

## Internet-Based Cognitive Behavioral Therapy for Depression in Community Settings: A Network Meta-Analysis and Systematic Review

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**Introduction.** This study aims to compare the effectiveness of Guided iCBT (Guided Internet-Based Cognitive Behavioral Therapy), Unguided iCBT (Unguided Internet-Based Cognitive Behavioral Therapy), TAU (Treatment as Usual), and Waiting List in improving subthreshold depressive symptoms using a network meta-analysis approach.

**Methods.** Randomized controlled trials (RCTs) related to iCBT and subthreshold depression were retrieved from PubMed, ScienceDirect, and Wiley online libraries. A network meta-analysis was conducted using a random-effects model within a Bayesian framework to summarize direct and indirect evidence. The outcome measures included the Patient Health Questionnaire-9 (PHQ-9) and the Beck Depression Inventory (BDI).

**Results.** A total of 17 eligible studies with 2,274 participants and four interventions (Guided iCBT, Unguided iCBT, Waitlist, and TAU) were included. The ranking of interventions based on their treatment effects for the PHQ-9 outcome was as follows: i) Unguided iCBT, with a SURCA value of 97.2; ii) Guided iCBT, with a SURCA value of 57.3; iii) Waitlist, with a SURCA value of 38.5; iv) TAU, with a SURCA value of 7.0. For the PHQ-9 outcome, Unguided iCBT was significantly superior to Waitlist (SMD: -3.06, 95% CI: -6.06 to -0.05), and there were no significant differences between the other treatment modalities. For the BDI outcome, the ranking of interventions was as follows: i) Guided iCBT, with a SURCA value of 75.3; ii) Unguided iCBT, with a SURCA value of 61.9; iii) TAU, with a SURCA value of 59.4; iv) Waitlist, with a SURCA value of 3.3. For the BDI outcome, both Unguided iCBT and Guided iCBT were significantly superior to Waitlist (SMD: 0.73, 95% CI: 0.15 to 1.32), and there were no significant differences between the other treatment modalities.

**Conclusion.** This network meta-analysis provides evidence that iCBT is an effective intervention for improving depressive symptoms in community settings. Both guided and unguided iCBT showed significant improvements in depressive symptoms, with no significant differences between the two approaches. These findings suggest that iCBT can be a valuable treatment option for individuals with depression, offering flexibility and accessibility. Further research is needed to assess the long-term efficacy of iCBT and explore its potential benefits in diverse populations. Overall, iCBT has the potential to expand access to evidence-based treatment for depression and improve mental health outcomes in community settings.

**Keywords.** Depression; Cognitive Behavioral Therapy; Internet; PHQ-9; BDI; Network Meta-Analysis

## INTRODUCTION

Depression is a highly prevalent mental health disorder, with significant implications for individuals and society as a whole. It affects a substantial number of people worldwide, with estimates surpassing 300 million individuals [1]. Furthermore, projections indicate that depression will become the leading cause of the global burden of disease by 2030. Ensuring that individuals with depression receive timely and effective treatment is crucial [2].

Various treatment options, including psychological interventions and medication, have demonstrated efficacy in managing depression. However, there remains a considerable proportion of individuals with depression who do not seek or receive appropriate treatment. This discrepancy can be attributed to several factors, including the stigma surrounding mental illness and the limited accessibility of healthcare resources [3].

In addition to clinically diagnosed depression, there is also subthreshold depression, which is even more common. Besides depression treated in specialized hospitals, there is also community-based treatment for depression. Depression is a complex mental health condition that can present in various forms, with differences in symptomatology, severity, and duration. Previous research has highlighted the prevalence of subthreshold depression within the community, with estimates ranging from 7.3% to 23.1% [4]. Cognitive Behavioral Therapy (CBT) is a psychosocial intervention that has demonstrated effectiveness in improving mental health outcomes [5]. CBT is a structured therapeutic approach that targets the modification of unhelpful cognitive distortions, such as negative thoughts, beliefs, and attitudes, as well as maladaptive behaviors. It also aims to enhance emotional regulation skills and develop individual coping strategies to address current challenges. CBT has been extensively studied and is considered an evidence-based treatment for depression [6, 7].

However, due to limited opportunities to access qualified therapists and the relatively high cost, it is challenging to make face-to-face CBT interventions available to every individual with subthreshold depression. In the past two decades, there has been a significant technological revolution in mental healthcare for depression with the rapid development of the internet [8]. Psychological interventions, including CBT, have increasingly been adapted to the internet, giving rise to Internet-based Cognitive Behavioral Therapy (iCBT). This innovative treatment approach combines the principles of CBT with the convenience and accessibility of the internet, offering a promising solution for addressing the barriers commonly encountered in traditional face-to-face therapy. iCBT has shown effectiveness in treating depression and has the potential to bridge the treatment gap for individuals with depression [9, 10]. iCBT provides individuals with the opportunity to access evidence-based treatment for depression in a flexible and convenient manner. It can be delivered in a guided format, where individuals receive some form of therapeutic support and guidance throughout

the treatment process, or in a self-guided format, where individuals work through the treatment modules independently without therapist support. Both guided and self-guided iCBT formats have demonstrated efficacy in improving depressive symptoms [11, 12]. Guided iCBT, which involves therapist support, has been shown to be particularly effective in treating major depressive disorder. Therapeutic guidance can come in the form of regular check-ins, feedback on progress, and assistance in implementing CBT techniques. Guided iCBT has been found to be superior to treatment as usual (TAU) alone, indicating its potential as a valuable treatment option for individuals with depression [13].

However, there is currently no systematic review evaluating the effectiveness of guided iCBT, unguided iCBT, TAU, and waiting list interventions in improving symptoms among the community population with depression.

## 2. MATERIALS AND METHODS

### 2.1 Study Design

This study conducted a Network Meta-Analysis (NMA) following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement, which aims to assist authors in reporting comprehensive systematic reviews. Since this study is a retrospective review of published research, ethical approval was not required.

### 2.2 Search Strategy

The aim of this NMA meta-analysis is to rank the effectiveness of Guided iCBT, Unguided iCBT, TAU, and Waiting List in improving subthreshold depression symptoms. Computer searches were conducted in PubMed, ScienceDirect, and the Wiley Online Library for randomized controlled trials related to iCBT and subthreshold depression. The search was limited to studies published in English up to December 31, 2023. The search keywords included: internet, cognitive behavioral therapy, depression. As an example, the search formula used for PubMed was: ((((((internet[Title/Abstract]) OR (web[Title/Abstract])) OR (computer[Title/Abstract])) OR (online[Title/Abstract])) OR ("computerized"[Title/Abstract])) AND ((cognitive therapy[Title/Abstract]) OR (cognitive behavior therapy[Title/Abstract]))) AND (Depression[Title/Abstract])). Additionally, the reference lists of included studies were searched again to avoid missing any other relevant research.

### 2.3 Inclusion Criteria

The inclusion of literature was determined based on the PICOS principles. (1) Participants: Subthreshold depression, excluding special populations such as menopausal, postpartum, cancer, and post-stroke individuals. (2) Intervention: At least one type of iCBT intervention. (3) Control: No restriction on the treatment method in the control group. (4) Outcome: At least the post-intervention scores of the PHQ-9 and BDI. (5) Study design: Prospective randomized controlled trials. Studies with a sample size of less than 10, inability to extract data, and other criteria were excluded.

For duplicate publications of the same study, the most recent study containing outcome measures was included.

#### 2.4 Data Extraction

Data extraction and assessment of literature quality were performed independently by two researchers, with discrepancies resolved by a third researcher. A pre-designed Excel table was used for data extraction, including the first author, publication year, intervention measures, number of patients, and outcome measures.

#### 2.5 Assessment of Study Quality

The Cochrane Collaboration's risk of bias assessment tool was used to evaluate the quality of included studies, including random sequence generation, allocation concealment, blinding of participants and personnel, blinding of outcome assessment, incomplete outcome data, selective reporting of results, and other biases.

#### 2.6 Statistical Analysis

In direct comparisons, if the direct comparison was based on two or more studies, the  $I^2$  test was used to calculate the statistical heterogeneity. If  $I^2 < 50\%$  or heterogeneity  $p > 0.10$ , it indicates that the heterogeneity among studies is small, and a fixed-effects model was used. If  $I^2 \geq 50\%$  or heterogeneity  $p < 0.10$ , it indicates significant heterogeneity among studies, and a random-effects model was used. When the 95% confidence interval does not include 1, it indicates statistical significance.

Bayesian network meta-analysis was performed using the gemtc package in R software combined with JAGS software. Nodes represented different interventions, and the edges of the nodes represented head-to-head comparisons of different interventions. The consistency of direct and indirect comparisons was verified using the node-splitting method. The cumulative probability ranking plot and the corresponding surface under the cumulative ranking (SUCRA) were calculated using Stata 16.0 software to rank the interventions based on their superiority or inferiority. Except for heterogeneity tests, a two-sided  $p$ -value  $< 0.05$  was considered statistically significant.

### 3. RESULTS

#### 3.1 Literature Screening and Quality Assessment

After conducting a database search and importing the results into EndNote, a total of 552 articles were retrieved. Upon reviewing the titles, review articles, case reports, and other non-clinical studies were excluded, resulting in 123 remaining articles. The abstracts of these 123 articles were read, and 83 non-prospective randomized controlled trials were excluded, leaving 40 articles. The full texts of these 40 articles were read, and 23 articles without specified outcome measures were excluded, resulting in a final inclusion of 17 articles. The flowchart of the literature screening process is shown in Figure 1. The Cochrane Risk of Bias assessment tool was used to evaluate the quality of the included studies, and the results are presented in Figure 2. Considering the lack of participant blinding and uncertainty in data collection, the risk of bias was deemed high for implementation bias and the risk of bias in measurement

was uncertain.

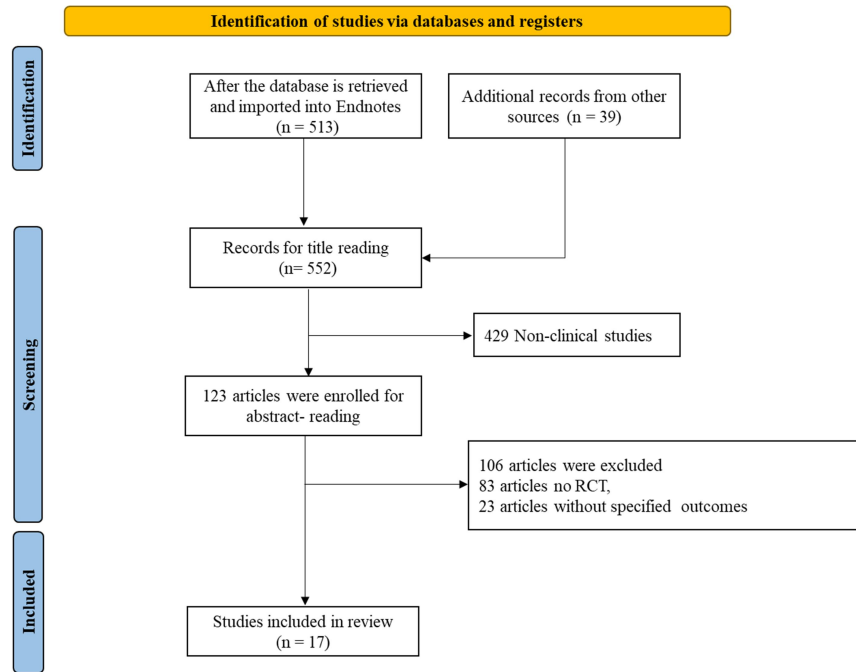


Figure 1 The flowchart of the literature screening process

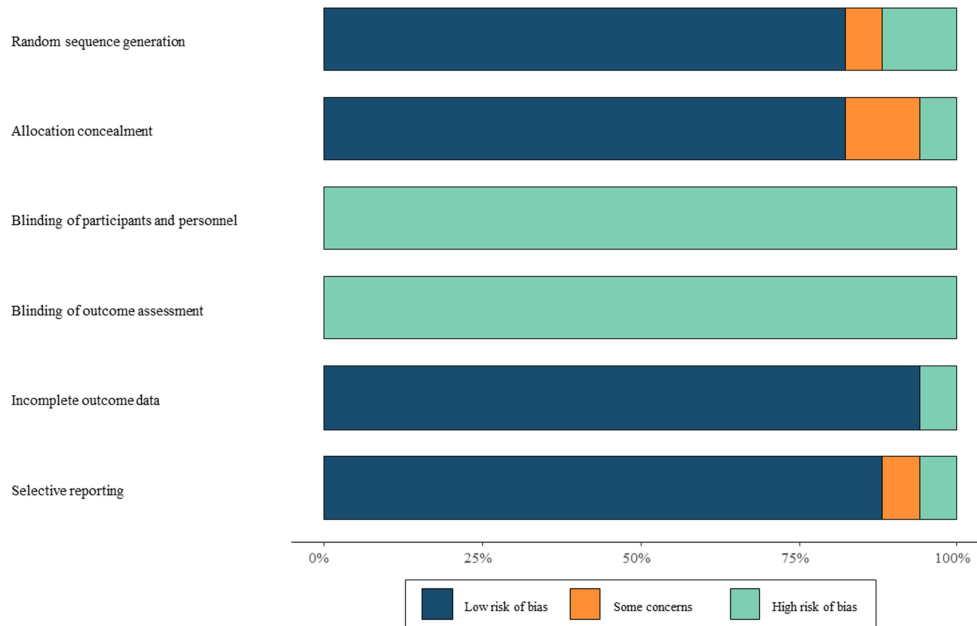


Figure 2 Quality of the included studies

### 3.2 Basic Information of Included Studies

A total of 17 studies, all of which were randomized controlled trials (RCTs), involving 2,274 participants, were included. Among the included studies, 2 were three-arm studies, and 15 were two-arm studies, evaluating a total of 4 treatment interventions. The basic information of the included studies is presented in Table 1.

Table 1 Basic Information of Included Studies

Authors	Publication date	Treatment modalities	Number of patients	Outcome indices
Forand NR[14]	2018	Guided iCBT	59	PHQ-9
		Waitlist	30	PHQ-9
Berger T[15]	2011	Guided iCBT	25	BDI-II
		Unguided iCBT	25	BDI-II
Choi I[16]	2012	Waitlist	26	BDI-II
		Guided iCBT	25	PHQ-9, BDI-II
de Graaf LE[17]	2011	Waitlist	30	PHQ-9, BDI-II
		Guided iCBT	100	BDI-II
Johansson R[18]	2012	TAU	103	BDI-II
		Unguided iCBT	100	BDI-II
Meyer B[19]	2009	Guided iCBT	37	BDI-II
		Waitlist	42	BDI-II
Mira A[20]	2017	Unguided iCBT	159	BDI-II
		Waitlist	57	BDI-II
Moritz S[21]	2012	Guided iCBT	36	BDI-II
		Waitlist	44	BDI-II
Perini S[22]	2009	Unguided iCBT	90	BDI-II
		Waitlist	80	BDI-II
Richards D[23]	2015	Guided iCBT	27	BDI-II
		Waitlist	18	BDI-II
Rosso IM[24]	2017	Guided iCBT	96	BDI-II
		Waitlist	92	BDI-II
Ruwaard J[25]	2009	Guided iCBT	37	PHQ-9
		Waitlist	40	PHQ-9
Smith J[26]	2017	Guided iCBT	54	BDI-II
		Waitlist	33	BDI-II
Williams AD[27]	2015	Unguided iCBT	54	PHQ-9
		Waitlist	59	PHQ-9
Karyotaki E[28]	2022	Guided iCBT	36	PHQ-9, BDI-II
		Waitlist	39	PHQ-9, BDI-II
Stuart R[29]	2022	Guided iCBT	48	PHQ-9
		TAU	52	PHQ-9
Ying Y[30]	2023	Unguided iCBT	148	PHQ-9
		TAU	154	PHQ-9
		Guided iCBT	110	PHQ-9, BDI-II
		Waitlist	109	PHQ-9, BDI-II

### 3.3 NMA Meta-analysis Results

#### 3.3.1 Network Diagram

A total of 8 articles reported the PHQ-9 outcome measure, all of which were two-arm studies evaluating 4 interventions: Guided iCBT, Unguided iCBT, Waitlist, and TAU. The studies comparing Guided iCBT against Waitlist had the highest number of comparisons and participants. There were no direct comparisons between Guided iCBT and Unguided iCBT or between Waitlist and TAU. A total of 12 articles reported the BDI outcome measure, with 2 being three-arm studies and 10 being two-arm studies evaluating 4 interventions: Guided iCBT, Unguided iCBT, Waitlist, and TAU. The studies comparing Guided iCBT against Waitlist had the highest number of comparisons and participants, while there were no direct comparisons between Waitlist and TAU. The overall network diagrams for PHQ-9 and BDI measures across different treatment modalities are shown in Figure 3.

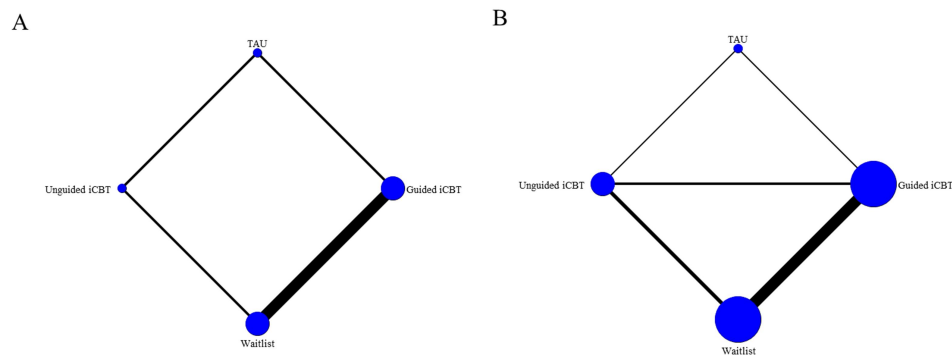


Figure 3 The overall network diagrams for PHQ-9 and BDI measures across different treatment modalities

Note: figure 3A represents the indices of PHQ-9, figure 3B represents the indices of BDI;

PHQ-9= Patient Health Questionnaire-9, BDI= Beck Depression Inventory

#### 3.3.2 Network Meta-Analysis (NMA) Results for PHQ-9 and BDI Measures

To evaluate the treatment effects of different interventions on depression, the effectiveness rankings for the PHQ-9 outcome measure were as follows: i) Unguided iCBT, SURCA value of 97.2; ii) Guided iCBT, SURCA value of 57.3; iii) Waitlist, SURCA value of 38.5; iv) TAU, SURCA value of 7.0. For the PHQ-9 outcome measure, Unguided iCBT was significantly superior to Waitlist (SMD: -3.06, 95% CI: -6.06 to -0.05), while there were no significant differences among the other treatment modalities. For the BDI outcome measure, the effectiveness rankings were as follows: i) Guided iCBT, SURCA value of 75.3; ii) Unguided iCBT, SURCA value of 61.9; iii) TAU, SURCA value of 59.4; iv) Waitlist, SURCA value of 3.3. For the BDI outcome measure, both Unguided iCBT and Guided iCBT were significantly superior to Waitlist (SMD: 0.73, 95% CI: 0.15 to 1.32), while there were no significant

differences among the other treatment modalities. The SURCA values for the PHQ-9 measure across different treatment modalities are shown in Figure 4, and the SURCA values for the BDI measure are shown in Figure 5. The results of SMD comparisons between different treatment modalities are presented in Table 2.

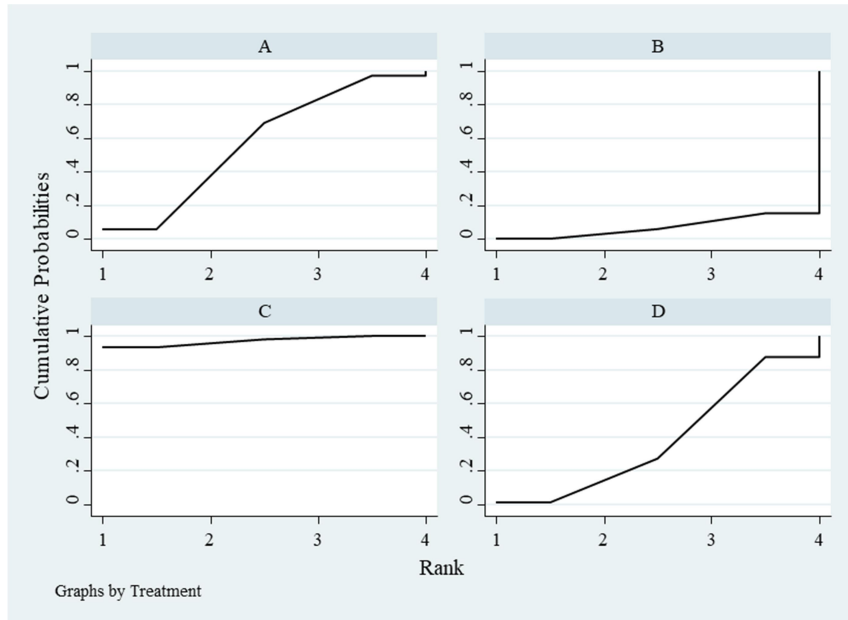


Figure 4 The SURCA values for the PHQ-9 measure across different treatment modalities

Note: A = Guided iCBT, B = TAU, C = Unguided iCBT, D = Waitlist

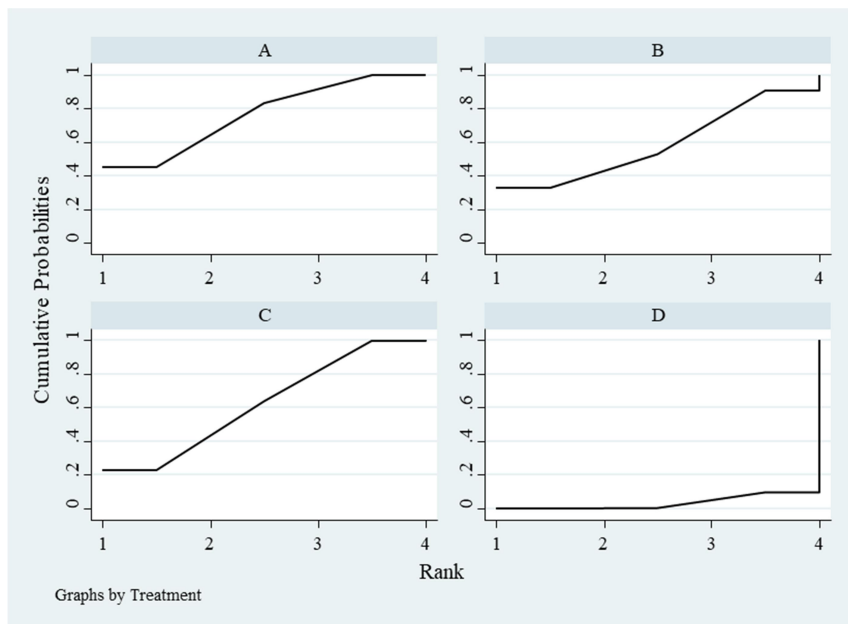


Figure 5 SURCA values for the BDI measure

Note: A = Guided iCBT, B = TAU, C = Unguided iCBT, D = Waitlist



Table 2 The results of SMD comparisons between different treatment modalities (Mean with 95%CI)

		PHQ-9		
BDI	Guided iCBT	0.50 (-1.07,2.07)	-2.56 (-5.70,0.58)	2.23 (-0.78,5.23)
	<b>-0.85 (-1.24,-0.47)</b>	Waitlist	<b>-3.06 (-6.06,-0.05)</b>	1.73 (-1.41,4.87)
	-0.12 (-0.73,0.49)	<b>0.73 (0.15,1.32)</b>	Unguided iCBT	4.78 (1.77,7.80)
	-0.15 (-1.18,0.88)	0.70 (-0.36,1.76)	-0.03 (-1.07,1.00)	TAU

### 3.3 Publication Bias

A funnel plot was employed to assess publication bias, and the results are shown in Figure 6. Visual inspection of the scatter distribution in the funnel plot did not reveal significant publication bias. However, considering the limited number of studies included in the comparison, the assessment of publication bias using this method is unreliable.

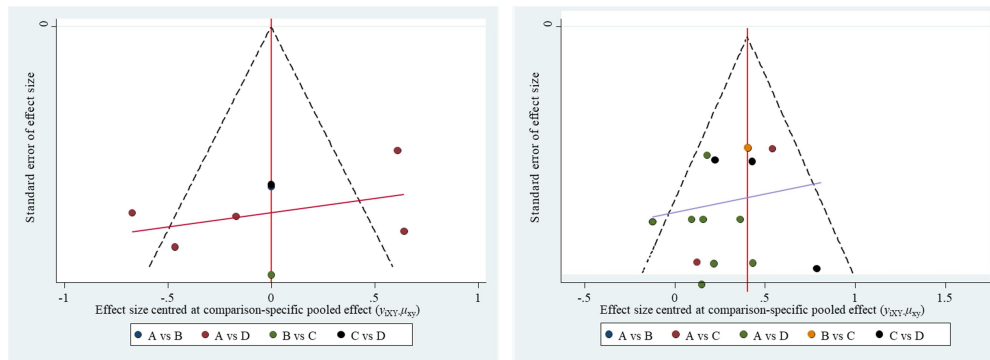


Figure 6 Funnel plot of publication bias

Note: A = Guided iCBT, B = TAU, C = Unguided iCBT, D = Waitlist

### 4. DISCUSSION

In this network meta-analysis, we analyzed data from 17 randomized controlled trials to compare the effects of Guided iCBT, Unguided iCBT, Waitlist, and TAU on the PHQ-9 and BDI outcomes in patients with depression. The results revealed that Unguided iCBT had the most favorable intervention effect for the PHQ-9 outcome, while Guided iCBT had the most favorable intervention effect for the BDI outcome. Furthermore, there were no significant differences in PHQ-9 and BDI scores between Guided iCBT and Unguided iCBT. Unguided iCBT was significantly superior to Waitlist for the PHQ-9 outcome (SMD: -3.06, 95% CI: -6.06 to -0.05), and both Unguided iCBT and Guided iCBT were significantly superior to Waitlist for the BDI outcome.

Depression is a prevalent mental disorder that contributes to significant disability and healthcare costs [31,32]. Diagnosis and monitoring of depression primarily rely on clinical interviews or self-report scales due to the absence of laboratory or imaging

tests. The PHQ-9 and BDI are widely used measures to assess depression severity [33]. The PHQ-9 encompasses the diagnostic criteria for major depressive disorder in the DSM-5, making it useful for evaluating severity and providing diagnostic indications [34]. The BDI-II, utilized in this study, assesses depression symptoms, cognition, and physical manifestations, with higher scores indicating greater severity [35]. It is important to note that these tools serve as assessments and not diagnostic tools, which require consideration of other clinical symptoms and professional judgment.

The interventions examined in this study were Guided iCBT, Unguided iCBT, Waitlist, and TAU. iCBT, based on Beck's cognitive model and behavioral activation, delivers standardized therapy through online platforms, resembling traditional CBT. iCBT has gained popularity due to its acceptability, efficacy, and feasibility [36,37]. It can be delivered with or without therapist guidance, and this study found no significant difference in effectiveness between the two forms. A meta-analysis by Karyotaki et al. reported inconsistent findings, with Guided iCBT showing greater overall improvement compared to Unguided iCBT [38]. The disparity in conclusions may stem from the inclusion of patients from both community and clinical settings in Karyotaki et al.'s study, while our study exclusively focused on community settings. Evidence has indicated that within-group pre-post effects for depression treatment interventions range from -0.64 to -2.24 [39]. Anxiety often coexists with depression, and for anxiety disorders [40], a meta-analysis found that Unguided and Guided iCBT interventions yield similar results, although Guided iCBT may be slightly more effective in the short term [41]. The lack of follow-up data in this study warrants further assessment of long-term efficacy. Notably, both forms of iCBT were significantly superior to Waitlist, and TAU also showed better results, albeit without statistical significance.

This study has a few limitations. The meta-analysis was unable to account for the impact of cluster randomization due to inadequate reporting in many included cluster randomized controlled trials. Additionally, long-term follow-up results were not available in the analysis.

## 5. CONCLUSION

In individuals with depression residing in community settings, iCBT demonstrates significant improvements in depressive symptoms, with no significant differences observed between guided and unguided interventions.

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