Meta-Analysis

Computer-Assisted Cognitive-Behavior Therapy for Depression in Primary Care: Systematic Review and Meta-Analysis

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ABSTRACT

Objective: To examine evidence for the effectiveness of computer-assisted cognitive-behavior therapy (CCBT) for depression in primary care and assess the impact of therapist-supported CCBT versus self-guided CCBT.

Methods: A search for randomized studies of CCBT compared to control groups for treating depression in primary care settings was conducted using Ovid MEDLINE, PsyCINFO, PubMed, and Scopus. We extracted the following information from the studies that met inclusion criteria: mean depression rating scale scores before and after treatment, number of patients, type of control group and CCBT program, therapist support time and method of support, and treatment completion rate. Meta-analyses compared differences between posttreatment mean scores in each condition, as well as mean scores at follow-up. Study quality and possible bias also were assessed.

Results: Eight studies of CCBT for depression in primary care met inclusion criteria. The overall effect size was g = 0.258, indicating a small but significant advantage for CCBT over control conditions. Therapist support was provided in 4 of the 8 studies. The effect size for therapist-supported CCBT was g = 0.372—a moderate effect. However, the effect size for self-guided CCBT was g = 0.038, indicating little effect.

Conclusions: Implementation of therapist-supported CCBT in primary care settings could enhance treatment efficiency, reduce cost, and improve access to effective treatment for depression. However, evidence to date suggests that self-guided CCBT offers no benefits over usual primary care.

Prim Care Companion CNS Disord 2018;20(2):17r02196


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Adequate treatment of depression remains a major challenge for primary care clinicians. With an 8.6% annual prevalence of major depressive disorder in the general population in the United States and a heightened risk for depression in patients with medical illnesses such as diabetes, cardiovascular disease, and chronic obstructive pulmonary disease, this illness is one of the more common problems encountered in primary care. The intense personal and familial suffering associated with depression and the large economic burden of over 200 billion dollars annually in the United States underscores the need for development and dissemination of effective treatments.

The US Preventive Services Task Force recommends that primary care doctors screen for depression in adults when resources are in place to “assure accurate diagnosis, effective treatment, and follow-up”; however, there can be many problems in service delivery, especially when psychotherapy is recommended. For example, there are a number of recognized barriers to implementation of cognitive-behavior therapy (CBT), a treatment that has been shown to be effective in a large number of outcome studies in mental health populations. These obstacles include an insufficient number of trained therapists, costs of treatment, lack of transportation, and difficulty in scheduling and attending a large number of therapy sessions. Thus, most primary care patients who could benefit from CBT do not participate in this form of treatment or receive any psychotherapy. Integration of behavioral health into primary care can increase the frequency of psychotherapy contacts. However, collaborative care with integrated behavioral health treatment is unavailable in most primary care practices, and cost, transportation, and time constraints also are present in collaborative care delivery models.

Computer-assisted CBT (CCBT) has been developed as a way to reduce cost and improve access to evidence-based treatment for depression and other psychiatric disorders while providing data tracking and treatment management features not found in standard CBT. Previous reviews and meta-analyses of CCBT that focused largely on patient populations from mental health or community settings found evidence for effectiveness and acceptance of this form of treatment.
Medium-to-large effect sizes have been reported for CCBT of depression in such reviews and meta-analyses. One previous meta-analysis of all forms of CBT for depression or anxiety disorders in primary care included 4 studies of CCBT among a total sample of 29 randomized controlled trials. Three of the 4 CCBT studies in this meta-analysis had effect sizes that indicated significantly better reduction in depression than control conditions. However, there have been no previous reviews and meta-analyses with a focus on studies of CCBT for depression in primary care.

**METHODS**

A computerized literature search was conducted using Ovid MEDLINE, PsycINFO, PubMed, and Scopus from their inception to July 18, 2016. In addition, the authors performed a manual search using other meta-analyses and published reports of CCBT. The search keywords were randomized controlled trials of computer-assisted cognitive-behavior therapy for depression and randomized controlled trials of mobile apps for cognitive-behavior therapy of depression. Criteria for inclusion of studies were (1) randomized controlled trial with control group (ie, no treatment, wait list, attention control, or treatment as usual [TAU] other than standard face-to-face CBT); (2) subjects were depressed as measured by depression rating scales; (3) inclusion criteria specified for depression (ie, clinical diagnosis of depression, diagnosis with standardized assessment, eg, DSM-IV, Structured Clinical Interview for DSM-IV Axis I Disorders, Mini International Neuropsychiatric Interview, see Supplementary Appendix 1 for listing of full names of diagnostic instruments and measures) or assessment with validated measure for depressive symptoms and appropriate cutoff score, eg, 9-item Patient Health Questionnaire [PHQ-9], Beck Depression Inventory [BDI], Center for Epidemiologic Studies Depression Scale [CES-D]; (4) participants were 16 years of age or older; (5) involved use of a computer program or mobile app that covers core methods of CBT to deliver all or part of the treatment; (6) pre- and posttreatment mean scores with standard deviation using a standard depression rating scale (eg, PHQ-9, BDI, Hamilton Depression Rating Scale, CES-D); and (7) participants were drawn from a primary care setting (family medicine and internal medicine).

Decisions on inclusion and exclusion were reached by consensus of 3 of the authors (D.R., M.E.T., and J.H.W.). Data were abstracted on pre- and posttreatment means and standard deviations on depression rating scales, means and standard deviations on depression rating scales for follow-up assessments (if available), numbers of subjects, type of control group, CCBT program utilized, completion rate, clinician support time, and type of clinician support. If these data were not in the published report, the corresponding author of the study was contacted to request data.

Study quality was assessed using the CLEAR NPT, a checklist developed to evaluate reports of nonpharmacologic, randomized clinical trials. The CLEAR NPT includes 15 questions that address study characteristics such as the adequacy of the randomization process; description of the interventions; care provider experience or skill; measurement of adherence to treatment protocols; blinding of care providers, participants undergoing treatments, and outcome evaluators; consistency of follow-up assessments across all groups; and whether the data analysis used intent-to-treat principles. Two of the study authors (T.D.E. and G.K.B.) independently evaluated each study using the CLEAR NPT. Ratings were compared, and differences were reconciled through consensus.

**Data Analysis**

To determine the efficacy of CCBT versus control conditions, we calculated effect sizes with Hedges g, which is the difference in means at posttreatment or follow-up divided by the pooled standard deviation of both conditions and the estimate of variance. The primary measure of depression was used for these calculations. Two studies did not conduct follow-up assessments after completion of treatment, while 5 studies had multiple follow-up assessments at varying times. A single study had only 1 follow-up assessment. For the follow-up analysis, we aggregated all of the follow-up assessments per study. For some studies, there were multiple comparisons (eg, multiple versions of CCBT vs control conditions), which were aggregated per study. We used random effects estimates to better generalize beyond the participants in these studies. The heterogeneity of the effects was examined with Q-tests and I² statistics. Comparison of effects of studies that used therapist-supported CCBT versus self-guided CCBT was planned in advance because of previous research showing heterogeneity between these 2 types of studies and lower effect sizes for self-guided CCBT.

**RESULTS**

Of the 223 studies identified in the search, 215 were excluded, most commonly because the study was not a randomized controlled trial (60 studies). A list of reasons for exclusion is provided in Supplementary Appendix 1. We found 8 studies that were randomized controlled trials of CCBT for depression in primary care that met our study criteria. Study characteristics, other than means and SDs, are

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Prim Care Companion CNS Disord 2018;20(2):17r02196
reported in Table 1. Three\textsuperscript{33,35,36} of the 8 studies reported no therapist support time and thus were self-guided, 4 studies\textsuperscript{32–37} utilized a blended method of a computer program plus therapist support (ranging from 60 to 194 minutes for the entire course of treatment), and 1 study\textsuperscript{32} did not report support time. All studies used multimedia computer programs that integrated text with video or other multimedia elements and were delivered on personal computers or electronic notebooks. No studies used mobile delivery. Typically, CCBT was delivered in a series of lessons (5–18) over a time period of 7 to 16 weeks.

A forest plot for the posttreatment effects and 95% confidence intervals, along with numerical effect sizes for each study, is displayed in Figure 1. The random effects weighted mean effect size for CCBT versus TAU at posttreatment was \( g = 0.258 \) (SE = 0.097; 95% CI, 0.068–0.449; \( P = .008 \)). As expected, there was significant heterogeneity in the effects (\( Q_g = 47.397, P < .001, I^2 = 85.23 \)), most likely influenced, in part, by inclusion of studies of self-guided CCBT. Examining the funnel plot for posttreatment effects, there was good symmetry, and, consistently, the Egger test of asymmetry was not significant (intercept = 0.65, SE = 2.34, \( P = .78 \)); however, some caution should be taken with this test given the limited number of studies. A Duval and Tweede trim and fill analysis yielded 1 study adjustment that only affected the overall \( g \) by 0.02. Collectively, these bias tests revealed no meaningful indications of bias in findings.

Six studies\textsuperscript{32–37} included follow-up assessments ranging from 1 to 8 months after completion of treatment. In these studies, the random effects weighted mean effect size for CCBT versus control was \( g = 0.400 \) (SE = 0.103; 95% CI, 0.198–0.602; \( P < .001 \)). Similar to posttreatment effects, there was significant heterogeneity in the effects (\( Q_g = 29.782, P < .001, I^2 = 83.21 \)).

For analysis of the influence of therapist support on outcome, we dichotomized the studies on the basis of whether patients received significant therapist support time (\( k = 4 \)) or no (or negligible) therapist support time (\( k = 3 \)). Therapist support was usually provided on a weekly basis throughout the active treatment period of 7 to 12

![Figure 1. Posttreatment Effect Sizes for Computer-Assisted Cognitive-Behavior Therapy (CCBT) Versus Control Conditions](image-url)
### DISCUSSION

The findings of our review and meta-analysis indicate that CCBT has potential for improving delivery of effective psychotherapy in primary care settings. Studies that incorporated a modest amount of therapist support (60–194 minutes) had a mean effect size in the moderate range, indicating that CCBT was significantly better at relieving depression than usual care or a wait-list control. However, self-guided CCBT (3 of 7 studies reporting therapist support time) had a negligible effect size and thus was ineffective.

Meta-analyses of larger samples of CCBT studies that included persons recruited on the internet, patients from mental health care delivery settings, and other non–primary care populations have found somewhat higher overall effect sizes for both guided and unguided CCBT. For example, Richards and Richardson reported a mean effect size of \( d = 0.56 \) for all of the 19 studies in their meta-analysis. Therapist-supported studies in this meta-analysis had a mean effect size of \( d = 0.36 \). In contrast, the effect sizes in our meta-analysis of primary care patients were lower. Although available data do not provide enough information

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**Figure 2. Percentage of Studies Meeting CLEAR NPT Quality Criteria**

<table>
<thead>
<tr>
<th>Quality Criterion</th>
<th>0.0%</th>
<th>12.5%</th>
<th>25.0%</th>
<th>37.5%</th>
<th>50.0%</th>
<th>75.0%</th>
<th>100.0%</th>
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<tbody>
<tr>
<td>Was the generation of allocation sequences adequate?</td>
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<td>75.0%</td>
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<td>Was the treatment allocation concealed?</td>
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<td>50.0%</td>
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<tr>
<td>Were details of the intervention administered to each group made available?</td>
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<td>87.5%</td>
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<tr>
<td>Were care providers’ experience or skill in each arm appropriate?</td>
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<td>50.0%</td>
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<tr>
<td>Was participant (ie, patient) adherence assessed quantitatively?</td>
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<td>87.5%</td>
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<tr>
<td>Were participants adequately blinded?</td>
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<td>75.0%</td>
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<tr>
<td>If participants were not adequately blinded, were all other treatments and care the same in each randomized group?</td>
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<td>37.5%</td>
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<tr>
<td>Were care providers or persons caring for the participants adequately blinded?</td>
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<td>75.0%</td>
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<tr>
<td>If care providers were not adequately blinded, were all other treatments and care the same in each randomized group?</td>
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<td>37.5%</td>
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<tr>
<td>Were outcome assessors adequately blinded to assess the primary outcomes?</td>
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<td></td>
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<td>75.0%</td>
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<tr>
<td>If outcome assessors were not adequately blinded, were specific methods used to avoid ascertainment bias?</td>
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<td>12.5%</td>
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<tr>
<td>Were the main outcomes analyzed according to the intention-to-treat principle?</td>
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<td>75.0%</td>
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*Based on Boutron et al.18

Abbreviation: CLEAR NPT = checklist to evaluate a report of a nonpharmacological trial.
to discern why CCBT may be less effective in primary care patients, these influences could be implicated:

1. CCBT has been investigated less frequently in primary care than in other settings. Thus, less is known about how to effectively implement CCBT in primary care patients. It is possible that further research could help improve the delivery of CCBT in primary care.

2. Recruitment methods in many studies in non-primary care settings utilized the internet or advertisements, perhaps gathering a more highly motivated, better-educated, healthier, and computer-savvy group of participants than may be drawn from primary care practices. 

3. It is likely that comorbid medical conditions are more common in primary care patients. These conditions could make it more difficult to participate in CCBT or benefit from it. None of the CCBT programs used to date in primary care have been tailored to persons who may have a significant physical illness.

Six of the 8 studies in our meta-analysis provided follow-up data, an important indicator of the durability of treatment. Although the mean effect size was in the moderate range for follow-up assessments, there has not been enough research to conclude that CCBT for depression is a durable treatment in primary care settings. It would be ideal to have follow-up assessments at least a year posttreatment. However, funding is usually limited for extending evaluations to a year or longer.

The primary limitation of our review and meta-analysis is the small number of studies that have been conducted to date. However, research on CCBT has been expanding, and additional studies in primary care are anticipated. Our research group is currently conducting an investigation of CCBT for depression in primary care using therapist support via telephone (NCT 02700009). An additional study (NCT 03068676) of CCBT for anxiety and depression in primary care is being conducted using graduate interns as supporters.

Quality assessments of studies also raise questions about research performed to date on CCBT for depression in primary care. Although some of the CLEAR NPT criteria (e.g., care providers are blinded to treatment allocation; patients are blinded to treatment allocation; if care providers not blinded, other treatments are adequately controlled; if patients not blinded, other treatments are adequately controlled; assessments are performed by blind raters) are very difficult standards for practical studies of the effectiveness of CCBT in primary care settings, there is room for improvement in other CLEAR NPT criteria. Two of the 8 studies did not use intent-to-treat principles for data analysis. Their reliance on data from treatment completers could have inflated effect sizes compared to investigations that employed more rigorous intent-to-treat analytic methods. Additional areas for enhanced study design include using best-practices randomization sequences, insuring that therapists are experienced in the delivery model, and employing outcome measures that do not rely solely on participant self-report.

Another limitation of the current review is that the optimal amount and type of therapist support (e.g., face-to-face, telephone, e-mail) and predictors of outcome, other than therapist support, could not be determined. It would be helpful for future studies to report actual therapist support time and to give more detail on the methods of support. Only one of the studies published a cost-benefit comparison. In this investigation, CCBT was more efficacious and cost-effective than usual treatment. Because studies of patients treated in mental health settings have found economic advantages for CCBT, and CCBT requires considerably less therapist time than standard CBT, it is likely that CCBT would offer cost savings if widely disseminated in primary care.

Engagement in CCBT among primary care patients is another concern that has not been fully addressed to date. Will patients accept and complete this form of treatment compared to other approaches to treat depression? Two of the 8 studies reported patient satisfaction, and both found high levels of acceptance of CCBT. Treatment satisfaction for CCBT typically has been high in studies in mental health settings, and completion rates usually have been good in therapist-supported CCBT. The overall completion rate in studies reviewed by Richards and Richardson was 72%. However, more research is needed on acceptance of CCBT in primary care patients.

None of the 8 studies reviewed here used mobile delivery for the CBT computer program. A wide variety of CBT apps have been developed. However, the quality, security, and efficacy of most apps have been questioned, and CBT apps are typically designed for specific interventions such as relaxation or breathing training instead of delivery of a full program of CBT. Only a few mobile apps have been investigated as treatments for depression in randomized controlled trials. It is possible that mobile delivery could provide greater flexibility and engagement if used as part of CCBT for depression.

Despite gaps in our current knowledge of CCBT for depression in primary care, there are indications that this method, if combined with therapist support, offers a way to engage greater numbers of patients in evidence-based psychotherapy, while improving the efficiency of treatment and reducing cost. Some of the important challenges for future research include detailing implementation strategies and improving the effectiveness of CCBT in primary care practice, delineation of the most effective ways of integrating human and computer elements of treatment, and realizing the potential for newer technologies as they become available.
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Potential conflicts of interest: Dr Richards is an employee of SilverCloud Health, developers of computerized psychological interventions for depression, anxiety, stress and comorbid long-term conditions. Dr Thase reports the following relationships during the course of this study. He was an advisory/consultant to Acadia, Alkermes, Allergan (Forest, Naurex), AstraZeneca, Carenix, Eli Lilly, Johnson & Johnson (Janssen, Ortho-McNeil), Lundbeck, MedAvante, Merck, Modkasha, Nestlé (PamLab), Neuroneuretics, Novartis, Otsuka, Pfizer, Shire, Sunovion, and Takeda. In addition to the National Institute of Mental Health, he received grant support from the Agency for Healthcare Research and Quality, Alkermes, Assurex, Avanir, Forest, Johnson & Johnson, Otsuka, and Takeda. Dr Thase received royalties from the American Psychiatric Press, Guilford Publications, Herald House, and W.W. Norton & Company, Inc. Dr Thase’s spouse, Dr Diane Sloan, works for Peloton Advantage, which did business with Pfizer and AstraZeneca.

Dr Wright is an author of the Good Days Ahead (GDA) program used in this investigation and has an equity interest in Empower Interactive and Mindstreet, developers and distributors of GDA. He receives no royalties or other payments from sales of the program. His conflict of interest is managed with an agreement with the University of Louisville. He also receives book royalties from the American Psychiatric Press, Inc, Guilford Press, and Simon and Schuster. Dr Wright receives grant support from the National Institutes of Health (Agency for Health Care Research and Quality). Drs Wells, Owen, McCray, Bishop Eells, and Brown report no conflicts of interest related to the subject of this article.

Funding/support: None.

Supplementary material: See accompanying pages.

REFERENCES

Computer-Assisted CBT for Depression in Primary Care


42. Wright JH, Wright AS, Albano AM, et al.


Supplementary material follows this article.
**Supplementary Material**

**Article Title:** Computer-Assisted Cognitive-Behavioral Therapy for Depression in Primary Care: Systematic Review and Meta-Analysis

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**DOI Number:** https://doi.org/10.4088/PCC.17r02196

**List of Supplementary Material for the article**

1. Supplementary Appendix 1

**Disclaimer**
This Supplementary Material has been provided by the author(s) as an enhancement to the published article. It has been approved by peer review; however, it has undergone neither editing nor formatting by in-house editorial staff. The material is presented in the manner supplied by the author.
Supplementary Appendix 1

**Diagnostic and Symptom Measures**
Beck Depression Inventory (BDI)
Center for Epidemiologic Studies Depression Scale (CES-D)
Diagnostic and Statistical Manual of Mental Disorders, 4th Edition (*DSM-4*)
Hamilton Rating Scale for Depression (HRSD)
Mini International Neuropsychiatric Interview (MINI)
Patient Health Questionnaire-9 (PHQ-9)
Structured Clinical Interview for DSM Disorders (SCID)

**Reasons for Excluding Studies from Meta-analysis:**
Studies found through computer search (Ovid Medline, PsychInfo, PubMed, Scopus) = 208
Studies found “manually” (through other meta-analysis, reviews, and other papers) = 15
Total number of studies in search = 223
Number of studies excluded = 215
Number of studies included = 8

Primary reason for exclusion:
- Not an RCT = 60
- RCT with active therapy as only control = 9
- Not on depressed subjects = 31
- No inclusion criteria for depression = 12
- Mixed sample including stress and anxiety, n= 2
- Not on adults (child and adolescent studies) = 13
- Didn’t use computer-delivered therapy = 11
- Didn’t use CBT = 4
- No pre-post means/SDs with standard depression rating scale = 11
- Duplicate (follow-up or other report on principal study found elsewhere in search) = 22
- Otherwise qualified for inclusion but study not performed in primary care setting = 40