Meta-analysis on cognitive behavioral treatment and behavioral intervention technologies for anxious youth: more than a BIT effective

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Abstract
Anxiety disorders in youth are linked to impaired social and academic functioning; however, only 20% of individuals with these disorders receive treatment. The current stigma of seeing a psychologist or the accessibility of resources may represent barriers to treatment. This study aimed to review and compare the effects of Face-to-Face Cognitive Behavioral Therapy (F2FCBT) and Behavioral Intervention Technologies (BITs) for youth anxiety disorders. BITs are electronic interventions (e.g., mobile phones, internet, virtual reality) that aim to help the user improve mental and physical health. Little research comparing the effects of the two types of modalities has been conducted previously. Methods: Systematic review methods and meta-analysis techniques were used to analyze thirty-four randomized controlled trials that included F2FCBT and/or BITs therapy. Results: Both types of interventions were effective for the reduction of childhood anxiety, with the overall effect for F2FCBT indicating less post-test anxiety (F2FCBT $g = -.84$ and BITs $g = -.40$). A subgroup analysis revealed that there were significant effect sizes for F2FCBT and for the combination of the two modalities, but not for BITs alone. Conclusion: Although F2FCBT has shown a larger effect size, BITs with guided therapist help can be an effective modality for delivering treatment for youth with anxiety disorders.

Abbreviations: F2F: face-to-face; F2FCBT: face-to-face cognitive behavioral therapy; BITs: behavioral intervention technologies; cCBT: computerized cognitive behavioral therapy; NEB: non-evidence based control condition; WLC: waitlist control condition

Introduction
Approximately three percent of children and adolescents suffer from an anxiety disorder before adulthood [1]. Anxiety lifetime prevalence rates span from 5.9% to 25.1%, often leading to poor outcomes in social and academic functioning, increased risk of serious mental illness and substance use disorder [1–3]. Although anxiety disorders cost more than one-third of the United States mental health bill (42 billion dollars), only 20% of youth with an anxiety disorder receive treatment [4]. The current stigma of seeing a psychologist and the accessibility of resources represent barriers to treatment. Early, effective, and engaging delivery of treatment for youth anxiety disorders are necessary due to the associated level of impairment. Currently, the leading psychosocial method for delivering treatment for youth anxiety is face-to-face (F2F) psychotherapy. Cognitive Behavioral Therapy (CBT) is the F2F treatment with the strongest empirical support [5–7].

Behavioral Intervention Technologies (BITs) have been developed as an alternative method of delivering evidence based treatments for anxious youth. BITs are electronic interventions (e.g., mobile phones, internet, virtual reality) that aim to help the user improve mental and physical health [8]. BITs have been shown to increase the reach of mental health resources, thus representing a potential benefit [9]. Additionally, there is an increase of applications being developed surrounding health (e.g., there are over 160,000 new health applications) [10], but most of these applications have not been tested, therefore there is a need to know the impact and efficacy of such applications. Electronic interventions such as Cool Teens, BRAVE-ONLINE, and Camp Cope-a-Lot are just a few of the examples of evidence-based BITs specifically designed to reduce anxiety symptoms in children and adolescents [11–13].

In the last 10 years, several meta-analyses and reviews have focused on the utilization of BITs [2,3,7,14–20]. Most of the meta-analyses addressed the effectiveness of BITs for comorbid anxiety and depression. Ebert and colleagues [14] concluded that computerized CBT (cCBT) is an effective treatment for both disorders and an attractive alternative for younger generations. Similar results were found when using computerized therapies (e.g., self-help interventions) for anxiety and depression in youth [3]. Twenty-seven studies were analyzed, concluding that there were small positive effects for symptoms of anxiety and depression in young people but uncertainty around the effectiveness of cCBT in children. Likewise, Richardson, Stallard, and Velleman [16] found that cCBT yielded reductions in behaviors and cognitions related to anxiety and depression with moderate to high user satisfaction. Ye and colleagues [19] found that Internet-based interventions increased remission rates and decreased symptom severity for anxiety but did not affect depression symptoms.

Although there have been several meta-analyses reviewing BITs...
interventions for comorbid disorders, only one completed a systematic review and meta-analysis looking at Internet-delivered CBT for childhood anxiety [17]. The review included seven studies and used interventions that were either fully delivered through technology (computer assisted program plus an online therapist) or technological interventions that included an in person contact (computer assisted program plus an in person facilitator). Though the results suggested that both therapies were effective, the researchers acknowledged that the diverse range of samples, heterogeneity in study designs, and inclusion of only seven studies were significant limitations. Additionally, the meta-analysis did not compare the effectiveness of BITs directly to any form of F2F treatment [17].

The BITs meta-analyses described above have several limitations. The majority used participants with co-morbid disorders (e.g. anxiety and depression) thereby limiting the known treatment effect on anxiety. Although anxiety and depression are highly comorbid, anxiety onset tends to be earlier developmentally in children and adolescents than depression. Also, there is a population of youth with solely anxiety and not depression, thus the efficacy of anxiety BITs treatments must be researched [21]. Many of the meta-analyses above mentioned treatment for youth and included young adults over the age of 17, making the results less representative of the children and adolescent population. Children and adolescents have varying cognitive skills and developmental differences exist that could change the outcome of treatment. Thus, separating the children and adolescent population from the young adult population and researching the differences in outcome for treatment using BITs modalities is imperative [22]. Additionally, the reviewed meta-analyses compared identical modalities (e.g. F2F vs. F2F; BITs vs. BITs) without cross comparison to determine the most effective treatment systems for youth with anxiety. The meta-analysis done by Rooksby et al. [17] focused only on childhood anxiety, not adolescent anxiety, and did not compare BITs vs. F2F treatment. Lastly, previous meta-analyses did not compare inactive control groups to treatments, leading to data that does not identify the total effect of BITs treatment. This meta-analysis aims to address and expand on these limitations by comparing F2FCBT to BITs and BITs + F2FCBT interventions for anxious youth across age groups.

Methods

**Selection process of articles**

The search was limited to publications in English that evaluated the efficacy and effectiveness of F2FCBT and/or BITs treatment for youth anxiety. A computer-based information search was conducted in April 2015, which included (a) PsycINFO (b) PsycARTICLES (c) PsycBOOKS (d) Psychology and Behavioral Sciences Collections (e) Mental Measurements Yearbook with Tests in Print (f) Ebook Collection (EBSCOhost) (g) Academic Search Premiere (h) MEDLINE with Full Text (i) PsycTESTS (j) Ebook Academic Collection Trial (k) Funk and Wagnalls New World Encyclopedia (l) Health Source – Consumer Edition (m) Health Source: Nursing/Academic Edition by two of the study authors (MJ & BD). The references of the chosen studies were checked for other relevant publications. Details of the above search process are outlined in Figure 1.

To identify relevant articles, synonyms of the term “children and adolescents” crossed with “anxiety” were searched. This was followed by the search term “cognitive or behavioral or psychotherapy or treatment.” The age range of participants within the studies was limited to birth through 17 years. Only peer-reviewed articles published between 1990 and 2015 were used. This search yielded an initial pool of 2824 articles. Duplicate articles were automatically removed by the search program, and titles and abstracts were screened for relevance.
by the authors, resulting in a pool of 226 articles (See Figure 1). The articles were each individually read and several were removed, as they did not meet the inclusion/exclusion criteria. Authors of articles with incomplete data sets were contacted to obtain means and standard deviations necessary for effect size calculations. A final set of 34 articles was included in this meta-analysis. These articles were divided into two groups: 24 F2FCBT publications and 10 BITs publications.

Inclusion/exclusion criteria

The search process for this meta-analysis was modeled after the one used by Richardson et al. [16]. Individuals who were 17 and younger and diagnosed with an anxiety disorder were included in the analysis. Studies that included participants who had a learning disability or a neurological disorder were excluded. Studies consisting of participants with comorbid disorders such as depression or attention-deficit hyperactivity disorder were excluded to isolate the effect on anxiety alone. In order to assess the direct effects of F2FCBT and BITs interventions, studies including medication were excluded, as this was an expected confounding variable. Studies that included a waitlist control condition (WLC) or a non-evidence-based control condition (NEB) were included, in order to reduce potential confounding variables relating to treatment type. NEBs are defined as conditions currently not supported by the literature (e.g., Education Support Therapy, Computer-assisted Education/Support/Attention, or Family-based Education/Support/Attention). Finally, only articles that assessed the outcome of anxiety following CBT and/or BITs were included; pilot studies, case studies, and prevention research were excluded.

An article was considered BITs research, when the target of the intervention received active treatment alone using BITs. It was considered F2FCBT if the target client received active treatment from another person, either therapist or parent. If an intervention was targeted at child behavior but acted via the parents of that child, it was included as a F2FCBT study. Finally, a study was considered a combined treatment when the target child or adolescent at various times throughout the intervention received active treatment through BITs or from another person.

Results

The studies included in this meta-analysis that are considered F2FCBT, used CBT in varying modalities including manuals such as “Coping Koala” [19] and “Coping Cat” [20]. Treatments were given in several formats including individual, group, and family. Treatment length ranged from 3 to 18 weekly sessions that were 60 minutes to 2 hours long. Included BITs studies used CBT in varying modalities such as computer programs and Internet video games. Treatments were given individually and ranged from single 3 hours sessions to 12 weekly hour sessions (refer to Table 1 for more information on the components of each treatment).

Methodological quality

Methodological quality was calculated using a 19-item author-developed measure that was adapted from relevant items from the Quality of Cohort Studies (Q-Coh) [21] and a previous meta-analysis with a researcher-created quality rating system [22]. Adaptation of these previous established measures helped ensure consistency in the items with relevancy to the studies included in the analysis. The final quality rating form included categories of study design (2 points), comparability of groups (2 points), treatment quality (3 points), measurement (8 points), attrition (3 points), and analyses (3 points).

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Table 1. Evidence-Based CBT studies for anxiety disorders in youth.

| Authors | Age | % of Boys | Study Conditions | n | Components | Primary Outcome Measure |
|---------|-----|-----------|------------------|---|------------|------------------------|
| [35]    | 7-14 | 53        | GCBT             | 19 | GCBT condition used Coping Koala Group Workbook. GCBTF condition used Group Family Anxiety Management workbook. Two-hour weekly sessions for 12 weeks. | FSSC-R |
| [36]    | 7-14 | 56        | ICBT             | 28 | ICBT condition used Coping Koala Workbook. ICBTF condition received the same workbook along with Family Anxiety Management therapy sessions. 60 to 80 weekly sessions. | FSSC-R |
| [37]    | 8-12 | 40        | SET-EC           | 30 | SET-C includes one child and parent educational session, social skills training, and in vivo exposure. Test-buster was a NEB control involving study skills techniques. | ADIS-CSR |
| [38]    | 8-14 | 51        | ICBT             | 13 | Both groups received Coping Cat Workbook. Aid them in psychoeducation and learning coping techniques for anxiety; 18 weekly 60 minute sessions for the ICBT and 90 minutes sessions for the GCBT. | RCMAS |
| [39]    | 8-11 | 47        | GCBT             | 12 | Treatment Consisted of psychoeducation and exposure. Three 3 hour sessions to groups of five to seven children. Homework included. | ADIS-CSR |
| [40]    | 12-17 | 40       | ITG              | 39 | ITG included cognitive restructuring, psychoeducation, exposure, and relapse prevention. 8-day intensive treatment, 2 to 6 hours of treatment a day with a total of 20 hours of treatment. | ADIS-CSR |
| [41]    | 8-12 | 43        | CBT1             | 21 | CBTI condition participated in twelve 50 minutes sessions. CBTG condition participated in ten 90 minute sessions. Both conditions used a manual based on The C.A.T. Project Manual for the Cognitive Behavioral Treatment of Anxious Adolescents. | SPJ-C |
| [42]    | 9-13 | 60        | CBT              | 27 | CBT condition used Coping Cat Workbook. Therapy included psychoeducation about anxiety, cognitive restructuring, and coping. Seventeen hour long weekly sessions | FSSC-R |
| [43]    | 9-13 | 62        | CBT              | 60 | Used The Coping Cat Workbook in eight weekly sessions consisting of psychoeducation, practicing skills, and in vivo exposure. | FSSC-R |
| [44]    | 7-14 | 56        | ICBT             | 50 | The ICBT condition followed the Coping Cat Workbook manual and the FCBT condition followed an anonymous children manual as well as referred to Coping Cat Workbook. Sixteen weekly 60-min sessions, included psychoeducation, skill building, and exposure. | ADIS-CSR |
| [45]    | 6-17 | 18        | CBT              | 20 | CBT consisted of exposure activities and coping skills training. Homework assignments were given to encourage engagement in the treatment and to build the participants coping skills. | FSSC-R |
| [46]    | 6-11 | 53        | CBT              | 24 | Treatment focused on psychoeducation, exposure and coping. Nine two-hour sessions that including puppet play, worksheets, and games. | SCAS |
| [47]    | 13-17 | 25       | SASS             | 18 | Treatment focused on psychoeducation, realistic thinking, social skills training, exposure, and relapse prevention. Twelve weekly group school sessions, two brief individual meetings, two group booster sessions, four weekend social events. | ADIS |
| [48]    | 14-16 | 16       | SASS             | 17 | Treatment focused on psychoeducation, realistic thinking, social skills training, exposure, and relapse prevention. Twelve weekly group school sessions, two brief individual meetings, two group booster sessions, four weekend social events. | SPA-C |
| [49]    | 9-12 | 33        | GCBT             | 10 | Treatment adapted from the Coping Cat program for Australian youth. Twelve sessions focused on recognition of anxious feelings, bodily reactions to anxiety, cognitive restructuring, coping self-talk and exposure. | STAIC |
| [50]    | 7-16 | 45        | OST              | 85 | Forty-five minute session with rapport building and analysis of phobia and one three-hour sessions including graduated exposures targeted towards the subject's phobia. | ADIS-CSR |
| [51]    | 7-17 | 39        | OST              | 21 | Forty-five minute session with rapport building and analysis of phobia and one three-hour sessions including graduated exposures targeted towards the subject's phobia. | FSSC-R |
| [52]    | 7-16 | 41        | CBT              | 95 | Treatment included psychoeducation, cognitive restructuring, and exposure. Families received nine 90-minute weekly group sessions. | FSSC |
| [53]    | 5-7  | 42        | CBT              | 15 | Treatment adapted from the Coping Cat program. Four weeks of child-only psychoeducation, four weeks of parent-only psychoeducation, four weeks of parent-and-child sessions focused on exposures and relapse prevention, and four weeks of parent-only sessions focused on conducting exposures at home. | RCMAS |
| [54]    | 6-10 | 40        | FGCBT            | 53 | Treatment was based on the Coping Cat CBT program. Ten weekly sessions and two booster sessions at 1 and 3 month follow-up. | RCMAS |
| [55]    | 6-16 | 60        | GCBT             | 25 | Children and parents met in separate groups that used natural group processes to discuss anxiety, self- evaluation, self-rewards, and facilitating exposure training at home. | FSSC-R |
| [56]    | 7-14 | 51        | SC               | 32 | Sessions focused on developing SC skills that can be used out of session and CM session focused on parental positive reinforcement and shaping of fear-confronting behavior in the context of graduated exposures. | FSSC-R |
| [57]    | 4-8  | 47        | Parent + Child   | 24 | Parent + Child conditions are ten weekly sessions focusing on psychoeducation, relaxation skills, exposure, and social skills training. Parents received information on child anxiety, management techniques, positive parental coping skills, and communication and problem-solving skills. Parent Only condition covered same material without the child involved. | ADIS-CSR |

BITs

| Authors | Age | % of Boys | Study Conditions | n | Components | Primary Outcome Measure |
|---------|-----|-----------|------------------|---|------------|------------------------|
| [25]    | 8-10 | 42       | ABM Control      | 18 | In ABM training, participants did a dot probe task with a face stimuli to reduce arousal. Contained four 60 minute over the course of two weeks | STAIC |
| [30]    | 10-17 | 36       | LGE              | 8  | Participants conducted vicarious exposure by guiding computer avatars towards virtual spider pictures, plastic spiders, dead spiders, and live spiders. Participants used the computer for three sessions. | SPQ-C |
|         |      |           | CAVE             | 9  | | |
|         |      |           | WLC              | 8  | | |

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### Table 1: Study Characteristics and Mean Differences

| Study or Subgroup | State or Subgroup | Weight | IV, Random, 95% CI | IV, Random, 95% CI |
|------------------|------------------|--------|------------------|------------------|
| [28] 3-6 46       | NET WLC         | 23     |                  |                  |
| [11] 7-13 67     | ICBT CCAL       | 17     |                  |                  |
| [29] 7-12 45     | NET WLC         | 30     |                  |                  |
| [27] 12-18 41    | NET CLIN WLC    | 41     |                  |                  |
| [32] 12-15 28    | CBM CBT Control | 73     |                  |                  |
| [26] 7-13 38     | ATP ATC         | 12     |                  |                  |
| [5] 6-17 43      | ATF + OST AC + OST | 17 |                  |                  |

Note: ABM: Attention Bias Modification Training, AC: Attention Control, ADIS-CSR: Anxiety Disorders Interview Schedule for Children-Clinician Severity Rating, AP: Attention Placebo, ATC: Attention-Training-Control Condition, ATP: Attention-Towards-Positive Condition, BITs: Behavioral Intervention Treatments, CAV: Computer-Aided Vicarious Exposure, CBM: Cognitive Bias Modification, CBTG: CBT-Group, CBTI: CBT-Individual, CCAL: Computer CBT (Camp Cope-a-Lot), CES: Computer-assisted Education/Support/Attention, CLIN: Clinic-based Treatment, CM: Exposure-based Contingency Management, ED: Educational Placebo, ES: Education Support Therapy, ET: Education Support Therapy, ETG: Exposure Treatment Group, FCBT: Family CBT, FES: Family-based Education/Support/Attention, FGCBT: Family CBT, FSSC-R: Fear Survey Schedule for Children-Rev, GCBT: Group Cognitive-Behavioral Therapy, GCBT: GCBT + Family, ICBT: Individual CBT, IBTFT: ICBT + Family, ITG: Immediate Treatment Group, LGE: Live-Graded Exposure, NEB: Non-evidence based control, NET: Internet-based Treatment, n: Posttreatment Sample Size, NTG: No Treatment Control, OST: One Session Treatment, PBI: Parent Involvement, PNI: CBT + Parent Not Involved, POST: Parent + OST, RCADS: Revised Children’s Anxiety and Depression Scale, RCAM: Revised Children’s Manifest Anxiety Scale, SASS: Skills for Social and Academic Success, SC: Exposure-based Cognitive Self-Control, SCAS-C: Spence Children’s Anxiety Scale-Child Version, SET-C: Social Effectiveness Therapy for Children, SPAC-L: Social Phobia and Anxiety Inventory for Children, SPQ-C: Spider Phobia Questionnaire for Children, STAIC: State-Trait Anxiety Inventory for Children, WLC: Waitlist Control.

### Table 2: Forest Plot for F2FCBT vs. BITs Treatment

Figure 2. Forest Plot for F2FCBT vs. BITs Treatment.
Jones MK (2016) Meta-analysis on cognitive behavioral treatment and behavioral intervention technologies for anxious youth: more than a BIT effective

-0.84, 95% C.I. = -1.06, -0.63) than interventions that included BITs (g = -0.40, 95% CI: -0.69, -0.11).

A second analysis separated the groups into F2FCBT (n = 24), BITs only, (n = 5), and BITs and F2FCBT combined (n = 5). The differences between these groups reached marginal significance (χ²(2)=5.21, p = 0.07). However, interpretation of these results should be cautious due to few studies in the BITs only and combined BITs and F2FCBT, with moderate heterogeneity still persisted with subgroups using this model (Table 2).

**Secondary comparisons**

Subgroup analyses were conducted for the control comparison groups as well as age differences following previous meta-analyses [14]. The control comparison groups were established to understand sources of heterogeneity based on NEB control or WLC comparisons across treatment type (F2FCBT or BITs total). The final model was also marginally significant (χ²(3) = 6.58, p = 0.09), however the comparison did provide information about sources of heterogeneity. Inconsistency was measured using I², which can be visualized as the amount of overlap in the confidence intervals of study effects, and understood as the degree of variance in point estimates that is attributed to true heterogeneity [27]. The BITs with WLC group had the least amount of heterogeneity attributed to random error rather than differences between study groups (I²=48%) while the F2FCBT group with a NEB control had the most amount of error-related heterogeneity (I²=81%).

Subgroup comparisons were split into three age categories, including ages 0-11 (n = 11), 12-17 (n = 5), and a combined age group (n = 18). The subgroup analysis yielded no significant differences in treatment efficacy (χ²(2)=1.29, p = 0.53).

**Discussion**

Due to the high prevalence rates of anxiety and the effectiveness of CBT in youth, it is imperative that researchers develop novel interventions that could make way for the future of psychology. Technology is becoming more associated with psychotherapy and mental health with over 160,000 new applications for treatment existing, but little research available to test the efficacy and impact of such applications [10]. This meta-analysis analyzed different CBT modalities to further understand if new developments such as BITs are comparable to F2F psychotherapy for youth anxiety. Previous meta-analyses compared various BITs and F2F treatments separately, but none were focused on direct comparisons of these modalities. Also, previous meta-analyses included a small amount of BITs studies, whereas this meta-analysis included ten studies. Because CBT represents the most empirically supported approach for youth anxiety, this meta-analysis compared the efficacy of F2FCBT and BITs treatments for youth with anxiety disorders. Although anxiety and depression are often comorbid disorders, anxiety tends to be more prevalent in children and precedes the onset of depression [21]. Thus, assessing the impact of interventions only on anxiety may yield a better understanding of effectiveness of treatment for youth with anxiety disorders and potentially prevent the later onset of depression. This meta-analysis focused solely on the children and adolescent population as previous analyses have included young adults, thus making the results not completely representative of youth and not taking into consideration the differing cognitive skills between the children and adolescent population and young adults [22]. The results showed that both types of modalities were effective for the reduction of childhood anxiety, with the overall effect for F2FCBT indicating less post-test anxiety than BITs (F2FCBT g = -.84 and BITs g = -.40). Effect sizes of BITs for anxious youth were slightly lower than those found in a previous meta-analysis on computerized CBT for depression and anxiety in youth (g = 0.68) (14) and adults (g = 0.88) (38). In order to develop a better understanding of the unique contribution of BITs, we compared the studies using solely BITs with those combining BITs with some F2F component. A subgroup analysis revealed that there were significant effect sizes for F2FCBT (g = -0.84) and for the combination of the two modalities (g = -0.41) but not for BITs alone (g = -0.39). This is the first subgroup analysis done to identify the efficacy of the combined modality.

Based on these findings, although F2FCBT yields a higher effect size, a combined BITs and F2FCBT modality can be a useful treatment to decrease symptoms of anxiety in youth populations. Combined treatment has some potential benefits that may be taken into consideration such as greater accessibility, increased engagement of a tech savvy population, and decreased stigma of therapy with a

| Overall effect** | Neo | g  | 95% CI        | Z  | I2  | Subgroup Differences                |
|------------------|-----|----|--------------|----|-----|-------------------------------------|
| Face to face     | 24  | -0.84 | -1.06, -0.63 | 7.64** | 67% |
| BITs total       | 10  | -0.40 | -0.69, -0.11 | 2.68** | 56% |
| Face to face     | 24  | -0.84 | -1.06, -0.62 | 7.56** | 68% |
| BITs Only        | 5   | -0.39 | -0.87, -0.08 | 1.62   | 66% |
| BITs and Face to face | 5   | -0.41 | -0.81, -0.01 | 2.01*  | 52% |
| Face to face with WLC | 18  | -0.88 | -1.16, -0.65 | 7.58** | 58% |
| Face to Face with non EB control | 6   | -0.76 | -1.36, -0.22 | 2.76** | 81% |
| BITs with WLC    | 6   | -0.40 | -0.71, -0.08 | 2.47*  | 48% |
| BITs with non EB control | 4   | -0.43 | -1.12, 0.27  | 1.21   | 72% |
| Ages 0-11        | 11  | -0.71 | -1.04, -0.38 | 4.17** | 64% |
| Ages 12-17       | 5   | -1.07 | -1.77, -0.36 | 2.97** | 86% |
| Ages combined    | 18  | -0.64 | -0.87, -0.41 | 5.37** | 64% |

†: 0.10 significance  
*: 0.05 significance  
**: 0.01 significance

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mental health professional. For example, in cases where accessibility, engagement and stigma act as barriers to treatment, an online program such as BRAVE-ONLINE [33] can be effective in treating anxiety disorders. However, further research is necessary to determine these advantages.

Subgroup comparisons based on treatment and control type (F2FCBT, BITs, WLC, and NEB control) were conducted in order to gain insight into the sources of heterogeneity. The present study indicates a marginal effect for subgroup differences, with WLC groups representing a more homogenous effect; and studies that included NEB control groups had high levels of heterogeneity, which can be expected by the various methods employed as control comparisons across these studies. Studies on F2FCBT and BITs that used WLC had a larger effect size, than those that used NEB controls. Additionally, the F2FCBT studies that used NEB controls found significant effects of treatment, while BITs with NEB controls did not. This finding is congruent with findings that F2FCBT has a higher effect size than BITs. Another subgroup analysis showed that F2FCBT and BITs were effective across age groups with no significant difference between groups, which is expected given known effectiveness of CBT with this population [39]. This shows that BITs can be engaging for not only young children in elementary school but also adolescents in high school.

The inclusion of modern technologies familiar to today’s youth may increase interest and engagement with mental health resources. Technologies that were used in BITs and combined treatments included in the present analysis may not be representative of modern technology. None of the studies in this meta-analysis included smartphones or tablets, which are currently a dominant form of Internet access for this population. It is possible that children and adolescents present differences in the utilization of technologies, thus affecting the impact of BITs used for the treatment of anxiety disorders. Thus assessing the impact and including up-to-date technologies in psychotherapy with youth may make BITs more user friendly and will increase the amount of interventions a mental health professional could deliver. Currently there is a wide selection of anxiety-directed smart phone and tablet applications that have yet to be empirically tested.

Limitations

There are several limitations that must be considered in the current meta-analysis. This analysis only included publications focused on CBT for youth anxiety disorders and did not take into consideration other types of treatments (psychosocial or psychopharmacological) for this specific population. Because our focus was to compare F2FCBT and BITs, we have excluded articles that were comparing active and evidence based control conditions. Within the 34 articles included in this analysis, significantly more treatments were F2FCBT (n= 24) rather than BITs (n= 10). This could have resulted in heavily weighted inaccurate BITs studies. Across studies, sample size varied greatly, which may have resulted in biased comparisons and increased heterogeneity. Although this analysis attempted to compare studies using common assessments tools, the wide breadth of assessments used by the various studies reviewed was a critical source of heterogeneity. With regard to treatment design, though methodological quality was assessed, all studies that passed the inclusion criteria were included in the current analysis due to a limited number of overall treatment studies. Future analyses would benefit from looking at methodological quality across the field of BITS and F2F research. Finally, this meta-analysis implemented several exclusion criteria in order to maintain consistency across articles. Variables such as psychopharmacology, learning disabilities, non-English studies, follow-up analyses, and active controls were excluded in order to increase homogeneity within the analysis. Intent-to-treat samples were not included and only data showing the outcome of participants who completed treatment within a study were used.

Clinical implications

The current meta-analysis suggests that youth with anxiety disorders may benefit from F2FCBT and the combination of F2FCBT+BITs treatments. While F2FCBT has higher efficacy rates, the combination of F2FCBT+BITs show significant improvement in anxiety and can provide increased accessibility to clients. However, BITs alone do not currently have a significant effect size, future research including newer technologies (e.g., smartphones or tablets) may yield more positive
outcomes and may help to increase therapy’s reach. Various barriers exist to seeking treatment for children and adolescents with diagnosed anxiety. For example, those living in geographically remote locations may have difficulty attending treatments, which are generally focused within cities. In addition, F2F therapy can be expensive, inhibiting access for those with low-income levels. Additionally, the stigma of mental health treatment represents a barrier to the treatment-seeking process, especially among children and adolescents. In this respect, BITs have the ability to reach youth who may be struggling with these barriers and can simultaneously treat more individuals at a lower cost than F2F interventions.

Conclusion

This meta-analysis compared the available research of F2FCBT and BITs treatments for children and adolescents with diagnosed anxiety. While F2FCBT has a larger effect size, combined interventions (F2FCBT + BITs) show marginal significance and have the potential to lower barriers to effective anxiety treatments for youth. However, studies including BITs alone did not yield a significant effect size and were relatively small in number compared to F2FCBT studies. Therefore current evidence does not support the utilization of BITs as a stand-alone treatment and future research including newer BITs is imperative to draw further conclusions.

Conflict of interest

The author(s) confirm that this article content has no conflict of interest.

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