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Review

Internet-assisted delivery of cognitive behavioural therapy (CBT) for childhood anxiety: Systematic review and meta-analysis

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ABSTRACT

Aim: To conduct a systematic review and meta-analysis of the literature to assess efficacy of internet-delivered cognitive behavioural therapy (CBT) for child anxiety disorder.
Method: A systematic search of 7 electronic databases was conducted to assess CBT intervention for children with anxiety problems with remote delivery either entirely or partly via technology. Six articles reporting 7 studies were included.
Results: The findings together suggested that CBT programmes involving computerised elements were well received by children and their families, and its efficacy was almost as favourable as clinic-based CBT. The mixture of children and adolescents included the studies, diverse range of programmes, and lack of consistency between study designs made it difficult to identify key elements of these programmes or draw conclusions on the treatment efficacy.
Conclusions: Analysis supports online delivery for wider access of this evidence-based therapy. Areas in need of improvement for this new method are indicated.

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Contents

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1. Introduction

Over the last decade, there has been accumulating evidence that cognitive behavioural therapy (CBT) provides effective treatment for children with depression and anxiety. Indeed, both group and individual sessions have been shown to offer sustained benefit for children and youth with such problems (Cartwright-Hatton, Roberts, Chitsabesan, Fothergill, & Harrington, 2004). Anxiety disorders are the most common psychological problem of childhood, with life-time prevalence of approximately 20% (Cartwright-Hatton, McNicol, & Doubleday, 2006). Its negative impact on academic performance, as well as social and emotional development in childhood, and morbidity with other forms of psychopathology (Achenbach, Howell, McConaught, & Stranger, 1995), has been well documented, including a poor prognosis into adulthood (Kendall, Safford, Flannery-Schroeder, & Webb, 2004). Despite the need highlighted above, it has been suggested that as high as 80% of children with anxiety disorders do not receive treatment (Essau, Conradt, & Petermann, 2002).

A number of factors contribute to this difficulty under the UK's National Health Services and health care systems elsewhere, including Australia and USA. At the root of these barriers seems to be the availability of qualified therapists (Weisz, Hawley, & Jensen-Doss, 2004), and issues that stem from this, including time and cost demands for the families or their lack of knowledge leading to failure to identify a problem in need of treatment (March, Spence, & Donovan, 2009).

CBT has been suggested to be suitable for remote administration for its highly structured content (Anderson, Jacobs, & Rothbaum, 2004). Together with the use of recent development in technology (e.g., palm-held devices, DVDs, CD-ROMS, interactive communication systems), research has shown success in delivering CBT in such a manner in adult populations (for reviews see Griffiths & Christensen, 2011; Katlenthaler, Parry, & Beverley, 2004). A recent review found that a range of programmes with differing levels of clinician input are effective and generally with high adherence rates (Christensen, Batterham, & Calear, 2013). Currently available means to receive CBT includes bibliotherapy (self-help books with or without therapist contact) or programmes using internet and computer. While computer-assisted programmes combine face-to-face clinic sessions with remotely administered online sessions, online CBT programmes are stand-alone with only remote contact with clinicians or educated but non-specialist 'coaches.'

Thus the evidence would suggest that places such as Scotland with rural and remote areas should consider promoting the use of online or computer-assisted CBT, and NHS-approved computer-based CBT programmes. A recent Scottish report found however, that despite the availability of necessary computer software, there was lack of dedicated patient computers. In addition, there was limited flexibility in offering a personally tailored communication method for patients (Kenicer, McClay, & Williams, 2012). The challenge appears to be one of policy, and extra resources, to deliver this proven mode of treatment.

The literature on online interventions and e-health also illustrates that online treatments include features that are perceived as both having advantages and disadvantages by their users. For example, while anonymity and convenience are welcomed by some users (Christensen et al., 2013), these are disliked as impersonal or perceived as work-like rather than therapeutic, leading to low motivation in others (Schneider, Foroushani, Grime, & Thornicroft, 2014). More discrete barriers have been suggested as visual impairment, poor IT provision, low educational levels (Waller & Gilbody, 2009), as well as patient level of hopelessness (MacLeod, Martinez, & Williams, 2009). The literature also seems to agree that guidance and support, whether the intervention is provided remotely or in person, is essential for the successful outcome (Gellatly et al., 2007). As well, a recent study reports that female and healthy adults were more likely to insist on the standards of online security and privacy of e-health in the home environment (Wilkowska & Ziefle, 2012), suggesting that there may be different levels of understanding and confidence in the domain amongst us, including those at whom intervention programmes are aimed. It seems that patient characteristics and symptom profiles require extra care in identifying suitable patients for this method of treatment.

Research on whether such methods may be effective for childhood anxiety, lags behind that for adult populations. It is possible that online treatment offers a unique advantage over clinic-based programmes. If successful, online CBT treatment addresses the barriers of CBT provision outlined earlier. It may also provide a relief for social stigma to which children and their families may be susceptible. According to a recent report, European children aged 9–16 spend on average 88 min per day online (Livingstone, Haddon, Görzig, & Ólafsson, 2011) and that the use of internet and computers are "thoroughly embedded in children's lives" (p 2, Livingstone et al., 2011). A treatment delivered online may therefore be accepted readily by children for their interests and skills in computing. In addition, an effective, evidence-based therapy delivered online will have the potential to save in therapist cost and time.

A recent systematic review on computer-assisted CBT for child and adolescent anxiety found that all the 10 studies reviewed reported reductions in anxiety and were generally well received by the participants (Richardson, Stallard, & Velleman, 2010). The aim of this review is to examine the evidence on the effectiveness of both online and computer-assisted CBT programmes for *child* anxiety disorder. Different treatment programmes are available for children and adolescents to accommodate the significant changes in social and cognitive development across childhood and adolescence (e.g., see Kendall, Khanna, Edson, Cummings, & Harris, 2011). Therefore there is a need to conduct a review focusing on pre-adolescent children. The aim was to present the latest range of all programmes involving computer (i.e., online and computer-assisted) designed for anxious children up to the age of 12.

2. Methods

2.1. Data sources and search strategy

The search was limited to publications in English, which investigated the efficacy of on-line or computer-assisted CBT programmes for anxiety-disordered children. Systematic searches of the following electronic databases were conducted: MEDLINE and CINAHL Plus via EBSCO (1950 – 7th August 2013), Cochrane Central Register of Controlled Trials (CENTRAL), Pubmed (2003 – 7th August

2013), SCOPUS (1960 – 7th August 2013), Web of knowledge (1970 – 7th August 2013) and PsychInfo (2004 – 10th December 2013). Relevant MeSH terms were searched for MEDLINE and are available upon request.

To construct the search strategy, key words were entered in the order of importance for our research questions. Thus, we first entered the key word "anxiety" and this was followed by "cognitive therapy", "internet", "online", "computer", "remote consultation", "bioliotherapy" and "child". The last keyword was entered with an asterisk to allow any articles with words containing "child" (e.g., children) to be extracted. While bibliotherapy differs from online delivery of CBT, we entered this term to ensure we captured any such studies with some online components. The keyword "remote consultation" was found to be one of relevant MeSH terms in our preliminary search and thus was used in our search strategy. After entering these terms separately, we then expanded our search by combining these keywords with "OR". First, "internet" or "online" or "computer" to search for any articles containing studies with technology elements. Second, "remote consultation" or "bibliotherapy" were entered to yield interventions which contained remote administration. We then narrowed the results down by combining searches (with "AND") as follows. The keyword "cognitive therapy" was combined with the results of "remote consultation" or "bibliotherapy" to capture articles containing CBT which was delivered online. The outcome was then combined with the results of "internet" or "online" or "computer" to ensure its involvement of relevant delivery mode. The result, at this stage, was then combined with the first keyword "anxiety" to relate the search to the disorder of our interest. Finally this result was combined with "child*" to ensure the articles yielded concerned children.

2.2. Study selection

The search outlined above returned 696 publications. After removal of 145 duplicates, abstracts and titles of the remaining 551 records were screened for eligibility by the authors. The screening process here identified 38 articles which met the inclusion criteria. The full text versions of these 38 publications were then retrieved and their reference lists screened for further relevant publications. Reference lists were checked and background sections identified another 9 relevant articles. Thus a total of 47 publications were found to meet the inclusion criteria.

These 47 publications were then examined to assess whether or not they reported the outcomes of empirical studies addressing the effectiveness of online or computer-assisted CBT programmes for childhood anxiety. The screening at this stage resulted in exclusion of 41 articles using the same inclusion criteria. Thus, the search produced 6 papers reporting 7 studies suitable to review (Fig. 1). The six papers were: Attwood, Meadows, Stallard, and Richardson (2012), Khanna and Kendall (2010), March et al. (2009), Spence, Holmes, March, and Lipp (2006), Spence et al. (2008), and Stallard, Richardson, Velleman, and Attwood (2011), which reported two eligible studies.

2.3. Quality assessment

Many different tools have been developed and used in health research for evaluating quality of studies. The Effective Public Health Practice Project (EPHPP) tool (http://www.ephpp.ca/tools.html) has been developed to assess quality of quantitative studies in public health research. The strength of the tool is its capacity to allow comparison across a wide range of study designs within public health research, making it particularly suited for the current review with diverse studies. We selected this tool over alternatives such as The Newcastle-Ottawa Scale (NOS) (Wells et al., 2013) or Cochrane Collaboration Risk of Bias Tool (CCRBT) which is more suitable for case-control or cohort studies, or more suitable for RCTs respectively. We also followed the findings from a recent study reporting the tool having a fairer inter-rater agreement than the CCRBT (Armijo-Olivo et al., 2013).

The EPHPP consists of the following components: (i) selection bias, (ii) study design, (iii) confounders, (iv) blinding, (v) data collection methods, (vi) withdrawals and drop-outs, (vii) intervention integrity (information on the proportion of participants that received the allocated intervention), and (viii) analyses. The first six components are used to arrive at a global rating for the paper. For both individual and global components, ratings are given as (1) strong, (2) moderate or (3) weak.

The first author was the primary rater for the EPHPP, whose rating was checked by the fifth author (RF). The inter-rater agreement was 100% for global ratings, with 3 slight disagreements at the component levels. These were resolved by discussion and all the 3 differences were due to oversight by the first author.

2.4. Data synthesis

All studies, with sufficient aggregated raw data were included for meta-analysis. Specifically the studies with means, standard deviations for the intervention and control groups at the pre- and immediate post-test were included. The Attwood et al. (2012) (study 2) was also entered into the meta-analysis. It contained limited details of the participants' response to the intervention, as there was no comparison group. All possible outcomes were included. As a result, the 5 studies included in this part of analysis were: Khanna and Kendall (2010), March et al. (2009), Spence et al. (2006), and the two studies in Attwood et al. (2012).

3. Results

3.1. Study pool characteristics

The selected 6 papers reporting 7 studies were published between 2006 and 2012 with a median publication date of 2009 (Table 1). Using EPHPP, four studies were indicated as randomised controlled trials (Khanna & Kendall, 2010; March et al., 2009; Spence et al., 2006; Stallard et al., 2011), one confirmed a case study (Spence et al., 2008), one controlled clinical trial (Attwood et al., 2012, study 1) and one cohort study (Attwood et al., 2012, study 2). The studies were conducted in Australia ($n = 3$), USA ($n = 1$) and UK ($n = 3$).

Two studies (Attwood et al., 2012, study 1; Stallard et al., 2011) did not report randomisation method. No randomisation was applicable in another study (Attwood et al., 2012, study 2) as the intervention was assigned to all participants. Two studies used a computer programme to randomise allocation of assessed and eligible participants (Khanna & Kendall, 2010; March et al., 2009). One study deployed block randomisation using tossing of a coin (Spence et al., 2006). The remaining study (Spence et al., 2008) was a single-case study thus no such opportunity. The studies conducted in Australia deployed the programme "BRAVE-ONLINE" (March et al., 2009; Spence et al., 2006, 2008), one in USA "CAMP COPE-A-LOT" (Khanna & Kendall, 2010), and "Think Feel, DO" (Attwood et al., 2012; Stallard et al., 2011) in the UK. The total number of participants was 240, with each study including a reasonably matched number of children in each condition (i.e., control, computer-based CBT or control) where applicable.

3.2. Population characteristics

The age of children included across studies ranged from 7 to 16. While this exceeded our study selection criteria, these studies

Table 1
Overview of online CBT programmes.

References	Treatment type (online or computer-assisted), features	Child	Parent	Additional contact	Therapist, role and training
Spence et al. (2006)	Computer-assisted programme	10 weekly 60-min sessions	6 weekly 60-min sessions	60-min group computer tutorial a week before commencing intervention for the on-line CBT group.	"Online therapist"
	BRAVE programme	5 sessions on-line, 5 in the clinic	3 sessions on-line, 3 in the clinic	Homework was given at each session and were either emailed or reviewed at a clinic appointment.	Introductory and midway phone calls (30 min each).
	Based on theoretical and empirical research on child anxiety.	The 3-months booster delivered on-line.	The 3-months booster delivered on-line.		Check homework
	Interesting and interactive.	Recognition of the physiological symptoms of anxiety			
	Self-assessment quizzes and interactive feedback provision.	Relaxation strategies, problem solving, self-reinforcement, application of anxiety management techniques			
Spence et al. (2008), March et al. (2009)	Online programme	10 weekly 60-min sessions, with 1 and 3 months booster sessions post-intervention.	Psycho-education about child anxiety	During intervention, automated emails for reminder and acknowledgement of completed sessions.	"BRAVE trainer" to minimise concerns over stigma and acceptability of the programme.
	BRAVE-ONLINE	Each session begins with a recap and quiz, and ends with a summary and quiz	Contingency management	Email feedback for weekly homework.	The same phone calls as Spence et al. (2006).
	BRAVE for Children-ONLINE, developed from BRAVE programme (Spence et al., 2006)	Automated feedback given	Relaxation training		Monitors responses and provides written feedback by email.
	Interactive recap and quiz at the start of each session	Homework given at the end of each session, to be reported at subsequent session	Information about cognitive restructuring		
			Graded exposure		
			Problem solving		
			Aimed at empowering parents to help their children		
Stallard et al. (2011)	Computer-assisted programme	6 weekly 45-min sessions	Not involved in intervention	None described	"Facilitator"
Attwood et al. (2012), Studies 1 and 2	Think, Feel, Do	Brief assignment at the end of each session			Teacher, nurse or assistant psychologist. Minimum CBT expertise and training required. Session conducted with the facilitator. Facilitator involved throughout the programme.
	Based on CBT principles, designed for anxiety, interactive	Responses saved to review later.			
	Developed through focus groups with young people				
Khanna and Kendall (2010)	Computer-assisted programme	12 weekly 35-min sessions	Two parent sessions	None described	"Coach"
	Camp COPE A LOT	The first six sessions to complete independently and are for skill building.			Mixed backgrounds, level of experience with CBT.
	Based on a clinic-based and empirically supported Coping Cat programme also developed by the authors.	The latter six sessions are completed with coach and consist of exposure tasks and rehearsal in a specific anxiety-arousing situations tailored for the child.			Assist in the second half of the programme with exposure tasks and rehearsal in chosen situations.
	Aims at experiential learning via interactive learning environment.				One-day workshop on the implementation of the allocated condition group. Weekly conference call with experienced clinical psychologists.
	Includes features that can be individualised.				

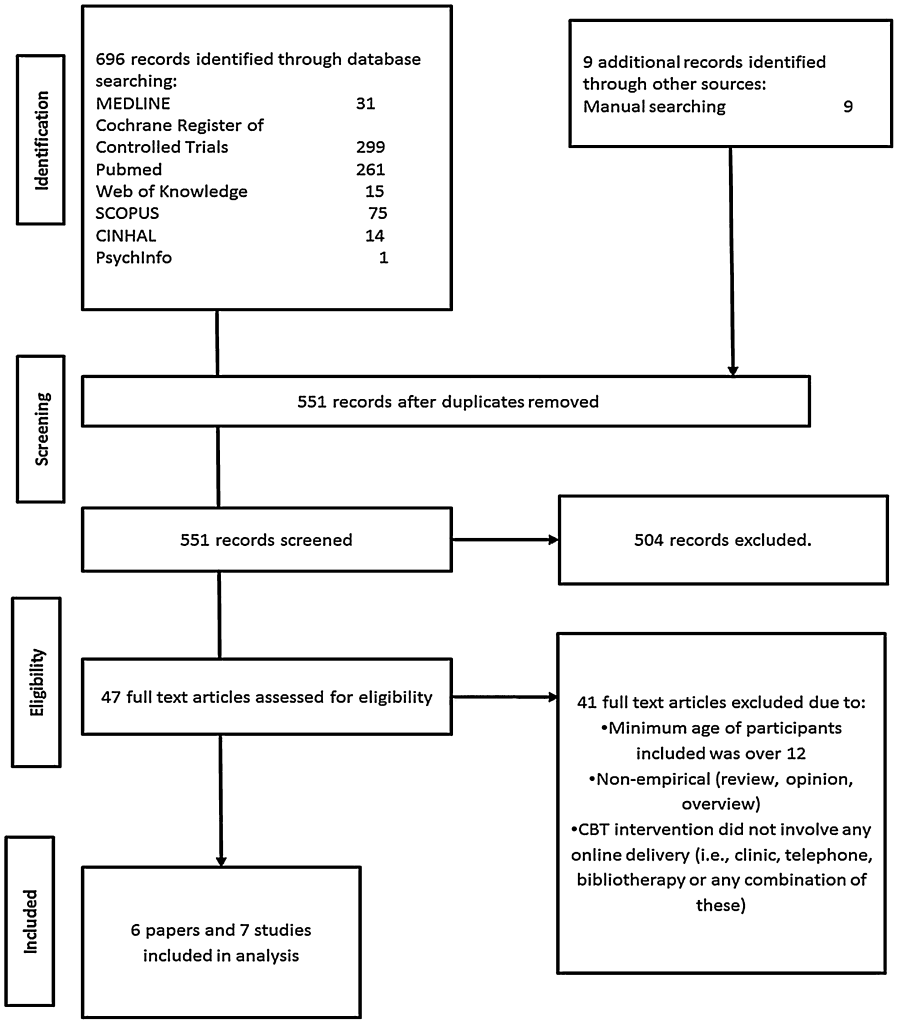

Fig. 1. PRISMA flow diagram of the literature reviewing process.

were included because of an overlap with the eligible age range. Two studies included boys only (Attwood et al., 2012, study 1), one of which was a single case study (Spence et al., 2008). One study did not report gender in their report (Khanna & Kendall, 2010). Both boys and girls participated in the remaining 4 studies.

Standardised diagnostic tools were used for the studies deploying BRAVE-ONLINE and CAMP COPE-A-LOT (i.e., Khanna & Kendall, 2010; March et al., 2009; Spence et al., 2006, 2008). These studies used the Child and Parent Interview of the Anxiety Disorders Interview Schedule for Children (ADIS-C & ADIS-P; Silverman & Albano, 1996). Both versions (child and parent) were used by March et al. (2009) and Spence et al. (2008); the parent version by Spence et al. (2006), and Khanna and Kendall (2010). The children in these studies had met criteria in the *Diagnostic and Statistical Manual of Mental Disorders* (4th ed.; DSM-IV) for principal anxiety problems. The remaining 3 UK studies (Studies 1 and 2 in Attwood et al., 2012; Stallard et al., 2011) either included children referred to Child and Adolescent Mental Health Services (CAMHS) provided by UK's National Health Services (NHS) (Stallard et al., 2011) or by nurses and teachers based on their knowledge of children with emotional problems (Attwood et al., 2012).

Of the 7 studies reviewed, 4 studies explained inclusion as well as exclusion criteria (Khanna & Kendall, 2010; March et al., 2009; Spence et al., 2006; Stallard et al., 2011). They systematically recruited children whose anxiety level was at least moderate, or at risk, with no other major mental health issues or other intellectual or developmental disorders, and within the age range of the study. Children whose English was not fluent, or those that were currently receiving pharmacological or behavioural treatment for their anxiety or depression were excluded.

Three (Attwood et al., 2012 studies 1 and 2; Stallard et al., 2011) out of seven studies reviewed did not offer any information on socio-demographic profile of their participants. One study only reported the racial profile of their child participants which was mostly Caucasian (Khanna & Kendall, 2010). Another study reported 3.58 out of 7 points on the Daniel Prestige Scale suggesting their sample mostly consisted of mid-income families (Spence et al., 2006), while another study reported their participants were from highly educated and mid-to-high income families (March et al., 2009). The remaining study was a single case study of a child living with his biological mother (Spence et al., 2008).

3.3. Intervention characteristics

The included 7 studies had between them deployed one online (i.e., stand-alone), BRAVE-ONLINE and three computer-assisted CBT programmes, BRAVE, CAMP COPE-A-LOT and "Think, Feel, Do". BRAVE-ONLINE and CAMP COPE-A-LOT were both described as evidence-based, and were developed from the authors' own clinic-based programmes. "Think, Feel, Do" was developed through focus groups and young people contributed to its development and production. While BRAVE-ONLINE was completed entirely via the

Internet, CAMP COPE-A-LOT and BRAVE each delivered half the programme content via online. Both programmes included sessions with parents, in order to assist and to guide them to help their children during the course of their intervention programmes. "Think, Feel, Do" was completed at child's school without family involvement. All involved an educated but non-specialist individual to assist children and families. All aimed at helping children with anxiety problems, thereby reducing their anxiety levels.

Baseline assessment was conducted using standardised measures by all studies, although a range of measures was selected and deployed between them: the Child Behaviour Checklist Internalising Scale (CBCL-Int: Achenbach, 1991), the Spence Children's Anxiety Scale Child and Parent version (SCAS-C/P, Spence, 1998, 1999), the Centre for Epidemiological Studies for Depression Scale (CES-D, Radloff, 1991), and Children's Global Assessment Scale (CGAS, Schaffer et al., 1982) by March et al. (2009); SCAS-C/P, CBCL, the Children's Depression Inventory (CDI, Kovacs, 1981), and Revised Children's Manifest Anxiety Scale (RCMAS, Reynolds & Richmond, 1985) by Spence et al. (2006); the CDI, CGAS, Multidimensional Anxiety Scale for Children (MASC, March, Parker, Sullivan, Stallings, & Conners, 1997) and Client Evaluation of Services (CSQ-8, Larsen, Attkisson, Hargreaves, & Nguyen, 1979), as well as two additional measures developed by the authors for therapeutic alliance and computer experience in Khanna and Kendall (2010); the SCAS-C/P and the Strengths and Difficulties Questionnaire Parent Version (SDQ-P, Goodman, 1997) in Study 1 of Attwood et al. (2012); the SCAS-C/P, the Schema Questionnaire for Children (SQC, Stallard & Rayner, 2005), Adolescent Well-Being Scale (AWS, Birleson, 1980),[1] the Rosenberg Self Esteem Inventory (RSEI, Rosenberg, 1965) and the authors' own measure of satisfaction of allocated condition for participants in Study 2 of Attwood et al. (2012); SCAS-C, AWS, RSEI,SQC, and the authors' own feedback questionnaire in Stallard et al. (2011); and CGAS, SCAS-C/P, CBCL, and the Working Alliance Inventory-Short Form for Parent and Children (WAI-SC/P, Tracey & Kokotovic, 1989), and author-developed questionnaire on efficacy, expectation and satisfaction in Spence et al. (2008). All the studies conducted telephone or face-to-face interviews with a trained psychologist. One of the prominent aims of these telephone calls was to provide assistance with the development of exposure tasks.

3.4. Intervention outcomes

The results of all included studies are summarised in Table 2. Khanna and Kendall (2010) and Spence et al. (2006) reported that their computer-based groups improved similarly if not better (Khanna & Kendall, 2010) than the clinic groups. Within each study, similar numbers of their participants were found to be free of diagnosis at post-intervention irrespective of whether they received treatment online or in clinic (range: 56–81% across studies). The rate was lower in March et al. (2009) where this was 30% post-intervention and was only marginally away from their wait-list control ($p = .06$). The remaining studies with smaller sample sizes (Stallard et al., 2011; two studies in Attwood et al., 2012) did not use diagnostic measure and reported somewhat more modest level of improvement in their measures.

3.5. Sustained outcomes

Three (Khanna & Kendall, 2010; Spence et al., 2006; March et al., 2009) out of 7 studies reviewed included follow-up assessment at post-intervention. Khanna and Kendall (2010) included a follow-up assessment at 3 months and reported continuing improvement in children's anxiety levels. March et al. (2009) showed that their modest improvement post-intervention was enhanced during their 6-month delay interval, thus time had a significant effect on their treatment efficacy. All other studies reported statistically significant improvements.

The remaining study (Spence et al., 2006) conducted two follow-ups, one at 6 months and other at 12 months and found that the effect of their intervention was maintained across time. All the three studies reported that the treatment efficacy was similar between online and clinic programmes.

3.6. Participant satisfaction and compliance

The studies included different measures of participant satisfaction and acceptance of their programmes. All studies reported that their treatments were rated high for satisfaction except one study (Stallard et al., 2011), which reported this to be moderate to high. Four (Khanna & Kendall, 2010; March et al., 2009; Spence et al., 2006, 2008) out of the 7 studies reported compliance. Three studies reported high compliance. One study reported that their compliance rate required improvement, with only 60% and 33.3% of parents and children respectively had completed their programme at the end of treatment, however this improved to be 72% and 62% at 6-months follow up (March et al., 2009). At both time points (at completion and follow up), average completion rate was high for both parents and children (5/6 and 7/10 for parents and children respectively). Another study (Spence et al., 2006) reported high percentage viewings of their session pages during the whole of their intervention.

3.7. Time requirement

The number of sessions across intervention programmes ranged from 6 to 12, and guide duration per session from 35 to 60 min (median 47.5 min). Time requirement per study is given in Table 1. Total guide time for completing intervention ranged from 270 min to 600 min.

3.8. Risk of bias within studies

The studies reviewed varied in strength in the components as well as the global rating as assessed with the EPHPP tool. None of the studies reviewed clarified whether the participants were aware of their research questions, thus blinding may not have been present. However, this was compensated in some of the studies by blinding researchers (Attwood et al., 2012, study 2, Khanna & Kendall, 2010).

The evaluation of withdrawals and drop-outs was restricted to the end of the intervention programmes for each study, as some of the studies did not include follow-up assessment. Attrition rate was minimum across studies. One was rated weak for no record of attrition (Attwood et al., 2012, study 1) and another was rated moderate for 25% attrition (Stallard et al., 2011) compared to below 20% in the rest of the studies. Of the three studies which conducted follow up assessment, two of them also conducted intent-to-treat analysis to help control the loss to follow up (March et al., 2009; Spence et al., 2006). There were 11 losses to follow up across the three studies which included follow up assessment. The total N across studies after screening was 157.

Only two studies were rated weak on the degree of confounding. There was evidence of confounding due to (a) being a case study (Spence et al., 2008); (b) not reporting pre-intervention scores on measures but instead only reporting on improvement within groups (Stallard et al., 2011).

In terms of global rating of quality, one study was rated strong overall (Spence et al., 2006), three moderate (Attwood et al., 2012,

[1] We report the use of the measure here despite its name, as it was administered to children and adolescents aged between 11 and 16 years, hence an overlap with the age range of our interest, 7 to 12.

Table 2
Overview of mean/total scores and standard deviations on standardised measurement deployed across all studies. Measures used in only one study are not included. The studies with raw values are entered into data synthesis.

Measure	Pre treatment		Post treatment		Follow up at 6 months
	NET	WL	NET	WL	NET
ADIS					
M (Spence et al., 2006)	5.81	5.96	2.40[a]	5.00	2.43
SD	0.96	1.07	2.20	2.20	2.21
M (March et al., 2009)	6.07	5.83	4.30[a]	5.14	2.32[b]
SD	0.58	0.60	1.58	1.43	1.78
Clinician Severity Rating (CSR)					
M (Khanna & Kendall, 2010)	5.7	5.2[c]	2.90[a]	4.2[c]	2.4[b,d]
SD	0.87	1.20	1.0	1.30	1.0
CSR rating (Spence et al., 2008)	17		9		0
SCAS-C					
M (Spence et al., 2006)	41.30	31.04	27.25[a]	25.83	27.55
SD	21.22	13.35	16.82	14.02	19.93
M (March et al., 2009)	40.00	38.56	27.36	29.72	20.77[b]
SD	15.11	17.31	12.57	14.20	9.81
Significant *t* scores (Stallard et al., 2011)[e]	Not reported	Not included	$t(8) = 2.08$, $p < .05$ (social phobia)	$t(8) = 2.83$, $p < .05$ (physical injury)	Not conducted
M (Attwood et al., 2012, study 1)	29.0	18.4[c]	21.3[a]	14.29[c]	Not conducted
SD	18.5	11.5	3.5	12.2	NA
M (Attwood et al., 2012, study 2)	33.9	NA	30.6	NA	NA
SD	11.3	NA	14.3	NA	NA
Total score (Spence et al., 2008)	20	NA	21	NA	25
CDI					
Mean *T* score (Spence et al., 2006)	55.07	53.48	46.96	50.00	46.53
SD	12.79	8.55	10.52	7.93	8.95
Mean total score (Khanna & Kendall, 2010)	27.2	23.2[c]	21.30[a]	21.8[c]	19.4[d]
SD	4.4	7.6	10.7	9.2	8.7
AWS					
Significant *t* scores (Stallard et al., 2011)[e]	Not reported	Not included	$t(5) = 2.49$, $p < .05$	Non significant[e]	Not conducted
M (Attwood et al., 2012, study 2)	11.2	NA	7.4[a]	NA	NA
SD	4.5	NA	5.3	NA	NA
RSEI					
Significant *t* scores (Stallard et al., 2011)[e]	Not included	Not included	$t(8) = -2.17$, $p < .05$	$t(8) = -2.16$, $p < .05$	Not conducted
M (Attwood et al., 2012, study 2)	18.4	NA	20.1[a]	NA	NA
SD	3.5	NA	3.4	NA	NA
SQC					
Significant *t* scores (Stallard et al., 2011)[e]	Not reported	Not included	$t(8) = 2.89$, $p < .05$	$t(8) = 2.30$, $p < .05$[e]	Not conducted
M (Attwood et al., 2012, study 2)	65.8	NA	51.9[a]	NA	NA
SD	12.1	NA	9.4	NA	NA
SDQ					
Significant *t* scores (Stallard et al., 2011)[e]	Not reported	Not included	$t(5) = 2.08$ (emotional); $t(5) = 2.67$ (hyperactivity); $t(5) = 2.98$ (total) all at $p < .05$	Non-sig.	Not included
M (Attwood et al., 2012, study 1)	3.5	8.2[c]	4	8.3[c]	Not included
SD	2.6	4.1	2.7	4.3	NA
SCAS-P					
M (Spence et al., 2006)	31.67	31.28	21.02[a]	26.04	15.29
SD	9.42	9.68	12.12	7.69	9.28
M (March et al., 2009)	38.29	32.93	25.79[a]	29.42	18.52[b]
SD	14.07	13.05	12.4	10.71	9.63
M (Attwood et al., 2012, study 1)	13.5	14.1[c]	10.5	12.6[c]	Not included
SD	11.1	7.8	11.1	9.9	NA
Total score (Spence et al., 2008)	40	NA	21	NA	17[b]
CBCL[f]					
Mean *T* score (Spence et al., 2006)	67.85	68.72	61.39[a]	66.83	57.60
SD	8.86	5.57	8.62	8.65	9.53
Mean *T* score (March et al., 2009)	72.29	71.31	60.17[a]	65.46	55.22[b]
SD	8.51	6.7	9.84	9.2	13.51
Total *T* score (Spence et al., 2008)	71		49		46[b]

Keys: NET, Computer-based CBT programme (index group); WL, Wait-list control.

[a] $p < .05$ NET vs. WL at post-intervention;

[b] $p < .05$ NET vs. WL at follow up, except Spence et al., 2008, which analysed efficacy for the overall study period.

[c] Online control.

[d] 3 months instead of 6 months interval.

[e] NET group for this study means the group that received cCBT at the beginning, and WL the group that was placed on the waiting list first. The paper only reported *t* scores which changed significantly after receiving intervention within each group (i.e., intervention and wait-list control group). The values from *t*-test and corresponding *p* values are reported here.

[f] Score for the internalising problems.

Table 3
Summary of study quality based on EPHPP quality assessment method.

References	Spence et al. (2006)	Spence et al. (2008)	March et al. (2009)	Attwood et al. (2012), study 1	Attwood et al. (2012), study 2	Stallard et al. (2011)	Khanna and Kendall (2010)
A. Selection bias	Moderate	Weak	Weak	Weak	Weak	Weak	Weak
B. Study design (study design indicated by the tool)	Strong (Randomised controlled trial)	Weak (Case study)	Strong (Randomised controlled trial)	Strong (Controlled clinical trial)	Moderate (Cohort study)	Strong (Randomised controlled trial)	Strong (Randomised controlled trial)
C. Confounders	Strong	Weak	Strong	Strong	Strong	Weak	Strong
D. Blinding	Moderate	Weak	Moderate	Weak	Moderate	Moderate	Moderate
E. Data collection methods	Strong	Strong	Strong	Strong	Strong	Strong	Strong
F. Withdrawals and drop-outs	Strong	Strong	Strong	Weak	Strong	Moderate	Strong
Global rating	Strong	Weak	Moderate	Weak	Moderate	Weak	Moderate

study 2; Khanna & Kendall, 2010; March et al., 2009) and three weak (Attwood et al., 2012, study 1; Spence et al., 2008; Stallard et al., 2011). A summary of risks and strengths within studies is given in Table 3.

3.9. Risk of bias across studies

Selection bias was evident in all articles, due to most studies relying on children's schools or family members to recruit participants to the studies. Thus the process was closer to self-referral than a systematic referral or random selection from a comprehensive list of children in the target population (i.e., children with anxiety problems). However, since all the studies sought to include children with anxiety problems, random selection method from a population of relevant age was not possible. No study reported to offering any incentives. All the studies were subject to self-reporting bias due to using interviews and questionnaires as the means of data collection. The RCT studies (Khanna & Kendall, 2010; March et al., 2009; Spence et al., 2006; Stallard et al., 2011) used wait-list control as a comparison group. None of the studies reported whether there was any contamination of treatments hence this is a potential area of bias.

3.10. Data synthesis

A meta-analysis was conducted to assess the overall effect size of the studies included in the review, summarised in Fig. 2. For the purposes of the analysis an effect size of the averaged outcomes for each study is diagrammatically presented in the forest plot. The assumption was made that all outcome measures were appropriate and were of equal weight. A fixed standardised effect size of 0.69 (95%CI 0.44, 0.94) was found which was highly statistically significant ($z = 5.45$, $p < 0.00001$). The Q statistic was 1.44, df = 4, $p > 0.8$ showing low heterogeneity. A further analysis was performed dropping study 2 in Attwood et al. (2012) to determine the overall effect without the more limited data that was available in this report. The effect size was nearly identical (forest plot not displayed) to the previous 5-study analysis: 0.70 (95%CI 0.39, 1.02), which was also significant ($z = 4.38$, $p < 0.0001$).

4. Discussion

There is a high demand for the evidence-based CBT to be made more widely available to children with anxiety disorders. Internet delivery of the treatment has the potential to enhance accessibility thereby relieving the pressure on the qualified therapists and saving costs.

The studies reviewed here have shown collectively that computerised delivery of CBT is effective at a comparable level to clinic-delivered CBT for reducing anxiety in children. Where these children were followed up (Khanna & Kendall, 2010; March et al., 2009; Spence et al., 2006), the effect seemed sustainable over time. In addition, all the studies sought feedback on their programmes and were reported to be generally well received by the children and their families. The review included a diverse range of studies: stand-alone, computer-assisted, school-based and single-case studies with a range of sample sizes and other methodological variations. The analysed programmes either involved children's parents as a coach or completed at school with an educated but non-specialist adult. The studies completed at school (Stallard et al., 2011; two studies in Attwood et al., 2012) yielded less consistent results. Yet no conclusion may be drawn on the role of parents given the considerable differences in design and sample sizes between these studies.

Khanna and Kendall (2010) reported the highest proportion (over 80%) of children free of diagnosis at post-intervention with their computer-assisted CAMP COPE-A-LOT. One may speculate that computer-assisted programmes combining the benefit of online and clinic treatment is most effective. While the weaker results in March et al. (2009) with their computer-only CBT programme may support the possibility, the findings from the studies with "Think, Feel, Do" question the position. The latter's much smaller sample sizes and lack of follow-up makes comparison difficult. What could be suggested however, is that given the generally positive outcomes in the analysed studies, CBT via technology could be delivered effectively without the specialist clinicians. A recent study of adults with social anxiety disorder reported that while clinician experience did not differentiate treatment outcome, experienced therapists delivered similar improvements with higher time efficiency (Andersson, Carlbring, & Furmark, 2012).

Sample selection appeared to be a weakness across studies which casts questions on the representativeness of the population included. This stemmed mainly from reliance on self-referral or non-systematic selection by the clinics. It is possible that the studies included motivated families who sought help for their children, thereby raising a concern on the generalisability of the results. Nevertheless, the nature of treating anxious children and their families, the practicality of recruiting within such a population, and the possible social stigma that may be associated with participation, must be borne in mind. Indeed, the analysed studies had the challenge that any other clinical studies face for recruitment. Given that the EPHPP defines the most optimal sample selection to be made from a comprehensive list of individuals in the target population, we suggest that the EPHPP may not be the most sensitive tool for examining clinical studies. Given the tool's other qualities, future work may include revising the tool for clinical population.

The children in the reviewed studies were from mid-to-high income families where the information was available. While this could have added to the selection bias risk, it is also possible that certain pre-requisites necessary to take part in an online

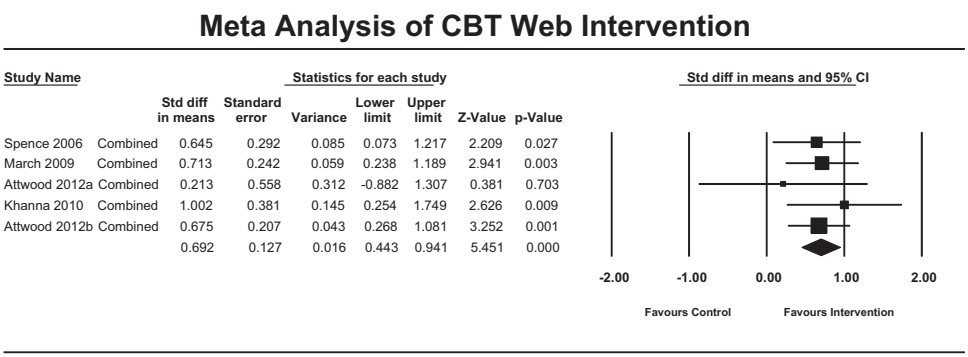

Fig. 2. Forest plot of the 5 studies entered into meta-analysis.

intervention at home (e.g., ownership of computer and broadband connection) may have had a role in the sample recruited. This therefore is a confounding variable in these studies. Given that the ownership of a computer and access to home broadband are fast spreading globally, future studies may recruit from wider socio-economical background to disentangle these factors.

The exclusive use of self-reported questionnaires was reported across studies, allowing the risk of self-reporting bias and social desirability effect. These effects may have been manifested either in maximising or minimising their concerns and problems. However, the studies deployed reliable and validated tests based upon psychometric principles for their screening and assessment of anxiety symptoms. These strengths in the data collection method may have counterbalanced the risk of social desirability as regards to completion of questionnaires. The blinding procedure used in some of the studies provided protection over the risk and bias, by using different researchers for assessment and implementation of the intervention.

All the studies obtained feedback on their online programmes from most of their participants, and it appeared that all the programmes were received positively. However, the questionnaires included those developed by the authors of the studies themselves, thus questioning their validity. Similar questions were included across studies. Work towards standardising questionnaire for collecting feedback on acceptability and satisfaction is therefore warranted.

Out of 7 studies reviewed, only two studies reported the details of compliance and completion. Given its importance for assessing such a diverse range of studies, it is difficult to infer its role for treatment efficacy. It will help future research to include completion rate more consistently.

The meta-analysis performed with the 5 studies with sufficient information to calculate effect sizes produced a clear moderate effect size in a positive direction in favour of the online CBT intervention. It is interesting that 3 of the studies with the highest N sizes produced a consistent effect size within a fairly narrow range between 0.62 and 0.72. The two low recruitment studies showed variable results. The level of heterogeneity as summarised by the Q statistic appeared low although this quantitative synthesis was only based upon 5 studies.

4.1. Limitations

The mixed study designs resulted in studies with mixed randomisation methods. The lack of consistent follow-up assessments affords us no firm conclusion about the sustained effects of online-delivered CBT. The variety in designs was also reflected in the wide range of sample size, from 1 to 73. Further, this review included studies which included much older children and adolescents despite its intention to focus upon children only. Three out of 7 reviewed studies included adolescents as well as children. As we outlined in the Introduction, treatment programmes for anxiety problems are age-sensitive; younger children need to be treated differently from those who are in their teens. The limitation has compromised our aim for this study. Yet, there remains the importance of conducting a comprehensive review for child CBT programmes that include an online component. We call for more trial studies focusing on pre-adolescent children to be conducted and published. The research on the efficacy of CBT delivered at least partly by technology in anxiety-disordered children is clearly at an early stage: the included studies were either presented as preliminary work or to the authors' best knowledge, their first clinical trial of the programme.

Additionally, none of the studies were double-blinded, thus the results allow the possibility of contamination with self-reporting bias both on the part of participants and researchers. It is surprising that despite nearly all the reviewed papers pointing out to the potential economical advantage of delivering CBT online (i.e., saving in therapist time, and reduced need for qualified therapists), none of the papers presented data on cost savings analysis. Such analysis will add to the proven efficacy of online CBT treatment from an economical perspective and further inform how to make this treatment more readily available to children in need of it. The literature will therefore benefit from a greater number of RCTs with a health economic analysis.

4.2. Clinical implications

The current review suggests that children with primary anxiety disorders may benefit from CBT programmes which include computerised delivery. The delivery of CBT programme by technology appears to be possible and effective by a non-specialist 'coach,' with minimum training. Still, in clinical research, any proportion of participants that did not improve with the target treatment is significant: indeed, where diagnosis was used as a measure for treatment outcome (ADIS), between 19 and 70% of children at post-intervention still remained within the diagnosis range. This is high and warrants further research to evaluate for whom, when and how such a delivery method for CBT is effective. Overall, the currently available evidence supports computerised delivery of CBT and suggests it is a promising alternative to clinic-delivered CBT, in order to help resolve barriers for accessing the treatment.

5. Conclusions

This review updated a recent systematic review on internet-delivered CBT treatment for anxious children and adolescents, focusing on studies with children. While it calls for improvement

in future research, the review supports online delivery of evidence-based CBT treatment for child anxiety disorders.

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