up	1	74	SMD 0.04 (−0.41 to 0.50)	NA	Low[a,c,d]
Global eating disorder psychopathology					
End of intervention	1	74	SMD −0.38 (−0.84 to 0.08)	NA	Low[a,c,d]
Follow-up	1	74	SMD −0.30 (−0.76 to 0.16)	NA	Low[a,c,d]
Shape concern					
End of intervention	1	74	SMD −0.30 (−0.76 to 0.15)	NA	Low[a,c,d]
Follow-up	1	74	SMD −0.23 (−0.69 to 0.23)	NA	Low[a,c,d]
Dietary restraint					
End of intervention	1	74	SMD −0.07 (−0.53 to 0.38)	NA	Low[a,c,d]
Follow-up	1	74	SMD 0.08 (−0.37 to 0.54)	NA	Low[a,c,d]
Drive for thinness					
End of intervention	1	74	SMD −0.38 (−0.84 to 0.08)	NA	Low[a,c,d]
Follow-up	1	74	SMD −0.44 (−0.90 to 0.02)	NA	Low[a,c,d]

Table 3 (*continued*)

Outcome	*k*	*N*	Effect size (95% CI)	Heterogeneity (% I^2)	Confidence in effect estimates (GRADE)
Bulimia					
End of intervention	1	74	SMD −0.85 (−1.33 to −0.37)*	NA	Low[a,c,d]
Follow-up	1	74	SMD −0.32 (−0.78 to 0.14)	NA	Low[a,c,d]
Cessation of binge eating					
End of intervention	2	109	RR 4.58 (1.54 to 13.60)*	0	Low[a,c,d]
CBT-based e-therapy for the treatment of binge eating disorder versus face-to-face group CBT					
Binge eating					
End of intervention	1	44	SMD 0.41 (−0.19 to 1.01)	NA	Low[a,d]
Cessation of binge eating					
End of intervention	1	28	RR 0.87 (0.14 to 5.32)	NA	Low[a,d]
Follow-up	1	17	RR 1.13 (0.08 to 15.19)	NA	Low[a,d]

Note.
BN = bulimia nervosa; BED = binge eating disorder; EDNOS = eating disorder not otherwise specified; *k* = number of studies; *N* = number of participants; NA = not applicable; SMD = standardised mean difference; RR = risk ratio; CI = confidence interval.
*$p < 0.05$.
Reasons for downgrading, based on the GRADE approach:
[a] Risk of bias (one or more of the following: selection bias, performance bias, detection bias, attrition bias, selective outcome reporting bias).
[b] Inconsistency ($I^2 > 50\%$, $p < 0.05$).
[c] Indirectness (comparison: waitlist control).
[d] Imprecision (optimal information size for dichotomous outcomes = 300 events, and for continuous outcomes = 400 participants).

evidence was inconclusive for all outcomes and confidence in the effect estimates was moderate.

A further study examined an internet-delivered program ('ESS-KIMO') designed to enhance motivation to change in people with an eating disorder through the use of motivational interviewing techniques (Hötzel et al., 2014). At the end of the intervention, when compared with a waitlist control condition, ESS-KIMO was associated with small improvements in shape concern, dietary restraint and vomiting. The evidence was inconclusive for weight concern. Confidence in the effect estimates was low for all outcomes.

Finally, two studies compared a version of Student Bodies (SB2-BED) designed for adolescents at risk of developing binge eating disorder with a waitlist control (Doyle et al., 2008; Jones et al., 2008). At the end of the intervention and at follow-up, the evidence was inconclusive for all outcomes except binge eating where there was a small effect in favour of the waitlist condition at follow-up (Jones et al., 2008). Confidence in the effect estimates was low for all outcomes.

Treatment studies

Four of the 20 studies investigated the efficacy of CBT-based e-therapy in the treatment of adults with bulimia nervosa (Ruwaard et al., 2013; Sánchez-Ortiz et al., 2011; Schmidt et al., 2008; Wagner et al., 2013). At the end of the intervention, when compared with a waitlist control condition, CBT-based e-therapy was associated with small improvements in binge eating, vomiting and/or laxative misuse, and improved rates of cessation of binge eating, vomiting and/or laxative misuse (24% of participants in the intervention

Table 4
Summary of findings and confidence in effect estimates for the relapse prevention studies.

Outcome	*k*	*N*	Effect size (95% CI)	Heterogeneity (% I^2)	Confidence in effect estimates (GRADE)
CBT-based e-intervention for relapse prevention in anorexia nervosa versus treatment-as-usual					
Inappropriate weight control behaviour (vomiting, laxative misuse and restrictive eating)					
End of intervention	1	239	SMD −0.19 (−0.44 to 0.07)	NA	Moderate[b]
Follow-up	1	208	SMD −0.30 (−0.58 to −0.03)*	NA	Moderate[b]
Global eating disorder psychopathology (clinician-rated)					
End of intervention	1	239	SMD −0.21 (−0.47 to 0.04)	NA	Moderate[b]
Bulimia (clinician-rated)					
End of intervention	1	239	SMD −0.26 (−0.51 to 0.00)*	NA	Moderate[b]
Follow-up	1	208	SMD −0.21 (−0.48 to 0.07)	NA	Moderate[b]
Global eating disorder psychopathology (self-rated)					
End of intervention	1	219	SMD −0.27 (−0.53 to 0.00)*	NA	Low[a,b]
Follow-up	1	190	SMD −0.23 (−0.52 to 0.06)	NA	Low[a,b]
Bulimia (self-rated)					
End of intervention	1	219	SMD −0.15 (−0.42 to 0.11)	NA	Low[a,b]
Follow-up	1	190	SMD −0.27 (−0.56 to 0.02)	NA	Low[a,b]
Drive for thinness					
End of intervention	1	219	SMD −0.17 (−0.44 to 0.09)	NA	Low[a,b]
Follow-up	1	190	SMD −0.18 (−0.46 to 0.11)	NA	Low[a,b]

Note.
k = number of studies; *N* = number of participants; NA = not applicable; SMD = standardised mean difference; RR = risk ratio; CI = confidence interval.
*$p < 0.05$.
Reasons for downgrading, based on the GRADE approach:
[a] Risk of bias (one or more of the following: selection bias, performance bias, detection bias, attrition bias, selective outcome reporting bias).
[b] Imprecision (optimal information size for dichotomous outcomes = 300 events, and for continuous outcomes = 400 participants).

group versus 13% in the control group). Confidence in the effect estimates was low. For the remaining outcomes, the evidence was inconclusive at the end of the intervention, and for some outcomes the confidence in the effect estimates was very low due to substantial inconsistency in the meta-analyses as well as other factors. Only one trial included a follow-up assessment (Sánchez-Ortiz et al., 2011), and it found medium to large effects in favour of CBT-based e-therapy on several outcomes including, binge eating, vomiting and/or laxative misuse, global eating disorder psychopathology, weight concern, shape concern and dietary restraint, although confidence in the effect estimates was low.

Two studies compared CBT-based e-therapy with bibliotherapy in the treatment of bulimia nervosa (Ruwaard et al., 2013; Wagner et al., 2013). The evidence was inconclusive for all outcomes and there was low confidence in the effect estimates.

Two studies compared CBT-based e-therapy with a waitlist control condition in the treatment of adults with binge eating disorder (Carrard et al., 2011; Shapiro et al., 2007). CBT-based e-therapy was associated with large improvements in cessation of binge eating at the end of the intervention. One study found large improvements in a measure of bulimic features at the end of the intervention, although this was inconclusive at follow-up (Carrard et al., 2011). There were no conclusive results for any of the other outcomes and confidence in the effect estimates was low.

Finally, one other study compared CBT-based e-therapy with face-to-face group-based CBT (Shapiro et al., 2007). The evidence for all outcomes was inconclusive and confidence in the effect estimates was low.

Relapse prevention studies

A single study, published in two papers, investigated an online CBT-based relapse prevention program, compared with treatment-as-usual, for women with anorexia nervosa or subthreshold anorexia nervosa who had been recently discharged from hospital (Fichter, Quadflieg, & Lindner, 2013; Fichter et al., 2012). The program was associated with small improvements in clinician-rated bulimia, and self- and clinician-rated global eating disorder psychopathology at the end of the intervention, although for clinician-rated global eating disorder psychopathology, the estimate was imprecise. Small improvements were also observed on the frequency of inappropriate weight control behaviour and self-rated bulimia at follow-up, although the estimate for self-rated bulimia was imprecise. The evidence was inconclusive for the remaining outcomes. Confidence in the effect estimates was low to moderate.

Discussion

In this study we applied the methods and standards used by NICE to the research on e-therapy, focusing on interventions designed to prevent or treat eating disorders. This has not been done before. There were four main findings. First, the evidence base is small. The literature search identified just 20 studies, none of which were of mobile-device apps. Second, no firm conclusions can be drawn from the treatment studies. Few effects emerged and there was low confidence in the effect estimates. Third, somewhat more positive findings emerged from the prevention studies, predominantly from the studies involving the 'Student Bodies' program. There was a small reduction in the level of eating disorder psychopathology, and in the levels of weight concern and drive for thinness, with there being moderate confidence in the effect estimates. Lastly, an online relapse prevention program was associated with some positive effects, but these came from only one study.

Our findings and conclusions are at variance with those from the two prior systematic reviews. Aardoom et al. (2013) concluded that "the internet is a promising vehicle for delivering eating disorder treatment" (p. 551) and Dölemeyer et al. (2013) stated that "internet-based interventions based upon CBT principles can be assumed to be a good alternative to face-to-face therapies for the treatment of eating disorders" (p. 15). We cannot agree. We have found that if the standards applied to the research on other treatments are applied to e-therapy, then it is impossible to describe the finding as "promising" and there is certainly no basis for saying that e-therapy is a good alternative to face-to-face treatment. Instead, we conclude that the value of e-therapy for bulimia nervosa and binge eating disorder is at present uncertain, and nothing is known about its effect as a treatment for anorexia nervosa. This being the case, it would be inappropriate at present to encourage this application of e-therapy. In contrast, the online preventive program 'Student Bodies' is associated with a reduction in the level of eating disorder psychopathology, albeit a modest one. The importance of this finding is unclear, however, as it is not known whether a change of this type and magnitude has a meaningful impact on the risk of subsequently developing an eating disorder (Stice, Becker, & Yokum, 2013). This needs to be established before the program can be recommended.

As e-therapy is here to stay, and this mode of treatment delivery has many advantages over face-to-face therapy (Fairburn & Patel, 2014), it needs more research attention. In our view, the current e-therapy treatment programs need re-thinking as at present they are basic in form and content. They make little use of two of the major strengths of the Internet, the ability to personalise interventions and make them interactive. Indeed, the existing interventions differ little from written self-help programmes. Their content also needs attention. At present it is largely focused on binge eating, like the early cognitive behavioural treatments for bulimia nervosa (e.g., Fairburn, 1981), whereas most contemporary treatments for eating disorders address additional features with the goal of achieving lasting change (Fairburn, 2008). Research on e-therapy interventions also needs to be improved. Aardoom et al. (2013) and Bauer and Moessner (2013) have made many important suggestions. We would also like to highlight the need for direct-to-user studies as herein lies the greatest potential strength of e-therapy, its ability to directly reach those who would benefit from it (Fairburn & Patel, 2014).

Finally, the complete absence of trials evaluating mobile-device apps demands comment. The fact that there is no evidence to support their use needs to be brought to the attention of clinicians and users as some eating disorder apps promote the idea that they aid recovery. This would not be allowed if they were forms of medication yet, like medication, they have the potential to do harm. For example, people with eating disorders (and those around them) may think that by using an app they are addressing their eating disorder whereas in reality they may be simply delaying their entry into an empirically-supported form of treatment. Apps, as with other forms of e-therapy, may have a place in the eating disorder armamentarium, but this needs to be demonstrated empirically.

Conflict of interest declaration

The Authors declare that there are no known conflicts of interest.

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Appendix A. Supplementary data

Supplementary data related to this article can be found at http://dx.doi.org/10.1016/j.brat.2014.09.011.

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