

Effectiveness of Internet-Based Cognitive Behavioral Therapy (iCBT) in Treating Depression: A Meta-Analysis Study

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Abstract

Depression is a major mental health concern worldwide and requires effective, accessible, and scalable interventions. Internet-based cognitive behavioral therapy (iCBT) has emerged as a promising alternative to face-to-face therapy, particularly in overcoming barriers related to access, cost, and stigma. However, evidence regarding its effectiveness remains heterogeneous across individual studies. This study aimed to synthesize the available evidence on the effectiveness of iCBT in reducing depressive symptoms in adults and to examine whether expert assistance influences treatment outcomes. A meta-analysis was conducted using studies identified through a structured literature search with predefined inclusion and exclusion criteria. Eight eligible studies were included in the analysis. Because heterogeneity was identified across studies, the pooled effect was estimated using a random-effects model. The results indicate that iCBT has a statistically significant beneficial effect on reducing depressive symptoms, as reflected by a negative standardized mean difference and a confidence interval indicating significance. Subgroup analysis further showed no statistically significant difference between guided iCBT and self-directed iCBT. In addition, Egger's test did not indicate significant publication bias. Overall, these findings suggest that iCBT is an effective intervention for depression in adults and may represent a flexible treatment option across different delivery formats.

Keywords: Depression, Cognitive Behavioral Therapy (CBT), Internet-Based

Introduction

Depression is a mental disorder characterized by a persistently low mood that lasts for an extended period and affects emotional, cognitive, and behavioral functioning (Acharya et al. 2015). The World Health Organization (WHO) identifies depression as one of the most prevalent mental disorders globally and a major public health challenge. Globally, more than 5% of adults experience depression, indicating that this condition requires serious attention because of its substantial impact on quality of life, daily functioning, productivity, and social well-being. As a mental health condition with broad personal and societal consequences, depression not only affects the individual sufferer but also places a burden on families, healthcare systems, and economies. This makes depression an important issue for both clinical intervention and public health policy.

Lubis (2016) stated that in severe cases, depression can lead to suicidal behavior among sufferers. This underlines the urgency of timely and effective treatment. Various approaches have been developed to reduce depressive symptoms, one of which is therapy. Among the available psychotherapeutic interventions, Cognitive Behavioral Therapy (CBT) has long been recognized as an effective treatment for depression. CBT is a form of psychotherapy that emphasizes cognitive processes, based on the assumption that maladaptive emotions and behaviors arise from dysfunctional patterns of thinking shaped by environmental experiences and interpersonal interactions (Hofmann et al. 2012). By helping individuals identify, challenge, and modify negative thought patterns, CBT aims to reduce depressive symptoms and improve adaptive coping strategies. Its structured and skills-based nature has contributed to its widespread use in mental health practice.

Along with technological development, online CBT has emerged as a potential solution to overcome barriers to therapy access, including geographical distance, financial limitations, and stigma associated with seeking psychological help. Online CBT offers greater flexibility and accessibility, enabling individuals to receive therapeutic support anytime and anywhere. This is particularly important in contexts where face-to-face mental health services are limited or underutilized. In addition, internet-based delivery may improve reach among populations who are reluctant to seek conventional therapy because of social stigma, time constraints, or concerns about privacy. Several studies have shown that online CBT can be as effective as face-to-face CBT in reducing symptoms of depression. Various studies have been conducted to examine the effectiveness of online CBT, both web-based and app-based, in addressing mental health problems (Karyotaki et al., 2022; McCloud et al., 2020; Ritvo et al., 2021; Stuart et al., 2022; Weiner et al., 2020). These studies collectively suggest that digital psychological interventions are increasingly relevant in modern mental healthcare.

However, despite the promising evidence, findings across studies remain heterogeneous. Differences in intervention format, duration, delivery platform, level of therapist support, participant characteristics, and outcome measurement instruments may contribute to variations in reported effectiveness. Some studies emphasize the benefit of guided online CBT supported by professionals, while others report positive outcomes even in self-guided formats. Such diversity makes it difficult to draw a single, robust conclusion from individual studies alone. Consequently, a synthesis approach is needed to integrate the available evidence and evaluate the overall effectiveness of online CBT for depression more systematically and objectively.

Meta-analysis is a statistical method used to integrate findings from multiple individual studies in order to derive a more comprehensive conclusion from the overall body of research (Cheung and Vijayakumar 2016). In health research, meta-analysis plays a crucial role because it allows researchers to quantify pooled effects, assess variability across studies, and produce more reliable evidence than any single study can provide. This is especially important when prior studies yield mixed or inconsistent findings. By combining evidence from several randomized or controlled studies, meta-analysis can strengthen inference regarding treatment effectiveness and provide a more solid basis for evidence-based clinical and policy decisions. Therefore, conducting a meta-analysis on online CBT for depression is important not only for summarizing existing findings, but also for clarifying whether this intervention consistently produces beneficial effects across different study settings.

An additional issue that warrants attention is the role of expert assistance in the implementation of online CBT. In practice, internet-based CBT may be delivered either with professional guidance, such as support from psychologists or psychiatrists, or in a fully self-directed format. The extent to which such expert involvement improves treatment outcomes remains an important empirical question, as it has implications for scalability, cost-efficiency, and accessibility. If self-guided online CBT is shown to be comparably effective, it may offer a more feasible intervention model in resource-constrained settings. Conversely, if guided interventions perform substantially better, then professional support should remain an integral component of digital mental health services. This issue further highlights the importance of a meta-analytic approach capable of examining subgroup differences across intervention types.

Therefore, this study conducts a meta-analysis to determine the effectiveness of online CBT in reducing depression. More specifically, this research seeks to synthesize evidence from eligible studies and evaluate whether online CBT provides a significant therapeutic effect on depressive symptoms in adults. In addition, this study examines whether the effectiveness of online CBT differs according to the presence or absence of expert assistance. The contribution of this study lies in providing a more integrated and evidence-based evaluation of internet-based CBT for depression, which may serve as a reference for future research, mental health practitioners, and policymakers involved in designing accessible and scalable depression interventions. By

systematically reviewing and quantitatively synthesizing previous findings, this study is expected to contribute to the growing literature on digital mental health and to support the development of more effective depression treatment strategies.

Method

Search Strategy

Literature search was conducted on the health research database, namely PubMed with the keywords "Cognitive Behavioral Therapy online", "Depression", and "Internet-Based". In addition, there are additional filters applied, namely, the articles used are articles published in the last 10 years to ensure the relevance of the research and full papers in English must be available to facilitate the review process. The inclusion criteria in this study are as follows.

1. The population is adults aged 18 years and over
2. The study is a randomized controlled trial (RCT) or clinical trial
3. The study carries out interventions in the form of online CBT either in the form of web, apps or other online media.
4. The study measures symptoms of depression with the standard beck depression index (BDI) and patient health questionnaire (PHQ-9)

Furthermore, there are exclusion criteria in the form of studies or research that should not be used as literature. The following are the exclusion criteria in this study.

1. Studies that do not specifically focus on online CBT as the main intervention
2. Studies that do not have a control group or use non-standard comparisons
3. Studies that do not use standardized assessments to measure depressive symptoms.
4. Studies with non-randomized designs such as meta-analyses, case reports, reviews, etc.

Data Synthesis and Analysis

The meta-analysis was conducted using R Studio software. The primary outcome measure was the change in depressive symptoms from baseline to post-intervention, measured by the standardized assessment tool BDI PHQ-9. Effect sizes were calculated using the Standardized Mean Difference (SMD) or with confidence intervals (CI) which can be estimated using Hedges's g based on the following equation (Chen and Peace 2021).

$$d = \frac{\bar{X}_1 - \bar{X}_2}{S}$$

Where $\bar{X}_1$ is the mean of the control group and $\bar{X}_2$ is the mean of the treatment group with S is the combined standard error by summing the standard errors S_1^2 of the control group with the treated group S_2^2 which can be calculated using the following formula.

$$S = \sqrt{\frac{(n_1 - 1)S_1^2 + (n_2 - 1)S_2^2}{n_1 + n_2 - 2}}$$

Furthermore, to conduct a meta-analysis, knowledge is needed regarding the existence of other variability that affects the study or what is called heterogeneity. Heterogeneity test. Heterogeneity can be used as a reference for determining the model used if there is heterogeneity, a random effect model is used, otherwise a fixed effect will be used. The meta-analysis in this case is carried out with the following steps (Borenstein et al. 2009).

1. Determine the heterogeneity test using the I^2 statistic, with values of 25%, 50%, and 75% representing low, moderate, and high heterogeneity, respectively. The random effect model is

used for meta-analysis if significant heterogeneity is detected ($I^2 > 50\%$); otherwise, the fixed effect model is applied.

2. Perform modeling based on heterogeneity conditions, if there is no heterogeneity, a fixed effect is used, but if there is heterogeneity, a random effect is used. Furthermore, in the subgroup analysis, it is necessary to determine whether the variance between subgroups is the same, if it is the same, a pooled estimate is used, and if not, a separate estimate is used. However, in small study conditions, the variance is considered the same and is estimated using the pooled estimate (Borenstein et al. 2009)

Results

Pemilihan literatur awal di peroleh sebanyak 315 publikasi dengan keyword yang telah dijelaskan sebelumnya. Selanjutnya dilakukan ekstraksi dengan memilih paper full text 10 tahun terakhir sehingga hanya tersisa 186 literatur. Kemudian berdasarkan karakteristik responden tersisa 75 literatur dengan 45 di antaranya adalah penelitian RCT. Kemudian dari seluruh penelitian tersebut terdapat 20 literatur yang berfokus pada intervensi CBT online dan terdapat 1 literatur yang memenuhi seluruh kriteria dan akan dilanjutkan dalam meta analysis dengan karakteristik studi pada tabel 1.

Heterogeneity Analysis

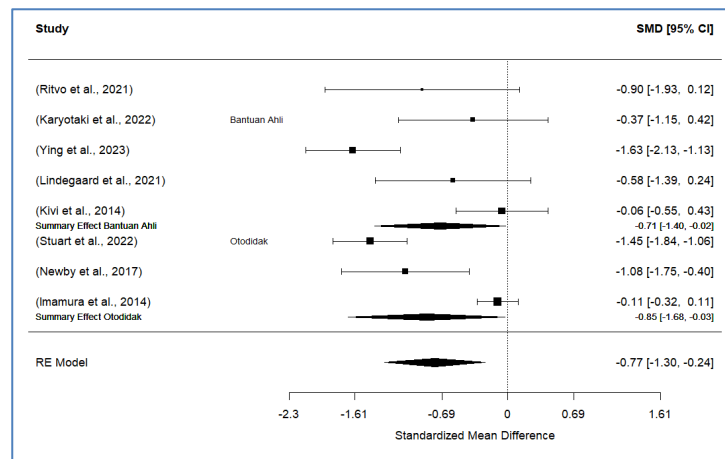
A meta-analysis was conducted on the 7 selected studies above with effect sizes in the form of standardized means of depression levels (PHQ-9 and BDI-II) of the intervention group compared to the group. In the first stage, a heterogeneity test was carried out between studies which refers to the variability of results between the included studies. In this study, the value was obtained. Thus, in this study, it can be stated that there is heterogeneity between studies. This shows that there is variability in studies that cannot be explained by sampling error.

Study	Intervention	Outcome Measure	Control (total; rerata umur; %pria)	Intervention (total, rerata umur, %pria)
(Ritvo et al. 2021)	Providing CBT-M content in the form of workbooks and videos that are accessed online	BDI-II	23; 24; 30	22; 25; 46
(Karyotaki et al. 2022)	Providing 7 weekly online CBT sessions with a weekly agenda consisting of introduction, problem recognition and behavioral activation, psychoeducation, cognitive restructuring, problem solving to future planning	PHQ-9	52; 22; 17,3	48; 22;10
(Stuart et al. 2022)	Teaching patients CBT techniques through videos with an introductory module and 3 learning modules containing 10 lessons	PHQ-9	154; 31;19,5	148; 32; 16,9
(Newby et al. 2017)	CBT via mobile phone and email where participants are asked to complete web-based CBT learning in cartoon format	PHQ-9	49; 47; 29	42; 47; 29
(Ying et al. 2023)	The intervention was conducted for 5 weeks via WeChat using a depression module that taught CBT practices	PHQ-9	109; 40,4; 31	110; 39,9; 31
(Lindegaard et al. 2021)	The intervention was conducted by providing a depression module with two psychologists using a special messaging platform with weekly feedback and weekly supervision	PHQ-9	29; 34,7; 48	30; 40,5; 63
(Imamura et al. 2014)	The program was conducted for 6 weeks with stress management material. Each week 1 material was given in manga format (Japanese comics)	BDI-II	381; 37,2; 82,4	381; 38,9; 85,3
(Kivi et al. 2014)	ICBT is carried out with 8-10 short modules provided in a workbook that can be accessed weekly for free	BDI-II	35; 36; 24	30; 36; 24

Meta Analysis Results

After identifying heterogeneity between studies that showed heterogeneity, an estimate was made using random effects. The results of the analysis showed that the estimated effect sizes in comparing the control and intervention groups individually showed that there were 3 studies that showed a significant effect on reducing depression influenced by the intervention, namely the research of Stuart, et. al (2022), Newby, et, al. (2017) and Ying et. al. (2023). In other studies, it was also shown that ICBT was able to reduce depression better than the control group although with an insignificant effect. Overall, the estimated value was obtained. These results indicate that based on all studies, interventions can reduce depression as indicated by a negative SMD value with a significant effect indicated by the confidence interval. The overall results can be seen in Figure 1.

Figure 1 also shows the difference in weight given by the study to the conclusion shown by the difference in the size of the box shown in the forest plot. This indicates that the differences in treatment, protocol, and population owned by each study have different effects on the results of ICBT. For example, what was done by Imamura et al. (2014) which is the study with the largest weight in this study. Shows that the provision of iCBT modules in manga format does not provide a significant difference compared to the control group in reducing depression as indicated by changes in BDI-II values.



It is further known that there are two subgroups in all studies obtained, namely the study group with ICBT accompanied by expert assistance in the form of psychologists or psychiatrists and the group with manual ICBT in the form of providing modules that are learned autodidactically through the media provided. The subgroup analysis in Figure 1 shows that both groups given expert intervention and those not given significant results in the success of ICBT in treating depression. Then an analysis was carried out to test the differences in the ICBT method with expert intervention and not using the Z-test and the p-value was obtained. This shows that there is no difference in the results obtained in treating depression with ICBT based on the expert intervention provided. In addition to testing for publication bias with the Egger test, the test showed a p-value of $0.2725 > 0.05$ so that it can be stated that there is no publication bias in the study.

Discussion

Systematic Review

The literature reviewed in this study is literature that measures the effectiveness of iCBT with a randomized controlled trial (RCT) research design. RCT in the study was conducted on 2 groups, namely, a control group in the form of patients who were given standard psychological care or called treatment as usual (TAU) and patients who were given intervention in the form of ICBT. There are two measuring instruments used to measure depression in this study, namely the Beck Depression Index-II (BDI-II) and the Patient Health Questionnaire-9 (PHQ-9). There are 3

literatures that use the BDI-II as a measure of depression (Imamura et al. 2014; Kivi et al. 2014; Ritvo et al. 2021). The BDI-II has been widely used to measure depression with good measurement validation. Measurement of depression with the BDI-II is carried out with 21 instruments that include cognitive, affective and psychological abilities that are able to describe the patient's depression condition (Milgrom et al. 2016). The higher the BDI, the higher the level of depression experienced by the patient. In a study conducted by Ritvo et al. (2021) showed a difference in BDI reduction experienced by patients given iCBT of 61% compared to the TAU group which only reached 14%. The iCBT given was in the form of mindfulness CBT. The most visible improvement in the intervention group was the lack of critical self-assessment after the intervention for 6 months and cognitive modification of depression. The treatment of depression carried out (Ritvo et al. 2021) was also accompanied by doctor intervention in the form of feedback given periodically to each patient.

Research by Imamura et al. (2014) also showed a significant decrease experienced by patients after being given iCBT. iCBT in this case was given based on Japanese comics (manga) where each material was presented in the form of manga. The research population given was workers in a company. This study shows the possibility of providing therapy for patients with quite high levels of activity at a relatively low cost. Research by Kivi et al. (2014) was conducted with a focus on health workers, especially nurses. The study showed no significant difference between the TAU and iCBT groups, based on the BDI-II, this is inseparable from various research limitations such as the number of respondents who were considered still below the specified standard and there was still an opportunity for respondents to receive other treatments outside the treatment that had been given. Although assisted by psychiatric intervention, the study did not show any difference between the TAU and iCBT groups. In addition to the BDI-II, depression can also be measured with the PHQ-9. The PHQ-9 is a psychiatric instrument that can be used for early detection of depression. The questions given include the possibility and desire to harm oneself and the feelings experienced at a certain time (Milgrom et al. 2016). Detection of depression with the PHQ is quite often used because it is easy to use. This was also done by (Karyotaki et al. 2022; Lindegaard et al. 2021; Newby et al. 2017; Stuart et al. 2022; Ying et al. 2023). Research conducted by Karyotaki et al. (2022) showed that there was no significant difference in reducing depression between the iCBT and TAU groups, although in the study almost 50% of respondents successfully completed the entire series of treatments with a fairly good assessment of the treatment.

The study suggests the importance of deeper identification of respondents in order to capture the effectiveness of iCBT in more depth, such as increasing the number of respondents and adjusting the patient's background to be more homogeneous. iCBT has shown effectiveness in reducing depression based on the PHQ-9 (Lindegaard et al. 2021; Stuart et al. 2022; Ying et al. 2023). The study by Lindegaard et al. (2021) was conducted on Arabic-speaking Swedish immigrants, while the study (Ying et al. 2023) was aimed at adults in China. This can show the effectiveness of using iCBT regardless of geographic location. Finally, the study by Stuart et al. (2022) was conducted by applying iCBT to depressed patients with diabetes. Research shows that the decrease in depressive symptoms in diabetic patients is greater when compared to patients without other diseases (Perini, Titov, and Andrews 2009).

Conclusion

This meta-analysis provides evidence that internet-based cognitive behavioral therapy (iCBT) is an effective intervention for reducing depressive symptoms in adults. Based on eight eligible studies, the pooled analysis using a random-effects model indicates that iCBT produced an overall beneficial effect, as reflected by a negative standardized mean difference and a confidence interval indicating statistical significance. These findings suggest that iCBT can serve as a meaningful alternative to conventional treatment approaches for depression, particularly in contexts where access to face-to-face psychological services is limited. Subgroup analysis further showed that both

guided and self-directed iCBT interventions were associated with significant improvements, while no statistically significant difference was found between interventions delivered with expert assistance and those undertaken independently.

This result implies that iCBT may retain therapeutic value even in less resource-intensive formats. In addition, the Egger test did not indicate significant publication bias, supporting the credibility of the synthesized evidence. Nevertheless, the findings should be interpreted with caution because the included studies varied in intervention format, participant characteristics, and delivery media, which may contribute to between-study heterogeneity. Future research should therefore examine specific intervention components, delivery platforms, participant adherence, and long-term outcomes to better identify the conditions under which iCBT is most effective for treating depression.

Acknowledgment

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