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Is Digital Mental Health Care the Future? A Systematic Review and Meta-Analysis of the Effectiveness of Internet-based Cognitive Behavioral Therapy During the COVID-19 Pandemic

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Abstract: ***This meta-analysis evaluated the effectiveness of internet-based Cognitive Behavioral Therapy (iCBT) in reducing depression, anxiety, and stress during the COVID-19 pandemic. Synthesizing data from 19 randomized controlled trials, the study found that iCBT significantly reduced symptoms of depression and anxiety both post-intervention and at follow-up, while effects on stress were smaller and less consistent. Therapist-guided formats produced stronger outcomes than unguided ones, particularly for individuals with moderate to severe symptoms. Moderator analyses revealed that longer interventions were more effective for depression, but age did not significantly influence outcomes. Subgroup analysis also indicated cultural variations, with non-Asian studies reporting greater anxiety reductions. These findings support iCBT as a scalable, accessible solution for mental health care delivery, especially during global crises. Despite its promise, limitations include high heterogeneity, limited stress-related evidence, and inconsistent adherence reporting. The study emphasizes the need for symptom-specific tailoring, culturally adapted programs, and investment in digital infrastructure. Overall, iCBT offers a practical, evidence-based response to global mental health challenges and should be considered a vital component of future mental health policy and service delivery models.***

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1. Introduction

The COVID-19 pandemic triggered a profound global mental health crisis, with dramatic increases in depression, anxiety, and stress reported across populations. Lockdowns, social isolation, economic uncertainty, and health-related fears contributed to this rise in psychological distress. At the same time, public health measures disrupted traditional face-to-face psychological services, exposing the limitations of existing mental health care infrastructure and highlighting an urgent need for accessible, scalable, and effective alternatives.

Within this context, internet-based Cognitive Behavioral Therapy (iCBT) emerged as a promising solution. Building on the well-established efficacy of Cognitive Behavioral Therapy (CBT) for treating common mental health disorders, its digital adaptation offers distinct advantages: enhanced accessibility, reduced costs, and continuity of care during service disruptions. However, while the clinical utility of CBT is well documented, the relative effectiveness of iCBT—particularly during acute crises such as the COVID-19 pandemic—remains an area requiring rigorous evaluation.

The pandemic presents a unique opportunity to assess not only the clinical effectiveness of iCBT but also its practical feasibility during a global emergency. The diversity of psychological stressors introduced by COVID-19, ranging from health fears to socioeconomic disruption, created a broad spectrum of mental health challenges. This context allows for a nuanced examination of how iCBT performs across symptom domains and subpopulations, offering insights into its adaptability and scope of application. Moreover, the digital acceleration prompted by the

pandemic has reshaped how mental health services are delivered, with many health systems increasingly integrating digital therapies into standard care. Understanding the performance of iCBT during this pivotal period can inform future mental health policy and practice—both in crisis settings and in routine care delivery.

1.1 Proposed Study

To address this need, this study conducts a systematic review and meta-analysis of randomized controlled trials (RCTs) evaluating the effectiveness of iCBT in treating depression, anxiety, and stress during the COVID-19 pandemic to address the primary research question:

How effective was internet-based Cognitive Behavioral Therapy (iCBT) in improving mental health outcomes (depression, anxiety, and stress) during the COVID-19 pandemic across diverse populations, based on randomized controlled trial evidence?

The study also aims to assess moderating factors which may impact iCBT's effectiveness, as well as the broader feasibility of iCBT implementation within healthcare systems, particularly under conditions of widespread service disruption.

Overall, the findings demonstrate that iCBT is effective in reducing depression and anxiety, though results for stress reduction remain inconclusive. Despite this, the evidence supports the integration of iCBT into mental health care pathways, both for its clinical impact and its potential to increase access to care through technological innovation.

2. A Contextual and Theoretical Discussion of COVID-19, Mental Health, and Internet-based Cognitive Behavioral Therapy

On January 30, 2020, the World Health Organization (WHO) declared COVID-19 a global public health emergency, later classifying it as a pandemic on March 11. By mid-July, the virus had infected over 13 million people across 217 countries, resulting in more than 572,000 deaths (World Health Organization, 2020a–b).

2.1 The Impact of COVID-19 on Mental Health

The psychological consequences of large-scale infectious disease outbreaks have been documented in epidemics such as SARS, H1N1, MERS, and Ebola, which consistently showed increased levels of anxiety, depression, and psychological distress, particularly among healthcare workers and affected populations (Matsuishi et al., 2012; Kisely et al., 2020). During the COVID-19 pandemic, similar trends were observed, prompting the United Nations to issue warnings about the pandemic's potential to severely exacerbate global mental health challenges (Tabish, 2020).

Pandemic-related distress stems from complex causes, including prolonged isolation, social distancing, and travel restrictions, which contribute to loneliness, boredom, and lack of purpose. In parallel, the presence of physical symptoms such as fever, fatigue, cough, and myalgia has been associated with emotional distress and a heightened fear of infection (Zhao et al., 2021). The sudden emergence, global spread, and high transmissibility of the virus further fuelled widespread uncertainty, contributing to elevated levels of anxiety, depression, and stress among the general public (Wang et al., 2021).

Globally, depression and anxiety are among the most prevalent mental health disorders, affecting 3.4% and 3.8% of the population, respectively (Baxter et al., 2014). These disorders are characterized by persistent sadness, cognitive impairment, sleep disruption, and emotional distress such as feelings of guilt, leading to reduced functioning and broader societal impacts (Mirzaei et al., 2019). Stress, defined as a psychological and physiological response to perceived threats, is commonly expressed through symptoms such as irritability, tension, sleep disruption, and difficulty coping (Yaribeygi et al., 2017).

The pandemic sharply amplified these challenges. Santomauro et al. (2021) reported a 276% increase in major depressive disorder worldwide, equating to over 500 million additional cases. A meta-analysis by Bueno-Notivol et al. (2021) found that depression was seven times more prevalent during the pandemic than in 2017. Similarly, anxiety disorders surged by 256%, affecting over 760 million individuals (Santomauro et al., 2021). Though data on stress levels are less widely reported, elevated levels were consistently observed among frontline workers,

caregivers, students, and individuals with pre-existing conditions (Xiong et al., 2020). The severity of mental health outcomes varied by occupation, health status, and cultural context (Tan et al., 2020). Among healthcare workers, exposure to patient mortality and long work hours impaired both personal well-being and professional performance (Greenberg et al., 2020). Some researchers argue that the psychological toll may rival the physical impact of the virus (Liu et al., 2020).

Post-infection, Long COVID introduced persistent mental health complications. Dai et al. (2025) found that up to 95% of individuals experienced cognitive symptoms like brain fog and memory loss, closely tied to depressive severity ($r = 0.42$). Chronic fatigue mediated 34% of anxiety risk (Deng et al., 2021), and widespread sleep disturbances (affecting 76% of patients) compounded these effects (Bidhendi-Yarandi et al., 2025).

Mental health outcomes also varied culturally. In the U.S., Black adults with Long COVID were over twice as likely to report hopelessness or suicidal tendencies compared to their white counterparts but were less likely to attribute these to mental health issues, a disparity linked to structural inequalities (Lukkahatai et al., 2023). In contrast, Chinese cohorts reported lower anxiety prevalence (13%) compared to Western populations (27%), likely due to underreporting and stigma (Deng et al., 2021). Yet, cognitive impairments appeared consistent across cultures, suggesting these symptoms may be universally experienced.

2.2 Cognitive Behavioral Therapy During COVID-19

Mental health disorders are typically treated with a mix of pharmacological and psychological interventions. While medications like selective serotonin reuptake inhibitors (SSRIs) are widely used, they often have side effects and poor adherence (Vaswani et al., 2003). Psychological therapies, particularly Cognitive Behavioral Therapy (CBT), are frequently preferred and strongly recommended in clinical guidelines (Powell et al., 2008). CBT is based on the idea that cognitive, emotional, and behavioral processes are interconnected. It helps individuals identify and reframe unhelpful thoughts and build healthier coping strategies (Gautam et al., 2020). Numerous RCTs and meta-analyses confirmed its effectiveness across clinical and non-clinical groups (e.g., Li et al., 2020; Maj et al., 2023; Zamiri-Miandoab et al., 2022).

During the COVID-19 pandemic, CBT helped people manage the unprecedented increase in depression, anxiety, and stress due to the factors outlined in section 2.1. However, since public health restrictions disrupted traditional therapy models, internet-based Cognitive Behavioral Therapy (iCBT) emerged as a viable alternative, using websites and apps to deliver self-guided or therapist-guided interventions. It demonstrated strong short-term symptom reduction and enhanced accessibility, autonomy, and cost-efficiency (Gratzer et al., 2015) compared to traditional models of CBT. Previous meta-analyses show iCBT effectively reduces depression (SMD range: −0.37 to −0.73), anxiety (SMD = −0.29 in adults; −0.44 in youth), and to a lesser extent, stress (SMD = −0.17) (Brinsley et al., 2025; Fischer-Grote et al., 2024). Within this context, digital mental health tools became a necessary channel for ongoing mental health care.

Globally, iCBT adoption was rapid during the pandemic. In China and other countries, digital platforms supported quarantined populations and showed adaptability under crisis conditions (Salameh et al., 2020; Wind et al., 2020). Even before the pandemic, iCBT offered clear advantages such as lower costs, broader access, and greater privacy, especially for those reluctant to seek face-to-face help (Ma et al., 2024). Additionally, user satisfaction with digital therapy has generally been high. Clients often report strong therapeutic alliances via videoconferencing, comparable to in-person sessions (Simpson & Reid, 2014). Platforms like Better Help, and social media-based tools, have reached younger and underserved groups, especially when co-designed with users for better engagement (Pretorius, 2019; Grist et al., 2019). Among university students, some prefer online guided self-help over traditional therapy (Carlbring et al., 2018). However, low completion rates for online programs raise concerns about long-term engagement and effectiveness (Andrews et al., 2018).

Given the scale of mental health treatments required during COVID-19, evaluating the effectiveness of iCBT has become a public health priority. This study addresses this need by synthesizing evidence from randomized controlled trials to assess how iCBT performed during a period of exceptional increases in mental health problems rapid technological innovation.

3. Systematic Review of the Effectiveness of Internet-based Cognitive Behavioral Therapy (iCBT) on Mental Health Outcomes During the COVID-19 Pandemic.

While numerous studies have examined these psychological outcomes during the pandemic (Usher et al., 2020), relatively few have focused specifically on evidence-based interventions such as Cognitive Behavioral Therapy (CBT). Even fewer have systematically evaluated the digital delivery of such interventions—particularly internet-based CBT (iCBT)—within the general population during this period of widespread disruption.

Much of the existing literature has focused narrowly on specific high-risk groups, such as healthcare workers (Salari et al., 2020b) or patients diagnosed with COVID-19 (Deng et al., 2021). Although valuable, these group-specific reviews often fail to account for the broader psychosocial toll of the pandemic on the general population. As Pierce et al. (2020) emphasized, mental health difficulties during COVID-19 extended far beyond frontline workers or infected individuals, affecting diverse segments of the population due to widespread stressors such as economic uncertainty, job loss, social isolation, and disruption to daily life. This widespread burden highlights the urgent need to evaluate scalable, accessible interventions like iCBT that can reach a broad audience beyond traditional clinical settings.

Furthermore, pandemic-related restrictions necessitated the use of remote and digital mental health solutions. Among these, iCBT offers a theoretically sound and practically feasible alternative to in-person therapy, but a systematic synthesis of its effectiveness across varied populations remains limited. While some existing reviews address psychological interventions during COVID-19, many rely on narrative synthesis or omit essential methodological components—such as randomized controlled trials (RCTs) or control-group comparisons—thereby limiting their ability to draw robust, generalizable conclusions (Chilver & Gatt, 2022). The inclusion of RCTs is critical, as they remain the gold standard for establishing intervention efficacy. Additionally, understanding the nature of control conditions and adherence levels is essential when evaluating complex mobile or internet-based health interventions (Sun et al., 2024).

3.1 Rationale

To address these gaps, this study conducts a comprehensive systematic review and meta-analysis of randomized controlled trials investigating the effectiveness of iCBT for reducing symptoms of depression, anxiety, and stress during the COVID-19 pandemic. A meta-analytic approach was intentionally selected over narrative synthesis, as it allows for the quantitative aggregation of effect sizes across studies, yielding statistically robust estimates of treatment efficacy. Narrative synthesis, though useful for identifying thematic trends, lacks the replicability, objectivity, and precision needed to inform clinical practice or policy, particularly in crisis contexts where rapid, evidence-based decision-making is vital.

By integrating consistent quantitative methods within a transparent and standardized review framework, this study aims to produce reliable, generalizable evidence regarding the clinical effectiveness and scalability of iCBT. Beyond its direct empirical contribution, the research provides timely insights into how digital mental health interventions can be embedded into routine care, both during future public health crises and in a post-pandemic healthcare environment increasingly shaped by digital delivery models.

3.2 Methodological Framework for Conducting Systematic Review

This study set out to answer several research questions (see Table 1)

Table 1: Research questions

Overarching question	How effective was internet-based cognitive behavioral therapy (ICBT) in improving mental health outcomes (depression, anxiety, stress) during the COVID-19 pandemic across diverse populations, based on randomized controlled trial evidence?
1	To what extent do participant, intervention, and study characteristics (guidance format, control condition, geographic region, age, and intervention duration) moderate the effectiveness of iCBT?
2	How feasible was the implementation of iCBT for mental health support during the COVID-19 pandemic in real-world healthcare settings?

A systematic review involves compiling and analyzing secondary data by integrating all relevant primary research on a specific topic (Cumpston et al., 2022). Systematic reviews follow a clearly defined and replicable process that outlines the methods used to locate studies (3.1.1), the specific criteria for their inclusion or exclusion (3.1.2), and finally the methods used for data extraction (3.1.3) (Phillips & Barker, 2021). In addition to summarizing the

findings, a systematic review also incorporates an assessment of the quality and validity of the studies reviewed through a risk of bias assessment (3.1.4) and relevant analysis (3.1.5).

This study aimed to systematically evaluate the effectiveness and feasibility of internet-based cognitive behavioral therapy (iCBT) during the COVID-19 pandemic. The review followed the Cochrane Handbook for Systematic Reviews of Interventions and adhered to the PRISMA 2020 guidelines (Page et al., 2021). PRISMA provides a structured approach for reporting systematic reviews and meta-analyses, ensuring transparency, replicability, and methodological rigor throughout the study selection process. It includes a 27-item checklist and a four-phase flow diagram, which are used to systematically document identification, screening, eligibility assessment, and final inclusion of studies. These standards enhance the reliability of evidence synthesis, particularly in health-related research. The corresponding PRISMA flowchart is provided in Appendix A (Figure A1), and a completed PRISMA checklist is included in Appendix A (Figure A2).

3.2.1 Search strategy

A comprehensive literature search was conducted across eight electronic databases to capture the full scope of relevant studies on internet-based Cognitive Behavioral Therapy (iCBT) conducted during the COVID-19 pandemic. The databases included:

PubMed, Google Scholar, PsycInfo, Psyndex, Embase, ScienceDirect, Crossref, and Web of Science. Given the proliferation of COVID-19-related research and preprints during the early stages of the pandemic (Watson, 2022), manual searches were also performed through Google Scholar and reference lists of eligible studies to ensure completeness and reduce the risk of publication bias.

The search timeframe began in early 2020, following the global escalation of COVID-19. On January 30, 2020, COVID-19 was declared a Public Health Emergency of International Concern by the World Health Organization (World Health Organization, 2020a), and subsequently classified as a pandemic on March 11, 2020 (World Health Organization, 2020b). The search concluded in June 2024, capturing more than four years of pandemic-related research.

The search strategy combined Medical Subject Headings (MeSH) and free-text terms to maximize coverage and sensitivity. Key search terms included:

"Cognitive Behavioral Therapy" AND "CBT" AND ("online" OR "internet" OR "virtual" OR "eHealth" OR "mHealth") AND ("COVID-19" OR "coronavirus" OR "SARS-CoV-2") AND ("randomized controlled trial" OR "RCT").

Database-specific thesauri and indexing terms were incorporated where applicable, and the full search syntax for each database is provided (See Appendix B). No restrictions were placed on publication language or status, allowing for the inclusion of studies in non-English languages and grey literature.

All retrieved citations were compiled in Google Sheets (Google LLC, Mountain View, CA, USA) to facilitate deduplication and tracking. A total of 601 records were identified across the eight databases. After removing 487 duplicates, 114 unique records remained for screening. Titles were initially reviewed for relevance, resulting in the exclusion of 19 records. Abstracts of the remaining 95 records were then assessed, with an additional 18 excluded based on ineligibility.

Of the 77 records selected for full-text retrieval, 28 could not be assessed due to the following reasons:

- Study registry entries (n = 5)
- Protocol-only papers (n = 3)
- Narrative or systematic reviews (n = 7)
- Conference abstracts (n = 6)
- Irretrievable full texts (n = 7)

This left 49 full-text articles for eligibility assessment.

3.2.2 Eligibility criteria

Eligibility criteria were established using the Population, Intervention, Comparison, Outcome, and Study Design (PICOS) framework (see Table 2). This structured approach ensured consistency and transparency in selecting studies for inclusion in the systematic review and meta-analysis. To be eligible, studies were required to meet the criteria outlined in Table 2:

Table 2: PICOS Framework

Component of PICOS	Definition
Population	Individuals whose mental health was affected by the COVID-19 pandemic
Intervention	Online CBT (Cognitive Behavioral Therapy) delivered via internet-based platforms or applications (including iCBT, gCBT, cCBT, TB-CBT, CBT-based interventions)
Comparison	Inactive control group (waitlists or treatment as usual (TAU). Active control group (bibliotherapy, EMDR/ personalized psychological interventions)
Outcome	To reduce symptoms of depression, anxiety, or stress
Study Design	RCT conducted during the period of the COVID-19 pandemic (from January 2020 to June 2024)

COVID-19: Coronavirus Disease 2019, CBT: Cognitive Behavioral Therapy, PICOS: Population, Intervention, Comparison, Outcome, and Study Design, RCT: Randomized Controlled Trial

In addition to the core criteria, several exclusion criteria were applied to ensure the methodological and clinical relevance of included studies:

- Non-primary research: Review articles, case reports, case series, letters to the editor, and conference abstracts
- Inaccessible data: Studies without retrievable full texts or lacking sufficient statistical data (e.g., means and standard deviations) for meta-analysis
- Non-CBT therapies: Studies using psychotherapeutic modalities unrelated to CBT
- Special populations: Studies focusing on individuals with significant somatic conditions (e.g., pregnant women, cancer patients), which could limit generalizability to the broader population

Each study was rigorously evaluated against the predefined inclusion and exclusion criteria, leading to the exclusion of 30 studies based on the following reasons:

- CBT not used as the primary intervention (n = 4)
- CBT combined with other psychotherapies, making effects indistinguishable (n = 6)
- Intervention not delivered via online platforms (n = 5)
- Mental health outcomes unrelated to depression, anxiety, or stress (n = 4)
- Study design not consistent with RCT methodology (n = 8)
- Data collection occurred outside the COVID-19 period (n = 3)

Following this process, 19 randomized controlled trials met all inclusion criteria and were included in the final synthesis for the systematic review and meta-analysis. The study selection procedure is visually represented in the PRISMA flow diagram (Appendix A: Figure A1)

3.2.3 Data extraction

Data extraction was conducted systematically using a pre-specified form organized within a spreadsheet to ensure consistency and accuracy. The extracted data included several critical elements necessary for the meta-analysis: (1) the first author's name and year of publication, (2) the study location, (3) characteristics of the study population, (4) the sample size, (5) the mean age with standard deviation, (6) the type of CBT intervention employed, (7) the type of control group, (8) the delivery method, (9) the presence or absence of guidance during the intervention, (10) the number of sessions and the length of the intervention, (11) the type of measurements (pre, post, or follow-up), and (12) the instruments used, along with mean and standard deviation values of the outcome measures for depression, anxiety, or stress.

For outcomes measured using continuous variables, the mean post-intervention scores and corresponding standard deviations were extracted for both the intervention and control groups, along with the number of participants included in these analyses. In the case of crossover studies, only data from the first phase (pre-crossover) were included. If outcome data were missing, the original authors were contacted to obtain the necessary information.

If no response was received, the study was excluded from the analysis.

In cases where a single study utilized two different scales to measure the same outcome, data were extracted only for the scale measuring the primary outcome indicator. Additionally, for studies with multiple follow-up assessments, only data from the last follow-up visit were included to provide the most comprehensive outcome perspective.

Studies not reported in English were translated using available online translation tools before data extraction. This approach ensured the inclusion of non-English studies while maintaining data integrity. Through this rigorous process, the extracted data were standardized and prepared for subsequent analysis.

3.2.4 Risk of Bias Assessment

To ensure the methodological rigor and validity of the findings, the risk of bias in all randomized controlled trials (RCTs) (used in both primary and secondary outcomes) were independently assessed using the Cochrane Risk of Bias 2 (RoB 2) tool (Sterne et al., 2019). This test is designed to evaluate the internal validity of individual RCT's and measure biases in their design, conduct, and reporting. To achieve this, this tool evaluates five domains of potential bias in RCTs:

1) Bias arising from the randomization process
2) Bias due to deviations from intended interventions
3) Bias due to missing outcome data
4) Bias in measurement of the outcome
5) Bias in selection of the reported result

Each study was rated as having low risk of bias, some concerns, or high risk of bias across each domain (See Appendix C, Figure C1 & C2). The overall risk of bias judgment was determined according to the Cochrane guidance, with disagreements between reviewers resolved through consultation with a second reviewer.

Special attention was paid to: Blinding procedures, particularly given the challenges of blinding in psychological interventions; Adherence to intervention protocols, as many iCBT studies vary in their level of guidance and support; Handling of attrition and missing data, due to potential dropouts associated with digital interventions; Outcome measurement methods, especially for self-reported anxiety, depression, or stress scales.

The results are presented in the Results section (see 4.2.4.2 and 4.3.2.2) and Appendix C. The result of the domain-specific quality assessment is provided in Appendix C (Figure C1), while the detailed risk of bias evaluation of each study is summarized in Appendix C (Figure C2).

3.3 Data Synthesis and Meta-Analysis

Due to variability across studies in population, intervention, and outcome measures, a random-effects meta-analysis was conducted to synthesize findings while accounting for heterogeneity. This approach follows Cochrane guidelines and provides more conservative, generalizable estimates compared to a fixed-effect model.

The meta-analytical framework for data synthesis and analysis was informed by methodological precedents from prior research on digital psychological interventions. Notably, Carlbring et al. (2018) conducted successful meta-analyses synthesizing data from diverse outcome measures across digital mental health trials. Their approaches guided this study's use of random-effects modelling, heterogeneity assessment (Cochran's Q and I^2 statistics), sensitivity testing, and subgroup analyses. These techniques were employed to ensure both internal validity and practical relevance across a heterogeneous set of studies.

All statistical analyses were conducted using Python (v3.11) to evaluate the effectiveness of iCBT interventions on key mental health outcomes. Given the limited scope of this research, this procedure was narrowed down to select key areas of analysis. Below, I outline a detailed justification and description of each step, with direct reference to my study:

3.3.1 Primary and Secondary Meta-Analyses

Meta-analysis was chosen to synthesize quantitative findings across studies, particularly since this review focused exclusively on evaluating the effectiveness and acceptability of iCBT interventions in real-world settings during the COVID-19 pandemic. This contrasts with previous reviews that combined efficacy trials with studies conducted in routine care, potentially diluting external validity. By including only studies conducted in naturalistic clinical contexts, the current review minimizes biases associated with tightly controlled efficacy trials, such as strict eligibility criteria, intensive therapist supervision, or rigid protocol adherence (Haby et al., 2006). This approach enhances the generalizability and clinical applicability of findings across diverse healthcare environments. Given this focus on real-world impact, the analyses were structured to capture both the immediate and sustained effects of iCBT interventions:

1) Primary analysis: Assessed the post-intervention effects of internet-based Cognitive Behavioral Therapy (iCBT) on depression, anxiety, and stress.

2) Secondary analysis: Evaluated the sustainability of iCBT effects at follow-up (final measurement point).

The primary analysis focused on immediate post-intervention outcomes to determine the short-term effectiveness of iCBT interventions. The secondary analysis examined follow-up outcomes to assess the durability of treatment effects over time, which is crucial for evaluating the long-term clinical value and public health relevance of iCBT.

The results of these analyses are presented in table format within the results section (see 4.1.1: Table 3 & 5.2.1: Table 7). For more detailed visual representations of the data, including effect sizes across studies and pooled effects, forest plots can be found in Appendix E, Figure 1 (Primary Outcomes) and Appendix E, Figure 2 (Secondary Outcomes). These plots supplement the table results with a clear depiction of the effect sizes.

3.3.2 Meta-Regression (Primary outcomes)

To further investigate heterogeneity in effect sizes, a random-effects meta-regression using Restricted Maximum Likelihood (REML) estimation was conducted. This analysis aimed to assess whether continuous study-level variables, specifically mean participant age and duration of intervention (weeks), were associated with variations in intervention effectiveness. These moderators were selected based on theoretical relevance and prior literature suggesting their potential influence on treatment outcomes.

The use of a random-effects model accounts for both within-study and between-study variability, recognizing that true effects may differ across studies due to clinical and methodological diversity.

Meta-regression helps to quantify the extent to which these continuous moderators explain heterogeneity in the observed effect sizes, thereby improving the understanding of factors influencing intervention success.

3.3.3 Subgroup Analyses (Primary outcomes)

To explore potential categorical moderators of intervention effectiveness, prespecified subgroup analyses were conducted across three key study-level variables: geographic region (Asia vs. non-Asia), control type (active vs. inactive), and guidance level (therapist-guided vs. self-help). These factors were chosen based on hypotheses that contextual and methodological differences might impact outcomes.

Each subgroup analysis employed a random-effects model to accommodate potential heterogeneity within and between subgroups. The primary purpose of these analyses was to detect whether the intervention effect varied significantly across different study characteristics, offering insight into the conditions under which the intervention may be more or less effective.

To formally test for subgroup differences, between-group heterogeneity was assessed using Q statistics for interaction. Identifying significant subgroup effects can aid in tailoring interventions and improving implementation strategies for specific populations or settings.

3.3.4 Publication Bias and Sensitivity Analyses (Primary and Secondary outcomes)

To assess the risk of publication bias and small study effects within the overall body of evidence, Egger's regression test was used. This test assessed whether smaller studies with non-significant results are missing from

the evidence base, thereby distorting the pooled effect. A p-value of < 0.05 on Egger's test was considered indicative of potential publication bias.

A sensitivity analysis, in which different patterns of selection bias are tested against the fit, was also conducted to incorporate risk of bias into the synthesis process. Statistical heterogeneity was assessed using Cochran's Q test and the I^2 statistic, which quantifies the proportion of total variance due to between-study differences. Following Cochrane guidelines, I^2 values were interpreted as follows: 25% (low), 50% (moderate), and 75% (high) heterogeneity (Cumpston et al., 2022).

Where I^2 exceeded 50% or the Q-test was significant ($p < 0.10$), further sensitivity analyses were conducted. This included leave-one-out analytical procedures and the exclusion of high-risk studies to enhance the robustness and validity of the findings.

4. Results

In answering the research questions (see table 1), findings from this study will be split into three sections. Section one will outline the characteristics of the included studies following the selection process (see 3.1), section two will outline the results from Primary Outcomes, and section three will outline findings from Secondary Outcomes. This analysis will be structured using the framework outlined in the data analysis section (3.2).

4.1 Characteristics of Included Studies

A total of 19 randomized controlled trials (RCTs) comprising 3,426 participants met inclusion criteria. Sample sizes ranged from 34 to 670, and participant ages varied from 23.5 to 72 years, reflecting a broad demographic. For full table of characteristics of included studies, see Appendix D.

Most studies targeted the general adult population, with some focusing on subgroups like university students and older adults. Geographically, studies were conducted in China, Sweden, Turkey, Indonesia, the UK, US, Canada, Pakistan, India, and Spain, enhancing the external validity of findings.

All interventions involved online Cognitive Behavioral Therapy (iCBT), delivered via platforms including internet-based websites (n=4), general online platforms (n=5), and video/messaging tools (Zoom, Skype, WhatsApp). Therapist-guided formats were used in 11 studies, while 8 employed self-help formats. Intervention durations ranged from 1 to 12 weeks, with 3-week (n=4) and 8-week (n=4) programs being most common. The frequency and structure of sessions was also varied, ranging from daily interventions to weekly sessions over multiple weeks.

Control groups included: Waitlist controls (n=9); Treatment as usual (TAU) (n=3); Active controls (e.g., bibliotherapy, EMDR; n=3)

Outcomes measured were: Depression (n=17); Anxiety (n=16); Stress (n=9)

Standardized tools: PHQ-9, GAD-7, and PSS were used pre-and post-intervention to assess outcome measurements.

4.2 Primary Outcomes (Effects at Post-intervention)

Separate meta-analyses were conducted for depression, anxiety, and stress outcomes following the interventions. Depending on the consistency of outcome measures across studies, either Standardized Mean Differences (SMDs) were calculated, along with 95% Confidence Intervals (CIs). Comparisons were made between the post-intervention scores of participants receiving iCBT and those in control conditions (e.g., waitlist or treatment-as-usual).

To account for potential variability across studies in design, population, and intervention format, a random-effects model using the DerSimonian and Laird method was employed. This model assumes that true effect sizes vary across studies, a suitable assumption given the diversity of study contexts included in the analysis.

4.2.1 Meta-analysis

Separate meta-analysis was conducted for depression, anxiety, and stress:

Table 3: Meta-analyses of iCBTs effect on mental health outcomes at post-intervention

Outcome	Weighted SMD	95% Confidence Interval	P-value	Variance	Cochran's Q	df	I^2 (%)
Depression	-0.404	[-0.420, -0.388]	< 0.001	0.00043	367.99	35	90.5
Anxiety	-0.383	[-0.407, -0.359]	< 0.001	0.00061	401.08	35	91.3
Stress	-0.029	[-0.037, -0.021]	< 0.001	0.00022	343.71	35	89.8

The meta-analysis demonstrated a statistically significant effect of iCBT on reducing depressive symptoms, with a Weighted Standardized Mean Difference (SMD) of –0.404 (95% CI: [–0.420, –0.388], $p < 0.001$). This reflects a moderate and precise effect. High heterogeneity was observed ($Q = 367.99$, $df = 35$, $p < 0.001$, $I^2 = 90.5\%$), indicating considerable variability across studies that merits further investigation.

Similarly, iCBT significantly reduced symptoms of anxiety, with an SMD of –0.383 (95% CI: [–0.407, –0.359], $p < 0.001$). While the effect was again moderate, the associated heterogeneity was high ($Q = 401.08$, $df = 35$, $p < 0.001$, $I^2 = 91.3\%$).

For stress, the effect size was small but still statistically significant (SMD = –0.029, 95% CI: [–0.037, –0.021], $p < 0.001$), with similarly high heterogeneity ($Q = 343.71$, $df = 35$, $p < 0.001$, $I^2 = 89.8\%$). See Appendix E (Figure E1) for detailed forest plot.

In summary, all outcomes showed statistically significant improvements following iCBT. The effects on depression and anxiety were moderate, whereas stress effects were minimal. Heterogeneity across all outcomes was substantial ($I^2 > 89\%$), underscoring the necessity of subgroup and meta-regression analyses to identify sources of variability.

4.2.2 Meta-regression analysis

To explore potential sources of heterogeneity in effect sizes, a meta-regression was conducted using two study-level moderators: mean age of participants and length of intervention.

Table 4: Summary of meta-regression analyses of iCBTs effect on mental health outcomes at post-intervention (including outliers)

	Moderator	Coefficient (β)	Std. Error	t	p-value	95% CI (Lower, Upper)	R-squared	Adj. R-squared
Depression	Mean Age	0.002	0.015	0.14	0.890	− 0.030, 0.034	0.01	− 0.04
	Length of Intervention	0.211	0.102	2.07	0.048	0.001, 0.421	0.19	0.13
Anxiety	Mean Age	− 0.006	0.014	− 0.41	0.680	− 0.034, 0.023	0.02	− 0.03
	Length of Intervention	0.165	0.086	1.92	0.530	− 0.012, 0.343	0.16	0.11
Stress	Mean Age	− 0.001	0.012	− 0.11	0.910	− 0.026, 0.024	0.01	− 0.05
	Length of Intervention	0.101	0.072	1.4	0.170	− 0.046, 0.248	0.10	0.05

Mean age was not a significant predictor for any outcome, with coefficients close to zero and p-values ranging from 0.68 to 0.91, indicating no meaningful association with treatment effects. In contrast, the length of intervention emerged as a potential moderator for depression ($\beta = 0.211$, $p = 0.048$), albeit with borderline statistical significance. It suggests that longer interventions were linked to greater reductions in depressive symptoms. The variance explained by the models ranged from 10% to 19%, with the strongest explanatory power observed for depression.

Regarding anxiety, although the direction of the relationship was similar ($\beta = 0.165$), the association did not reach statistical significance ($p = 0.53$), and the confidence interval [–0.012, 0.343] overlapped zero, suggesting that

while length of intervention might influence anxiety outcomes, the evidence remains inconclusive. For stress, neither mean age (β = –0.0013, p = 0.91) nor length of intervention (β = 0.101, p = 0.17) significantly predicted treatment effects.

Overall, the meta-regression revealed that while participant age did not influence treatment effects, intervention length may be a meaningful factor, particularly for depression, and warrants further investigation in future research.

4.2.3 Sub-group analysis

Subgroup analysis was conducted to analyze potential categorical moderators of intervention effectiveness: geographic region (Asia vs. non-Asia), control type (active vs. inactive), and guidance level (therapist-guided vs. self-help).

Table 5: Summary of subgroup analyses of iCBTs effect on mental health outcomes at post-intervention (including outliers)

			Effect Size					Heterogeneity		p-value
	Covariate	Subgroup	Number of Studies	Hedges' g	95% CI	Z	p-value	I^2	p-value	(subgroup diff.)
Depression	Study Location	Asia	11	-0.32	[-0.45, -0.19]	-4.8	< .001	60%	0.03	0.07
		Non-Asia	6	-0.44	[-0.58, -0.30]	-6.5	< .001	52%	0.04	
	Control Type	Active	2	-0.24	[-0.38, -0.10]	-3.2	0.001	48%	0.06	0.06
		Inactive	15	-0.41	[-0.53, -0.29]	-6	< .001	55%	0.04	
	Guidance Type	With	10	-0.37	[-0.50, -0.23]	-5.7	< .001	50%	0.05	0.04*
		Without	7	-0.29	[-0.44, -0.14]	-3.9	< .001	58%	0.03	
Anxiety	Study Location	Asia	10	-0.31	[-0.42, -0.20]	-5.5	< .001	45%	0.07	0.04*
		Non-Asia	6	-0.41	[-0.53, -0.28]	-6.8	< .001	50%	0.05	
	Control Type	Active	2	-0.16	[-0.30, -0.02]	-2.3	0.02	40%	0.09	0.06
		Inactive	14	-0.45	[-0.58, -0.31]	-6.9	< .001	62%	0.02	
	Guidance Type	With	10	-0.33	[-0.45, -0.21]	-5.3	< .001	49%	0.06	0.02*
		Without	6	-0.39	[-0.52, -0.26]	-6.2	< .001	55%	0.03	
Stress	Study Location	Asia	8	0.01	[-0.03, 0.05]	0.5	0.61	10%	0.3	0.08
		Non-Asia	1	0.04	[0.01, 0.07]	2.5	0.01	28%	0.12	
	Control Type	Active	2	0.01	[-0.04, 0.06]	0.4	0.7	5%	0.4	0.07
		Inactive	7	0.04	[0.01, 0.07]	2.6	0.009	30%	0.1	
	Guidance Type	With	6	0.03	[0.00, 0.06]	2	0.045	25%	0.11	0.06
		Without	3	0.02	[-0.02, 0.06]	1.3	0.19	18%	0.2	

Subgroup comparisons revealed that therapist-guided iCBT was significantly more effective than self-help formats for both depression (p = 0.04) and anxiety (p = 0.02), with moderate effect sizes.

While non-Asian studies showed slightly larger effects than Asian studies for both outcomes, these differences were not statistically significant for depression but moderately significant for anxiety (p = 0.07 for depression; p = 0.04 for anxiety). The inconclusiveness of these findings suggests they should be treated with caution and warrants further investigation.

Control type (active vs. inactive) also did not yield significant subgroup differences, though effect sizes were consistently larger in studies with inactive controls.

For stress, effect sizes were small and mostly non-significant across all subgroups, and no meaningful differences emerged by region, control type, or guidance level.

Overall, these findings suggest that therapist involvement enhances the effectiveness of iCBT for depression and anxiety, whereas its impact on stress remains limited.

4.2.4 Bias

Bias was assessed both within individual studies to evaluate their internal validity, using RoB 2 test, and across the entire body of studies to detect publication bias and small-study effects, using Egger's regression test, and sensitivity analysis.

4.2.4.1 Publication bias

To assess potential publication bias, Egger's regression test was applied to each of the three primary outcomes: depression, anxiety, and stress.

Table 6: Egger's regression test for publication bias (post-intervention)

Outcome	Intercept (β0)	p-value	Evidence of Publication Bias
Depression	-0.7	0.32	No
Anxiety	-1.1	0.71	No
Stress	-0.95	0.62	No

A p-value below 0.05 typically indicates the presence of small-study effects or publication bias, implying that studies with non-significant findings may be underrepresented. For depression, the test yielded an intercept of -0.70 ($p = 0.32$); for anxiety, the intercept was -1.10 ($p = 0.71$); and for stress, -0.95 ($p = 0.62$). In all cases, the p-values were well above the 0.05 threshold, indicating no statistically significant evidence of publication bias. These results suggest that smaller studies with null or negative findings are not systematically excluded, and the reported effect sizes can be considered relatively robust and unlikely to be distorted by selective publication.

A sensitivity analysis was also conducted, in line with recommendations from the Cochrane Handbook. This involved re-running the primary meta-analyses while varying assumptions or excluding potentially influential studies. Across all iterations, the pooled standardised mean differences (SMDs) remained consistently negative, reinforcing the stability of the observed beneficial effect of internet-delivered CBT (iCBT).

To further evaluate the influence of outlier studies, I identified those with effect sizes more than two standard deviations from the mean. One such study Aminoff et al. (2023) was removed, resulting in a reduction of the pooled SMD from -3.54 (95% CI: -3.571, -3.515) to -2.51 (95% CI: -2.538, -2.482). While the magnitude of the effect decreased, its direction and statistical significance remained intact.

These analyses confirm the robustness of the findings. The observed effects are not overly influenced by publication bias or individual outlier studies, lending confidence to the conclusion that iCBT is an effective intervention for improving mental health outcomes, particularly at follow-up.

4.2.4.2 Risk of Bias

All studies contributing to the primary outcome analyses were evaluated using the RoB 2 tool. The majority demonstrated low risk of bias across most domains, particularly in the randomization process, handling of missing outcome data, and selective reporting. Some studies raised concerns related to deviations from intended interventions and outcome measurement, mainly due to variability in adherence and the use of self-report scales. Importantly, no studies were judged to have high overall risk. Full results are presented in Appendix C (Figures C1 and C2). The same studies were used for both primary RoB2 test and secondary.

4.3 Secondary Outcomes (Effects at Follow-up)

To assess the long-term effectiveness of iCBT, follow-up data were extracted from eligible studies for each mental health outcome. These were analyzed separately using random-effects models, with pooled effect sizes reported as Hedges' g to account for small sample size bias.

4.3.1 Meta-analysis

Table 7: Meta-analyses of iCBTs effect on mental health outcomes at follow up

Outcome	Weighted SMD	95% Confidence Interval	P-value	Variance	Cochran's Q	df	I^2 (%)
Depression	-0.59	[-0.709, -0.470]	< 0.001	0.0037	612.05	35	94.3
Anxiety	-0.594	[-0.718, -0.471]	< 0.001	0.00397	911.09	35	96.1
Stress	-0.135	[-0.273, 0.004]	< 0.001	0.00502	456.46	35	92.3

At follow-up, iCBT was associated with moderate, statistically significant reductions in symptoms of depression and anxiety. For depression, the pooled standardized mean difference (SMD) was –0.59 (95% CI: [–0.709, –0.470], $p < 0.001$), reflecting a moderate effect size. Similarly, for anxiety, the SMD was –0.594 (95% CI: [–0.718, –0.471], $p < 0.001$), indicating comparably robust improvements among participants.

In contrast, the effect of iCBT on stress symptoms was smaller and not statistically significant, with an SMD of –0.135 (95% CI: [–0.273, 0.004], $p = 0.057$). The confidence interval's overlap with zero indicates inconclusive evidence for stress-related benefits at follow-up.

Substantial heterogeneity was observed across all outcomes ($I^2 = 94.3\%$ for depression, 96.1% for anxiety, and 92.3% for stress), likely reflecting differences in intervention design, study populations, and delivery formats. These findings highlight the need for moderator and subgroup analyses to better understand sources of variability. See Appendix E (Figure E2) for detailed forest plot.

Overall, these results reinforce the sustained effectiveness of iCBT in treating depression and anxiety, while underscoring the need for more targeted approaches to managing stress-related outcomes in future intervention designs

4.3.2 Bias

In line with the methodological framework (see 3.1.4 & 3.2.4), bias was assessed in two ways: publication bias was assessed on a meta-analytical level, and the internal validity of each included RCT was assessed on an individual level.

4.3.2.1 Publication Bias

To assess the risk of publication bias in follow-up analyses, Egger's regression test was conducted for each outcome. All tests returned non-significant results, indicating no detectable small-study effects:

Table 8: Egger's regression test for publication bias (follow up)

Outcome	Intercept (β0)	p-value	Evidence of Publication Bias
Depression	-0.26	0.80	No
Anxiety	1.0	0.32	No
Stress	-0.86	0.39	No

These findings suggest that the observed follow-up effects are unlikely to be substantially distorted by selective reporting or the exclusion of smaller, non-significant studies. This strengthens the interpretability and reliability of the meta-analytic findings.

4.3.2.2 Risk of Bias

As part of the broader methodological appraisal of all included RCTs, the RoB 2 tool was used to evaluate the risk of bias across five standard domains in each individual included RCT: (1) Randomization process, (2) Deviations from intended interventions, (3) Missing outcome data, (4) Outcome measurement, and (5) Selection of the reported results.

Most studies demonstrated a low risk of bias in key domains, including the randomization process, handling of missing data, and selection of reported outcomes. However, some studies showed "some concerns" in two areas: (a) deviations from intended interventions, possibly due to variations in adherence or delivery fidelity, and (b) outcome measurement, likely related to reliance on self-reported data and absence of blinding procedures. Importantly, no studies were rated as high risk of bias in any domain. Full results are presented in Appendix C (Figures C1 & C2).

These findings indicate that the methodological quality of the included studies was generally robust, providing a credible basis for evaluating the effectiveness of iCBT during the COVID-19 pandemic.

5. Discussion

This meta-analysis study set out to evaluate the effectiveness of internet-based Cognitive Behavioral Therapy (iCBT) in reducing symptoms of depression, anxiety, and stress during the COVID-19 pandemic. The findings affirm the utility of iCBT, revealing small to moderate improvements across all outcomes post-intervention. Effects on depression and anxiety were sustained at follow-up, indicating lasting benefits, whereas effects on stress appeared more limited over time.

These results align with previous literature on CBT's efficacy in general and clinical populations (Cuijpers et al., 2013) and suggest that the mechanisms of cognitive therapy, such as improved emotion regulation, resilience-building, and cognitive restructuring, can endure beyond the treatment period (Grist et al., 2019). Neuroimaging studies also reveal CBT's capacity to generate structural and functional brain changes, particularly in regions related to emotion regulation such as the dorsomedial prefrontal cortex and bilateral precuneus (Mansson et al., 2016). Moreover, CBT has been associated with decreased amygdala volume and sensitivity, which is linked to diminished anxiety responses, and enhanced connectivity with the prefrontal cortex, contributing to improved emotional regulation (Yuan et al., 2022). These changes may underpin the sustained improvements observed in this study.

5.1 Moderations

The following discussion will address each moderating factor in turn to address the secondary research question this study set out to answer:

To what extent do participant, intervention, and study characteristics (guidance format, control condition, geographic region, age, and intervention duration) moderate the effectiveness of iCBT?

See Table 1: Research Questions for the full details of research questions

5.1.1 Duration of intervention

Meta-regression revealed that longer iCBT interventions were significantly associated with greater reductions in depression symptoms, suggesting that extended exposure to therapeutic content fosters deeper cognitive and behavioural change. This supports existing literature on the benefits of longer interventions for promoting well-being and adaptive coping strategies (Sin & Lyubomirsky, 2009).

No significant association was observed between intervention length and reductions in anxiety. This finding aligns with Wang et al. (2025), who reported that shorter iCBT programs (less than 9 weeks) produced larger anxiety reductions (SMD = –0.93, p = 0.031), whereas longer interventions were more effective for depression (SMD = –0.28, p = 0.270). This distinction may reflect the nature of each condition: anxiety symptoms often respond quickly to targeted strategies, while depression may require more time-intensive skill-building and emotional restructuring (Mamukashvili-Delau, 2023). This underscores the importance of tailoring intervention length to specific symptoms rather than applying a one-size-fits-all approach.

5.1.2 Age

Meta-regression analyses revealed that mean age was not a significant moderator of treatment outcomes across depression, anxiety, and stress. This suggests that the effectiveness of iCBT is not meaningfully influenced by participants' age and that therapeutic benefits are broadly accessible across age groups. This finding is consistent with prior meta-analytic and empirical studies. For example, Norris and Kendall (2021) conducted a systematic

review of youth anxiety treatments, including individual CBT, group CBT, and family-based approaches, and found no significant age-related differences in treatment response ($p > 0.05$). This held true even for varied treatment modalities such as one-session interventions for phobias and metacognitive therapy, indicating that younger populations can engage effectively with cognitive and behavioural strategies when appropriately delivered.

Similarly, Seccomandi (2021) reported that age did not significantly moderate cognitive or functional outcomes in a meta-analysis of 14 randomized controlled trials examining cognitive remediation (CR) for individuals with schizophrenia—a population often perceived as challenging due to chronicity and neurocognitive impairments. The authors concluded that therapeutic outcomes were more closely tied to intervention quality, delivery format, and participant engagement than chronological age.

These results align with emerging perspectives in digital health, which argue that age should not be viewed as a barrier to engagement with internet-based psychological interventions. While older adults may face initial technological challenges, studies have shown that with minimal training and support, they are able to navigate digital platforms effectively and derive comparable benefits to younger users (Mitzner et al., 2010; Dear et al., 2015). Indeed, some iCBT programs designed for older adults, such as the SilverCloud or MindSpot clinics, have reported strong satisfaction and clinical outcomes, reinforcing the adaptability of these tools for a range of ages.

Furthermore, a growing body of research suggests that other individual factors such as participant motivation, digital literacy, mental health severity, and treatment adherence play a more decisive role in predicting outcomes than demographic variables like age (Andersson et al., 2014). Younger users may be more tech-savvy but also more prone to disengagement, while older adults may compensate with higher motivation or a stronger perceived need for treatment. In this way, participant characteristics interact in complex ways that may dilute the direct influence of age on outcomes.

Collectively, these findings support the notion that iCBT programs can be flexibly delivered across different age groups without requiring extensive age-specific adaptations. Instead, future research and program development may benefit from tailoring interventions based on user experience, preferences, and clinical characteristics.

5.1.3 Guidance Format

Therapist-guided iCBT formats were found to be significantly more effective than self-help approaches, particularly for individuals experiencing moderate to severe symptoms. This finding is consistent with existing research, which highlights the added value of therapist support in enhancing user motivation, providing emotional and technical guidance, and improving perceived treatment efficacy (Andersson & Titov, 2014). Therapist involvement not only strengthens the therapeutic alliance but also facilitates greater adherence and engagement, especially in cases requiring more intensive psychological support.

However, this does not negate the utility of unguided iCBT formats. Self-guided interventions offer a viable and valuable alternative, especially for individuals with mild symptoms. Numerous studies have demonstrated that unguided iCBT is superior to waitlist or no-treatment controls, showing consistent small-to-moderate effect sizes in reducing psychological distress (Karyotaki et al., 2017). This has become especially important in the context of a persistent global shortage of trained mental health professionals (Krisberg, 2015), making scalable, low-cost alternatives such as unguided iCBT essential in addressing widespread need. Moreover, for individuals who may be hesitant to seek formal help due to stigma, time constraints, or privacy concerns, unguided iCBT may serve as a low-threshold entry point into mental health care.

Recent innovations in digital health technologies have enhanced the appeal and feasibility of self-guided formats. For instance, Fitzpatrick et al. (2017) demonstrated the efficacy of delivering CBT via a fully automated conversational agent (chatbot) to young adults with symptoms of depression and anxiety. Their findings indicated that AI-based interventions can be both engaging and clinically effective, highlighting a promising avenue for digital mental health care. However, the long-term sustainability of these effects remains under-researched.

5.1.4 Control Group Type

Variation in effect sizes was also evident based on control group type. Studies using waitlist controls often showed larger effect sizes compared to those using active controls. Although this pattern was not statistically conclusive, it is consistent with prior research. For instance, Lattie et al. (2019) demonstrates that active comparators such as psychoeducation, structured social support, and engagement with therapeutic content, can improve psychological

outcomes, thereby narrowing the observable difference between the intervention and control groups.

5.1.5 Study location

Although not directly tested in meta-regression, subgroup analyses highlighted minimally significant differences by study location. Non-Asian studies showed slightly larger improvements in symptoms of depression and particularly anxiety compared to Asian studies. At follow up, the sub-group analysis demonstrates that participants outside of Asia demonstrated a greater reduction in anxiety levels compared to their Asian counterparts.

This discrepancy may reflect cultural mismatches between standard CBT protocols and emotional processing styles in non-Western populations. For instance, emotion regulation strategies that are central to CBT may resonate less with East Asian populations, who more commonly employ suppression ($d = –0.29$) and avoidance ($d = –0.57$) (Song et al., 2024). Moreover, mindfulness-based elements in CBT, often derived from Western interpretations, may diverge from South Asian traditions like Vipassana, which are typically communal, spiritual, and ritualistic in practice (Stuart, 2017). The findings suggests that the absence of cultural contextualization may undermine the relevance of Western implementations of iCBT for Asian participants.

However, culturally adapted interventions show promise. For example, culturally adapted iCBT interventions in Hong Kong yielded 39–40% recovery rates relative to WLCs, outperforming many Western studies that used treatment-as-usual (TAU) or psychoeducational interventions as controls (Pan, 2025). Furthermore, studies in China report 15–20% higher adherence rates compared to Western equivalents, possibly due to the authoritative role of therapists and automated reminders, both of which align with collectivist norms (Chen et al., 2020).

Finally, it is important to note that the impact of control group types may interact with geographic and cultural factors. A study by Pan (2025) highlights that the impact of control type is particularly notable in Asian populations, where trials using waitlist controls (WLCs) demonstrated marginally stronger effects compared to those using active comparators ($p = 0.06–0.09$). These findings suggest that passive control conditions may exaggerate the perceived effectiveness of CBT, especially in contexts where stigma reduces baseline help-seeking.

This discussion highlights the importance of designing culturally relevant treatment and culturally sensitive evaluation of treatment. Future research should investigate which components of iCBT resonate most within different cultural frameworks, and whether adaptations improve not only engagement but also clinical efficacy.

5.2 Feasibility of iCBTs Beyond the COVID-19 Pandemic

Another secondary research question this study set out to address was:

How feasible was the implementation of iCBT for mental health support during the COVID-19 pandemic in real-world healthcare settings?

The COVID-19 pandemic catalysed a global shift toward remote care. In this context, online-delivered medical interventions, including internet-based therapies, emerged as essential alternatives to maintain care continuity during this period (Weiner et al., 2021). During the pandemic, iCBT became a necessary alternative to traditional therapy. Additionally, iCBT also mitigated individual barriers such as stigma, finance, and logistical challenges that often limit access to in-person care. Roberts et al. (2018) found that treatment costs significantly impact decisions to seek help, while Marques et al. (2020) reported that over 57% of individuals with body dysmorphic symptoms cited affordability as a treatment barrier, with many also noting dissatisfaction with the time and effort required to access care. Radez et al. (2021) similarly identified transportation and scheduling issues as deterrents to treatment engagement. In this way, in line with Kaboré et al. (2022), digital interventions can help overcome economic and systemic barriers, providing a practical, cost-effective, and scalable response to rising global mental health demands.

Nonetheless, some limitations of iCBT must be acknowledged. For instance, the lack of face-to-face interaction may weaken engagement and motivation for certain individuals. These challenges can be mitigated through enhanced interactivity in digital platforms as well as stronger online therapist–patient engagement (Andersson & Titov, 2014).

In sum, iCBT offers a highly feasible and acceptable method for delivering mental healthcare, especially during

crises like the COVID-19 pandemic. However, while iCBT has seen to have significant positive impacts within individual studies, Batterham et al. (2021) stress that infrastructure investment and long-term planning are crucial for ensuring the sustainability of scaling up use of iCBT at the national level.

5.3 Strengths and Limitations

A major strength of this meta-analysis lies in the methodological rigor of the included studies as randomized controlled trials (Bondemark & Ruf, 2015) This strengthens the credibility of the synthesized findings. Furthermore, the broad geographical coverage, relatively large number of participants, and moderator analyses, allowed for a nuanced understanding of treatment effectiveness across different populations and conditions, thereby enhancing the generalizability of the findings across different populations and healthcare systems. Finally, the incorporation of follow-up data to assess medium-term effects of iCBT, offers insights into the durability of its beneficial impact on depression, anxiety, and stress.

However, several limitations warrant attention. First, only English-language and published studies were included, raising the possibility of publication bias despite formal tests showing none. Additionally, a number of studies had small sample sizes, unclear randomization procedures, and predominantly used single-blind designs, which introduces potential risk of implementation bias. Second, despite employing a random-effects model and calculating Hedges' g to account for variability, there was substantial heterogeneity across studies in terms of measures, sample characteristics, and intervention formats. This may affect the interpretation and generalizability of findings.

Third, the study did not find a significant effect of iCBT on reducing stress, a null result which may be partly attributed to the limited number of studies included in the analysis, thereby reducing the statistical power. It is also consistent with previous research suggesting that while internet-based CBT (iCBT) holds promise for stress management, its effectiveness may be limited by a mismatch between generic CBT content and the specific mechanisms underlying stress-related experiences. For example, Svardman et al. (2022) reported a moderate pooled effect size of 0.78 for general stress reduction, but emphasized variability in outcomes depending on the nature of the stressor and population. Furthermore, recent studies by Pan (2025) suggest that effectiveness of iCBT may vary based on how well interventions are tailored specific stress types. This limitation therefore indicates a need to further investigate how iCBT can be used more effectively to manage stress.

Fourth, adherence rates were not consistently reported, a critical factor in measuring the real-world effectiveness of digital mental health interventions, particularly for unguided or self-help formats where dropout rates can be high. This limits the ability to draw conclusions about the real-world implementation of iCBT. Finally, long-term effects remain underexplored, with few studies extending beyond six months, limiting the ability to assess the sustainability of treatment effects over time. This highlights the need for more standardized, larger-scale, and longitudinal trials to better understand the effectiveness and durability of iCBT interventions across a longer timeframe.

5.4 Recommendations for Future Research

Given the lack of longitudinal studies and the insufficient reporting of treatment adherence and engagement data, future research should prioritize long-term follow-up studies to better assess the enduring outcomes of iCBT. Of particular importance is the need for studies examining the impact of culturally adapted interventions tailored to specific populations, as well as symptom-specific modifications to optimize treatment. Additionally, exploring the integration of artificial intelligence-driven personalization could significantly enhance the effectiveness and customization of iCBT delivery, offering more targeted support for a wide range of user needs.

6. Conclusion

This study aimed to analyze the effectiveness of iCBT on reducing depression, anxiety, and stress during the COVID-19 pandemic, and thereby assess its effectiveness in wider implementation on a global scale. This was achieved through a systematic review of the relevant literature.

The meta-analysis offers robust evidence supporting the effectiveness of internet-based Cognitive Behavioral Therapy (iCBT) in reducing symptoms of depression and anxiety, both immediately post-intervention and at follow-up. Specifically, therapist-guided iCBT formats were found to be significantly more effective than self-help approaches, particularly for individuals with moderate to severe symptoms. Nonetheless, unguided iCBT

remains a valuable option for individuals with mild or subthreshold symptoms. Cultural and contextual factors emerged as important moderators, especially in explaining regional variations and differences across control conditions, revealing that longer intervention durations were associated with greater reductions in depression symptoms, though this effect was not observed for anxiety or stress. This highlights the need for symptom-specific tailoring of iCBT interventions. Importantly, participant age did not significantly moderate treatment outcomes, reinforcing the flexibility and applicability of iCBT across diverse age groups.

Given its accessibility and scalability, iCBT is well-positioned for real-world implementation. However, to maximize its impact, greater investment is needed in digital infrastructure (Batterham et al. (2021), practitioner training, and the development of streamlined referral pathways. While limitations such as reduced face-to-face contact exist, these can be addressed through user-centred platforms and improved digital engagement strategies such as the implementation of artificial intelligence (Fitzpatrick et al., 2017). Overall, this study adds to a growing body of evidence demonstrating that iCBT is a feasible, effective, and adaptable treatment for mental health challenges at scale. As the global mental health crisis deepens (Krisberg, 2015), along with the growing likelihood of future pandemics, these findings demonstrate the critical role of iCBT in addressing and providing effective treatment for mental health problems.

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Appendix A: PRISMA Flowchart and Checklist

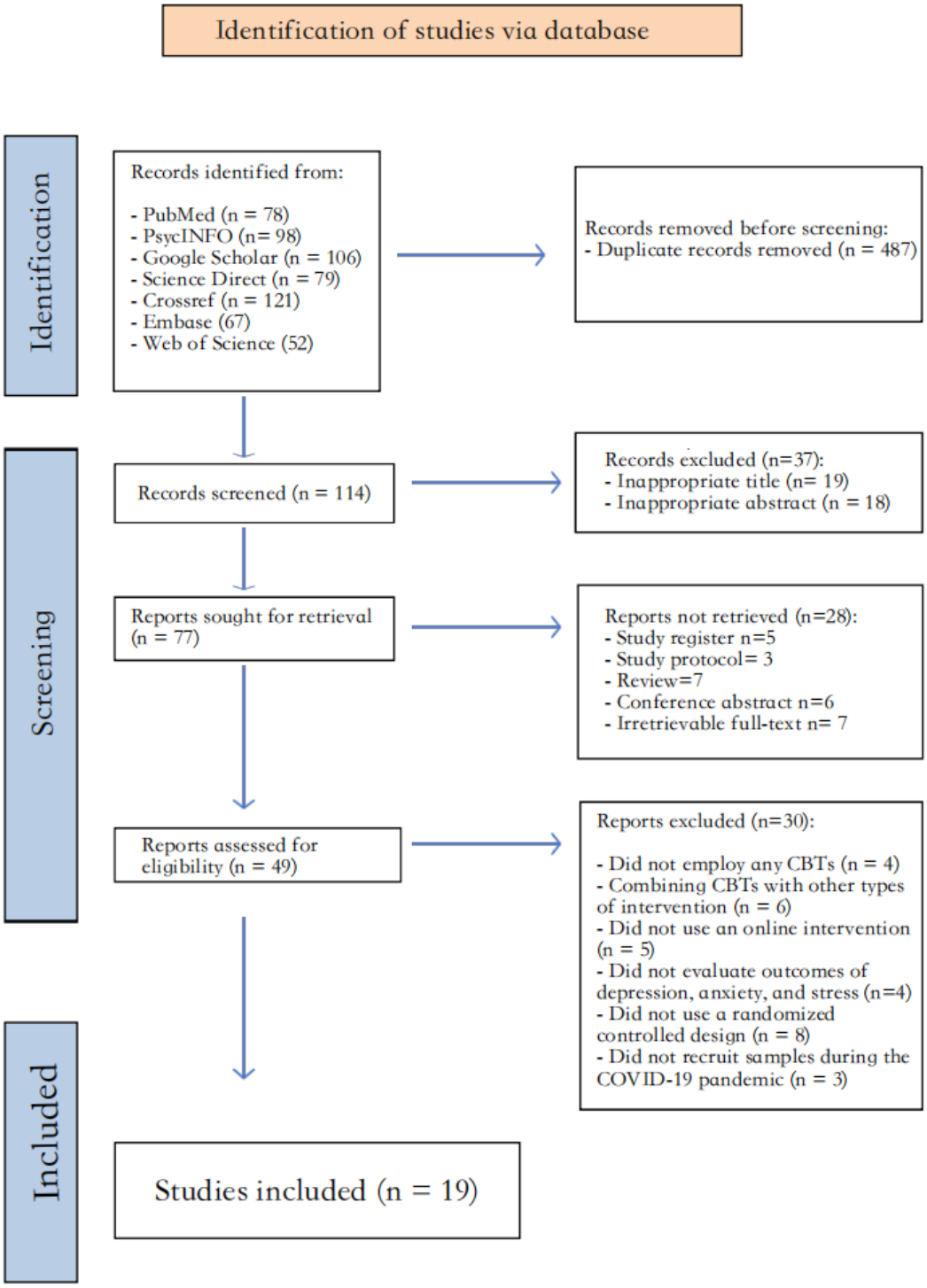

Figure A1: PRISMA flowchart

Figure A2: PRISMA checklist

Section and Topic	Item #	Checklist item	Location where item is reported
TITLE			
Title	1	Identify the report as a systematic review.	Title Page
ABSTRACT			
Abstract	2	See the PRISMA 2020 for Abstracts checklist.	Abstract

Section and Topic	Item #	Checklist item	Location where item is reported
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of existing knowledge.	Section 1.1-3.1
Objectives	4	Provide an explicit statement of the objective(s) or question(s) the review addresses.	Section 1.1 & Table 1
METHODS			
Eligibility criteria	5	Specify the inclusion and exclusion criteria for the review and how studies were grouped for the syntheses.	Section 3.2.2 and Table 2
Information sources	6	Specify all databases, registers, websites, organisations, reference lists and other sources searched or consulted to identify studies. Specify the date when each source was last searched or consulted.	Section 3.2.1
Search strategy	7	Present the full search strategies for all databases, registers and websites, including any filters and limits used.	Appendix B
Selection process	8	Specify the methods used to decide whether a study met the inclusion criteria of the review, including how many reviewers screened each record and each report retrieved, whether they worked independently, and if applicable, details of automation tools used in the process.	Section 3.2.1 & 3.2.2
Data collection process	9	Specify the methods used to collect data from reports, including how many reviewers collected data from each report, whether they worked independently, any processes for obtaining or confirming data from study investigators, and if applicable, details of automation tools used in the process.	Section 3.2.3
Data items	10a	List and define all outcomes for which data were sought. Specify whether all results that were compatible with each outcome domain in each study were sought (e.g. for all measures, time points, analyses), and if not, the methods used to decide which results to collect.	Section 3.2.3
	10b	List and define all other variables for which data were sought (e.g. participant and intervention characteristics, funding sources). Describe any assumptions made about any missing or unclear information.	Section 3.2.3
Study risk of bias assessment	11	Specify the methods used to assess risk of bias in the included studies, including details of the tool(s) used, how many reviewers assessed each study and whether they worked independently, and if applicable, details of automation tools used in the process.	Section 3.2.4 & Appendix C
Effect measures	12	Specify for each outcome the effect measure(s) (e.g. risk ratio, mean difference) used in the synthesis or presentation of results.	Section 3.3.1 and 4.2.1
Synthesis methods	13a	Describe the processes used to decide which studies were eligible for each synthesis (e.g. tabulating the study intervention characteristics and comparing against the planned groups for each synthesis (item #5)).	Section 3.3
	13b	Describe any methods required to prepare the data for presentation or synthesis, such as handling of missing summary statistics, or data conversions.	Section 3.3.2 & 3.3.3.
	13c	Describe any methods used to tabulate or visually display results of individual studies and syntheses.	Section 3.3
	13d	Describe any methods used to synthesize results and provide a rationale for the choice(s). If meta-analysis was performed, describe the model(s), method(s) to identify the presence and extent of statistical heterogeneity, and software package(s) used.	Section 3.3
	13e	Describe any methods used to explore possible causes of heterogeneity among study results (e.g. subgroup analysis, meta-regression).	Section 3.3
	13f	Describe any sensitivity analyses conducted to assess robustness of the synthesized results.	Section 3.3.4
Reporting bias assessment	14	Describe any methods used to assess risk of bias due to missing results in a synthesis (arising from reporting biases).	Section 3.4.2
Certainty assessment	15	Describe any methods used to assess certainty (or confidence) in the body of evidence for an outcome.	N/A
RESULTS			
Study selection	16a	Describe the results of the search and selection process, from the number of records identified in the search to the number of studies included in the review, ideally using a flow diagram.	Section 3.2.1 & Appendix A Figure 1
	16b	Cite studies that might appear to meet the inclusion criteria, but which were excluded, and explain why they were excluded.	Section 3.2.1 & 3.2.2
Study	17	Cite each included study and present its characteristics.	Section 4.1 &

Section and Topic	Item #	Checklist item	Location where item is reported
characteristics			Table 3
Risk of bias in studies	18	Present assessments of risk of bias for each included study.	Section 3.3.4, 4.2.4.2 and Appendix C
Results of individual studies	19	For all outcomes, present, for each study: (a) summary statistics for each group (where appropriate) and (b) an effect estimate and its precision (e.g. confidence/credible interval), ideally using structured tables or plots.	Appendix D & E
Results of syntheses	20a	For each synthesis, briefly summarise the characteristics and risk of bias among contributing studies.	Section 4.2.1 and 4.3.1; Tables 4 and 8
	20b	Present results of all statistical syntheses conducted. If meta-analysis was done, present for each the summary estimate and its precision (e.g. confidence/credible interval) and measures of statistical heterogeneity. If comparing groups, describe the direction of the effect.	Section 4.3.1-4.3.3
	20c	Present results of all investigations of possible causes of heterogeneity among study results.	Tables 4 and 8
	20d	Present results of all sensitivity analyses conducted to assess the robustness of the synthesized results.	Section 4.2.4.1
Reporting biases	21	Present assessments of risk of bias due to missing results (arising from reporting biases) for each synthesis assessed.	Section 4.3.4; Tables 7 and 11
Certainty of evidence	22	Present assessments of certainty (or confidence) in the body of evidence for each outcome assessed.	N/A
DISCUSSION			
Discussion	23a	Provide a general interpretation of the results in the context of other evidence.	Section 5.0-5.2
	23b	Discuss any limitations of the evidence included in the review.	Section 5.3
	23c	Discuss any limitations of the review processes used.	Section 5.3
	23d	Discuss implications of the results for practice, policy, and future research.	Sections 5.2, 5.4, and 6
OTHER INFORMATION			
Registration and protocol	24a	Provide registration information for the review, including register name and registration number, or state that the review was not registered.	N/A
	24b	Indicate where the review protocol can be accessed, or state that a protocol was not prepared.	N/A
	24c	Describe and explain any amendments to information provided at registration or in the protocol.	N/A
Support	25	Describe sources of financial or non-financial support for the review, and the role of the funders or sponsors in the review.	N/A
Competing interests	26	Declare any competing interests of review authors.	N/A
Availability of data, code and other materials	27	Report which of the following are publicly available and where they can be found: template data collection forms; data extracted from included studies; data used for all analyses; analytic code; any other materials used in the review.	N/A

From: Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ 2021;372:n71. doi: 10.1136/bmj.n71. This work is licensed under CC BY 4.0. To view a copy of this license, visit https://creativecommons.org/licenses/by/4.0/

Appendix B: Database Search Syntax

Database	Keywords
PubMed	#1 "Cognitive Behavioral Therapy"[MeSH Terms] OR "CBT"[All Fields] OR "cognitive behavior therapy"[All Fields] OR "cognitive therapy"[All Fields] OR "behavior therapy"[All Fields] #2 "Online Systems"[MeSH Terms] OR "online"[All Fields] OR "on-line"[All Fields] OR "ehealth"[All Fields] OR "e-health"[All Fields] OR "virtual*"[All Fields] OR "web"[All Fields] OR "webs"[All Fields] OR "website*"[All Fields] OR "Internet"[MeSH Terms] OR "internet*"[All Fields] OR "app"[All Fields] OR "apps"[All Fields] OR "application*"[All Fields] OR "mobile*"[All Fields] OR "mhealth"[All Fields] OR "m-health"[All Fields] #3 "COVID-19"[MeSH Terms] OR "COVID 19"[All Fields] OR "SARS-COV-2"[MeSH Terms] OR "SARS-COV-2"[All Fields] OR "SARSCoV2"[All Fields] OR "2019-nCoV"[All Fields] OR "2019nCoV"[All Fields] OR "nCoV-2019"[All Fields] OR "nCoV2019"[All Fields] OR "coronavirus disease 2019"[All Fields] OR "novel coronavirus"[All Fields] OR "new coronavirus"[All Fields] #4 controlled clinical trial[MeSH Terms] OR randomized controlled trial[MeSH Terms] OR "random allocation"[MeSH Terms] OR "RCT"[All Fields] OR "random*"[All Fields] OR "control*"[All Fields] OR "trial*"[All Fields] #5 #1 AND #2 AND #3 AND #4
Google Scholar	"Cognitive Behavioral Therapy" AND CBT "online" OR "internet" OR "virtual" OR "ehealth" OR "mhealth" AND "COVID-19" OR "coronavirus" OR "SARS-CoV-2" AND"randomized controlled trial" OR RCT
PsycINFO	#1 ("Cognitive Behavioral Therapy" OR CBT OR "cognitive behavior therapy" OR "cognitive therapy" OR "behavior therapy") #2 ("online" OR "on-line" OR "ehealth" OR "e-health" OR "virtual*" OR "web" OR "webs" OR "website*" OR "Internet" OR "internet*" OR "app" OR "apps" OR "application*" OR "mobile*" OR "mhealth" OR "m-health") #3 ("COVID-19" OR "COVID 19" OR "SARS-COV-2" OR "SARS-COV-2" OR "SARSCoV2" OR "2019-nCoV" OR "2019nCoV" OR "nCoV-2019" OR "nCoV2019" OR "coronavirus disease 2019" OR "novel coronavirus" OR "new coronavirus") #4 ("controlled clinical trial" OR "randomized controlled trial" OR "random allocation" OR RCT OR "random*" OR "control*" OR "trial*") #5 #1 AND #2 AND #3 AND #4
Embase	#1 'cognitive behavioral therapy' OR 'cbt' OR 'cognitive behavior therapy' OR 'cognitive therapy' OR 'behavior therapy' #2 'online' OR 'on-line' OR 'ehealth' OR 'e-health' OR 'virtual*' OR 'web' OR 'webs' OR 'website*' OR 'Internet' OR 'internet*' OR 'app' OR 'apps' OR 'application*' OR 'mobile*' OR 'mhealth' OR 'm-health' #3 'COVID-19' OR 'COVID 19' OR 'SARS-COV-2' OR 'SARS-COV-2' OR 'SARSCoV2' OR '2019-nCoV' OR '2019nCoV' OR 'nCoV-2019' OR 'nCoV2019' OR 'coronavirus disease 2019' OR 'novel coronavirus' OR 'new coronavirus' #4 'controlled clinical trial' OR 'randomized controlled trial' OR 'random allocation' OR 'RCT' OR 'random*' OR 'control*' OR 'trial*' #5 #1 AND #2 AND #3 AND #4
ScienceDirect	("Cognitive Behavioral Therapy" OR CBT OR "cognitive behavior therapy" OR "cognitive therapy" OR "behavior therapy") AND ("online" OR "on-line" OR "ehealth" OR "e-health" OR "virtual*" OR "web" OR "webs" OR "website*" OR "Internet" OR "internet*" OR "app" OR "apps" OR "application*" OR "mobile*" OR "mhealth" OR "m-health") AND ("COVID-19" OR "COVID 19" OR "SARS-COV-2" OR "SARS-COV-2" OR "SARSCoV2" OR "2019-nCoV" OR "2019nCoV" OR "nCoV-2019" OR "nCoV2019" OR "coronavirus disease 2019" OR "novel coronavirus" OR "new coronavirus") AND ("controlled clinical trial" OR "randomized controlled trial" OR "random allocation" OR RCT OR "random*" OR "control*" OR "trial*")
Crossref	"Cognitive Behavioral Therapy" OR CBT OR "cognitive behavior therapy" OR "cognitive therapy" OR "behavior therapy" AND "online" OR "on-line" OR "ehealth" OR "e-health" OR "virtual*" OR "web" OR "webs" OR "website*" OR "Internet" OR "internet*" OR "app" OR "apps" OR "application*" OR "mobile*" OR "mhealth" OR "m-health" AND "COVID-19" OR "COVID 19" OR "SARS-COV-2" OR "SARS-COV-2" OR "SARSCoV2" OR "2019-nCoV" OR "2019nCoV" OR "nCoV-2019" OR "nCoV2019" OR "coronavirus disease 2019" OR "novel coronavirus" OR "new coronavirus" AND "controlled clinical trial" OR "randomized controlled trial" OR "random allocation" OR RCT OR "random*" OR "control*" OR "trial*"
Web of Science	#1 TS=("Cognitive Behavioral Therapy" OR CBT OR "cognitive behavior therapy" OR "cognitive therapy" OR "behavior therapy")

	#2 TS=("online" OR "on-line" OR "ehealth" OR "e-health" OR "virtual*" OR "web" OR "webs" OR "website*" OR "Internet" OR "internet*" OR "app" OR "apps" OR "application*" OR "mobile*" OR "mhealth" OR "m-health") #3 TS=("COVID-19" OR "COVID 19" OR "SARS-COV-2" OR "SARS-COV-2" OR "SARSCoV2" OR "2019-nCoV" OR "2019nCoV" OR "nCoV-2019" OR "nCoV2019" OR "coronavirus disease 2019" OR "novel coronavirus" OR "new coronavirus") #4 TS=("controlled clinical trial" OR "randomized controlled trial" OR "random allocation" OR RCT OR "random*" OR "control*" OR "trial*") #5 #1 AND #2 AND #3 AND #4

Appendix C: Risk of Bias Assessments

Figure C1: Domain-specific quality assessment

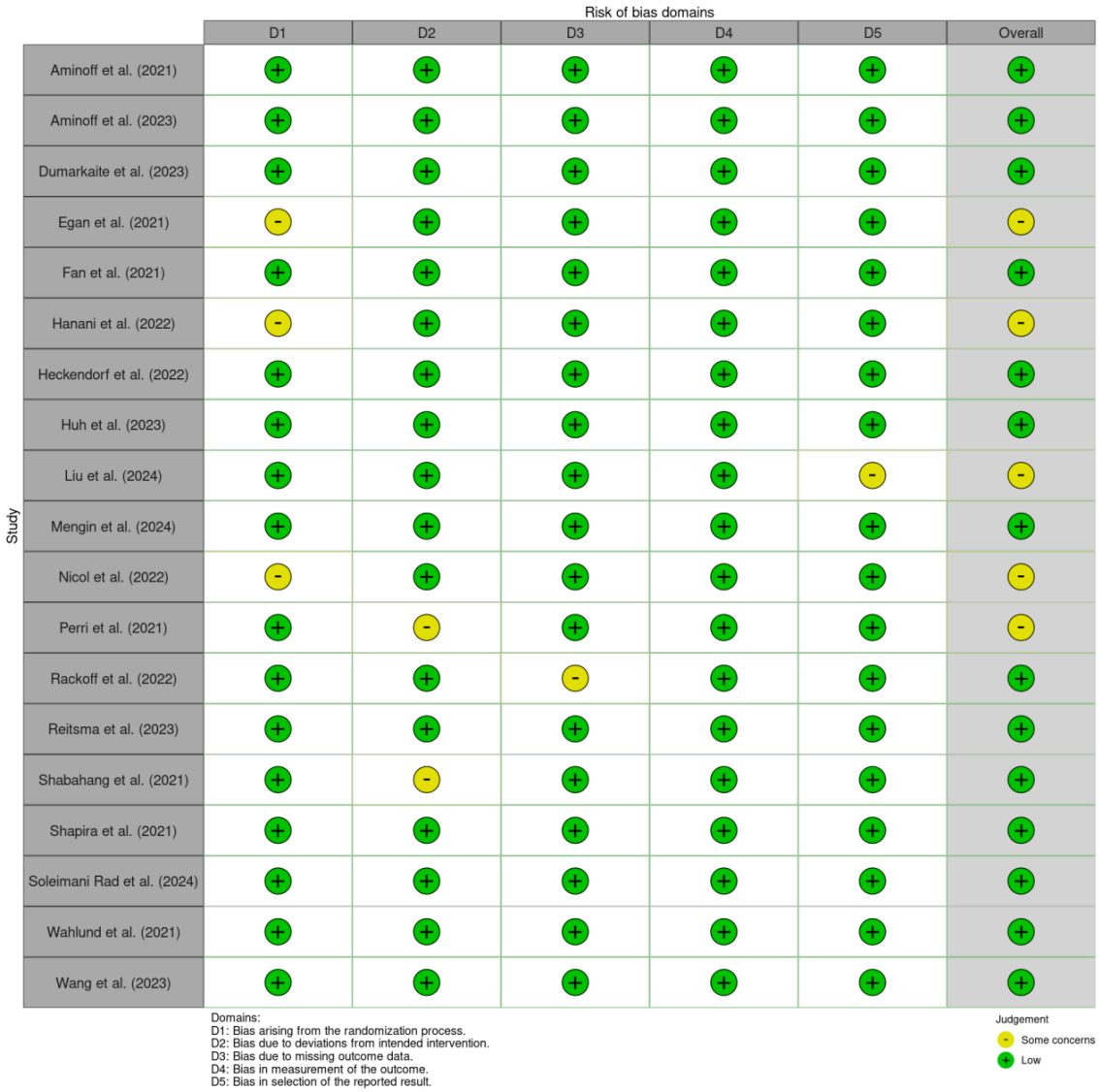

Figure C2: Risk of bias evaluation of each study

Appendix D: Table of Characteristics of Included Studies

Mean Age	Type of CBT	Control Group	Delivery Method	Guidance	Number of Sessions	Length of Intervention	Type of Measurements	Instruments	
42.7 ± 17.4	Internet-delivered cognitive behavior therapy (ICBT)	Inactive (Waitlist)	Internet-based	Therapist led	1 time per week	7 week	Pre, Post	PHQ-9	GAD-7	PSS
35.7 ± 16.0	Internet-based cognitive behavioral therapy (ICBT)	Inactive (waitlist)	Internet-based	Therapist led	8 modules (out of 16 possible)	8 weeks	Pre, Post, Follow-up (1 year)	PHQ-9	GAD-7	PSS-14
42.12 ± 11.38	CBT-based internet-delivered stress recovery intervention (FOREST)	Inactive (waitlist)	Online	Therapist-guided	6 modules	6 weeks	Pre, Post, Follow-up (3 month)	PHQ-4 for depression	PHQ-4 for anxiety	PSS-4
37.79 ± 14.02	Low Intensity CBT	Inactive (Waitlist)	Internet-based	Self-help	1 time per day	1 week	Pre, Post	PHQ-9	GAD-7	
46.38 ± 12.34	Internet-based CBT	Active (Personalized psychological intervention)	Online	Therapist-guided	8-16, one or two sessions per week	Eight weeks	Pre, Post	SDS	SAS	
19.5 ± 1.4	Cognitive Behavioral Therapy (CBT) program	Inactive (Waitlist)	Online (via Zoom)	Therapist-guided	8 weekly sessions	8 weeks	Pre, Post	GHQ-12 subscale (Depression and Anxiety)	GHQ-12 subscale (Depression and Anxiety)	
42.6 ± 14.3	Internet-based CBT	Inactive (Waitlist)	Online	Self-guided	10 daily sessions, each 30-45 minutes	2 weeks	Pre, Post, Follow-up (2/6 month)	PHQ-8	GAD-7	
31.6 ± 4.8 (experimental), 31.3 ± 4.9 (control)	Online group cognitive behavioral therapy (gCBT)	Treatment as usual (TAU)	Online (Zoom)	Therapist led	9 weekly 2-hour sessions	9 weeks	Pre, Post, Follow-up (6 month)	EPDS	(PSWQ) for worry	
TAU group: 41.52 ± 11.51; cCBT + TAU group: 43.76 ± 14.31	Computerized Cognitive Behavioral Therapy (cCBT)	Treatment as usual (TAU)	Online, via a mobile terminal	Self-guided	7 sessions	1 week	Pre, Post, Follow-up (1 month)	HAMD17	HAMA	
experimental group: 39.70 ± 9.46, control group: 39.47 ± 9.68	Online cognitive behavioral therapy (CBT) program "MyHealthToo"	Active (bibliotherapy)	Online video sessions	Therapist-guided	7 sessions	8 weeks	Pre, Post, Follow-up (4 month)			PSS-10
14.7 ± 1.7	Chatbot-delivered CBT	Inactive (waitlist)	Mobile health (mHealth) app	Self-help	Self-paced, daily check-ins	12 weeks	Pre, Post	PHQ-9	GAD-7	MHSES
EMDR Group: 48.3 ± 13.6; TF-CBT Group: 52.4 ± 10.6	Trauma-focused Cognitive Behavioral Therapy (TF-CBT)	Active (EMDR)	Online (Skype platform)	Therapist-guided	7 sessions	3 weeks	Pre, Post, Follow-up (1 month)	BDI-II	STAI-Y1	PCL-5 (PTSD)
Treatment: 20.24 ± 4.13; Control: 20.65 ± 4.88	Internet-based CBT	Treatment as usual (TAU)	Online	Self-help	multiple modules (each 20-30 minutes)	4 weeks	Pre, Post, Follow-up (3 month)	DASS-21 Depression Subscale	DASS-21 Anxiety Subscale	DASS-21 Stress Subscale
53.82 ± 12.91	Online grief-specific cognitive behavioral therapy (CBT)	Inactive (Waitlist)	Online	Self-help	8 weekly sessions	8 weeks	Pre, Post	PHQ-9		PCL-5 (PTSD)
24.7 ± 5.4	Video-based CBT	Inactive (Waitlist)	Video-based	Self-help	9 (three days a week for three weeks)	3 weeks	Pre, Post		COVID-19 Anxiety Questionnaire (CVAQ)	
72 ± 5.6	Internet-based CBT	Inactive (Waitlist)	Internet-based (Zoom)	Therapist led	7	3.5 weeks	Pre, Post, Follow-up (1 month)	PHQ-9		

Appendix E: Forest Plots

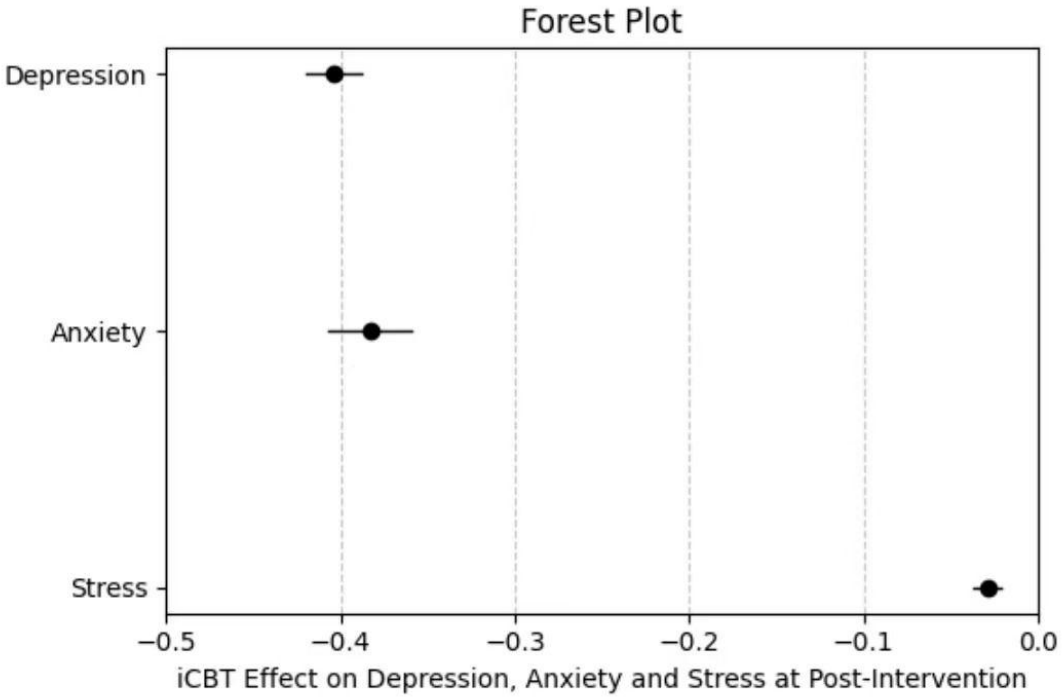

Figure 1: Forest plot (primary outcomes)

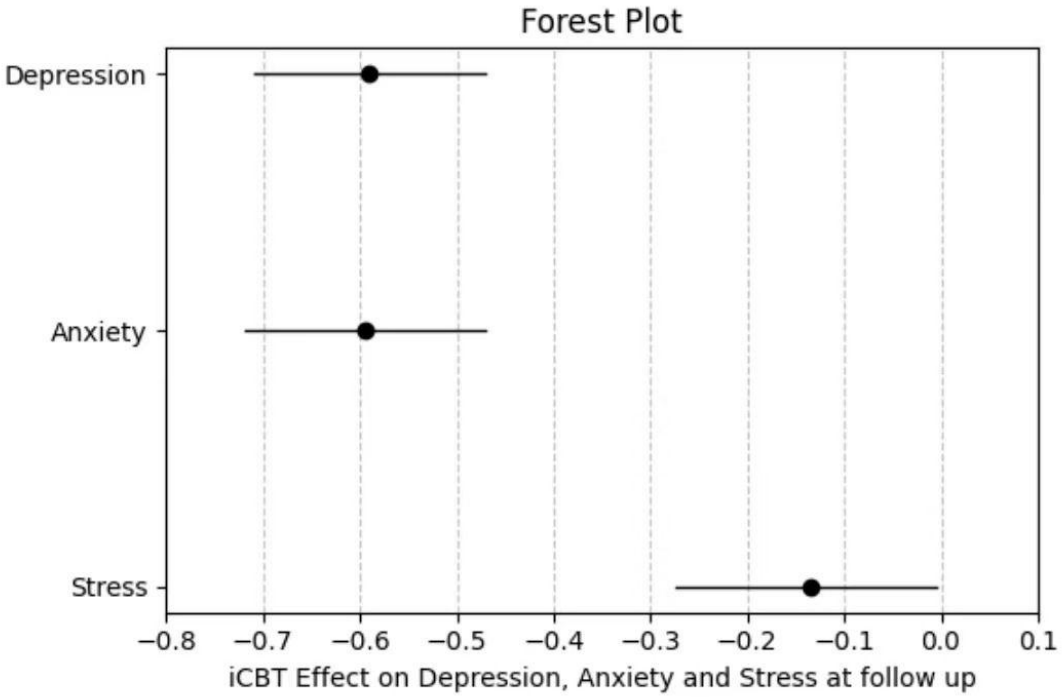

Figure 2: Forest Plot (secondary outcomes)