Systematic Review

Efficacy of Online-Based Intervention for Anxiety during COVID-19: A Systematic Review and Meta-Analysis of Randomized Controlled Trials

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Abstract: COVID-19 has caused widespread psychological suffering. Anxiety is one of the several psychological disorders that are escalating globally, yet social distance constraints restrict in-person mental health therapy. Anxiety and other psychological disorders whose treatments are limited due to social distancing continue to grow, so there is an increasing need to use mental healthcare that can be offered remotely, especially in the pandemic era. This study aimed to conduct a systematic review and meta-analysis of the efficacy of online-based interventions for anxiety during COVID-19. This study followed the Preferred Reporting Item for Systematic Review and Meta-analysis (PRISMA). We collected data from three databases, namely PubMed, CINAHL, and Oxford Library Press, published in 2020–2022. Additionally, we collected data using the snowball technique. This meta-analysis analyzed the pooled mean difference (MD) and its p-value using random-effects models. Critical appraisal and risk of bias were assessed using Cochrane Risk of Bias (Rob) 2. We retrieved 34 RCTs for systematic review and 14 RCTs for meta-analysis, yielding 9159 participants for general anxiety disorder (GAD-7) measurement and 1303 participants for depression anxiety stress scale (DASS-21) measurement. This study shows that online-based interventions significantly reduce GAD-7 score (a pooled MD of 1.30; 95% CI: 2.83–4.65; p = 0.00001) and insignificantly reduce DASS-21 (0.05; 95% CI: −2.63–2.72; p = 0.97) according to pre- and post-test in intervention group. Additionally, there is a significant difference between the intervention and control groups, where the intervention group performed statistically progressively better than the controls (−7.26; 95% CI: −11.58–−2.95; p = 0.001) (−2.08; 95% CI: −6.71–2.55; p = 0.001). Online-based interventions have proved effective for reducing general anxiety during the COVID-19 pandemic. Consequently, this meta-analysis can be adapted as a model for mental health services in the new normal.

Keywords: anxiety; COVID-19; global population; online-based intervention

1. Introduction

Anxiety is excessive worry that typically manifests as an emotional response to a perceived situation and is intuitively known as a threat, characterized by muscle rigidity, agitation, fatigue, and decreased concentration [1]. Anxiety related to health problems can become stronger in large populations during disease outbreaks, such as Ebola and COVID-19, resulting in collective fear that is widespread and disproportionate to the perceived
The outbreak and spread of the epidemic have a substantial impact on the mental health of the population. Populations are more likely to experience psychological disturbances such as anxiety during serious public health emergencies [3]. The prevalence of anxiety in the general population during the COVID-19 pandemic was extremely high (27.3%), with the highest anxiety was in Africa (61.8%), America (34.9%), Europe (30.7%), and Asia (24.5%) [4]. The American Psychiatric Association (APA) shows that 40% of Americans report anxiety related to fear of death or serious illness from COVID-19, even if they show only mild symptoms [2]. Additionally, according to the study by Zhang et al., more than half of the general population reported moderate or severe psychological impact from COVID-19, and 28.8% had moderate to severe anxiety [5].

Concerns related to the long-term COVID-19 pandemic may develop and spread disproportionately in intensity or duration to disrupt daily life [6]. In the long term, anxiety can cause chemical changes in the brain and release stress hormones that cause dizziness, headaches, and depression [1]. Anxiety is correlated to pain, disability, poor health, and high societal costs [7]. Moreover, they are linked to other comorbid illnesses such as cardiovascular disease, obesity, and diabetes [8–10]. As a consequence, treating these illnesses is critical for optimizing patient quality of life management, and scalable mental health supports and interventions are desperately needed.

Anxiety problems that arise during the COVID-19 pandemic must be addressed to prevent more severe physical and psychological manifestations from appearing. The COVID-19 pandemic demands rapid action from conventional care to telehealth. Internet-based interventions can be leveraged during the COVID-19 pandemic to enable patients to receive efficient, patient-centered and effective self-quarantine care services [11].

The current findings suggest that there are suitable self-help interventions for self-care to improve mental health and reduce anxiety during the COVID-19 pandemic. Previous meta-analyses suggest that internet-based cognitive behavioral therapy (ICBT) effectively deals with psychological distress and eating disorders in post-bariatric surgery patients in the context of the COVID-19 pandemic [12]. This research is reinforced by recent research during the COVID-19 pandemic, showing that ICBT can significantly reduce anxiety scores in patients during the COVID-19 pandemic [13]. Additionally, a previous meta-analysis reported that internet-based intervention significantly reduced depression during the COVID-19 pandemic [13]. Nevertheless, this study focused on CBT to reduce psychological distress, including depression. Our meta-analysis collected randomized controlled studies related to various online-based interventions in the population globally during COVID-19.

To our knowledge, this is the first study examining the use of online-based intervention to reduce anxiety among the global population during COVID-19. The aim of this study was to identify the efficacy of online-based interventions among the global population to reduce anxiety during the COVID-19 pandemic while also evaluating the quality of the selected RCTs. Besides this, our study not only investigates the pre- and post-online-based intervention to reduce anxiety but also investigates post-intervention and post-usual intervention. This study was created to serve as a reference for the prevention and treatment of anxiety in global populations during the COVID-19 pandemic.

2. Methodology
2.1. Study Design

This study employs systematic and meta-analysis following a Preferred Reporting Item for Systematic Review and Meta-analysis (PRISMA).

2.2. Search Strategy

The inclusion criteria applied to the PICOS framework (patient/problem, intervention/exposure, comparison/control, outcome) and included (1) population: people with anxiety during the COVID-19 pandemic; (2) intervention: online-based intervention for anxiety; (3) outcomes: anxiety scores using respective tools in mean, standard deviation,
and p-value for pre- and post-intervention and control; (4) pre-treatment or other care as the control; and (5) study: RCTs. In the meanwhile, the exclusion criteria for this were as follows: (1) incomplete studies at the time of retrieval; (2) studies having unretrievable full-text articles; and (3) studies published in languages other than English as the international language. Additionally, the Mendeley software was used to eliminate duplicates. Three independent reviewers selected the titles and abstracts of papers based on criteria regarding their accessibility. Any disputes were discussed to reach a consensus.

2.3. Eligibility Criteria

Using the PRISMA framework, we did a comprehensive literature search on PubMed, Scopus, CINAHL, and Oxford University Press. We gathered information on August, 2022, using the search terms: (“anxiety”[MeSH Terms] OR “anxiety”[All Fields] OR “anxieties”[All Fields] OR “anxiety s”[All Fields]) AND (“internet based intervention”[MeSH Terms] OR (“internet based”[All Fields] AND “intervention”[All Fields]) OR “internet based intervention”[All Fields] OR (“internet”[All Fields] AND “based”[All Fields] AND “intervention”[All Fields]) OR “internet based intervention”[All Fields] OR “internet based intervention”[All Fields]) AND (“COVID 19”[All Fields] OR “COVID 19” [MeSH Terms] OR “sars cov 2”[All Fields] OR “sars cov 2”[MeSH Terms] OR “severe acute respiratory syndrome coronavirus 2”[All Fields] OR “ncov”[All Fields] OR “2019 ncov”[All Fields]) AND (“coronavirus”[MeSH Terms] OR “coronavirus”[All Fields] OR “cov”[All Fields]). The medical subject headings (MeSH) Browser matched each and every term. Moreover, we collected data using snowball technique in Google Scholar. The details of the literature search are shown in Figure 1.

2.4. Data Extraction

We found the included studies by using a tabular outcome sheet with the following columns: (1) author and year of publication; (2) study characteristics, including study location, and study design; (3) study population, including sample size, mean/range age, and gender; (4) intervention, including the name of the intervention, how often it was carried out, the assessment tool used, and how long it took to follow up; and (5) study outcomes, including the number of participants who completed the intervention, the number of participants who two reviewers looked at the study’s qualities qualitatively, and while another author conducted statistical analysis, she double-checked the accuracy of the extracted data.

2.5. Quantitative Data Analysis

Review Manager 5.4 was used for statistical analysis (The Nordic Cochrane Center, The Cochrane Collaboration, Copenhagen, Denmark). Pre- and post-intervention mean differences, standard deviation, 95% CI, and p-value were retrieved from studies. Using random-effects models, we interpreted pooled effects. The statistical study employed the mean difference between pre- and post-treatment utilizing online-based intervention for patients with anxiety during the COVID-19 pandemic, as well as the mean difference between online-based intervention and control group patients. The mean difference, 95% CI, and p-value were used to estimate the efficacy of online-based intervention on anxiety patients during the COVID-19 pandemic. We employed inverse variance and DerSimonian–Laird random-effects model because heterogeneity outside the research might be found. Heterogeneity was evaluated using I2 statistics based on the Cochrane criteria, with 0%, 25%, 50%, and 75% as negligible, low, moderate, and high heterogeneity, respectively.
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Figure 1. The PRISMA flowchart.
2.6. Critical Appraisal

The Revised Tool for Risk of Bias in Randomized Trials (RoB 2.0), which consists of five areas for initiative studies, was used to assess the potential for bias in the final studies that were included in the analysis. The author will conduct an analysis of the potential for bias using the formula that was developed by the Cochrane Collaboration. Following that, the findings will be entered into the domain file bias (.xlsx). Following this step, the file will be uploaded to the ROBVIS website in order to facilitate accurate visualization of the final results.

3. Results

3.1. Characteristic Study

Quantitative studies were conducted on 34 RCTs, yielding 16,151 participants with anxiety during the COVID-19 pandemic who were treated with an online-based intervention. Qualitative analyses were conducted on 10 RCTs yielding 9159 participants for GAD-7 measurement and conducted on four RCTs yielding 1303 participants for DASS-21 measurement. The research was conducted in many countries (China, Oman, United States, Indonesia, Iran, Spain, Turkey, Switzerland, Germany, Sweden, Australia, Norway, Italy, and South Africa) and released during the COVID-19 pandemic from 2020 to 2022. The range age of the participants was 13.5–73.39, and they were further randomized into an intervention group, a control group, or several intervention groups for follow-up. Interventions consisted of online-based interventions. Outcomes were measured using standardized instruments, such as Generalized Anxiety Disorder (GAD-7), Depresssion, Anxiety, and Stress Scale (DASS), the Patient Health Questionnaire-9 (PHQ-9), questionnaire, Short Health Anxiety Inventory (SHAI), Hamilton Anxiety Rating Scale (HAM-A), COVID-19 Anxiety Questionnaire (CVAQ), and State Anxiety Inventory-Form (STAI). Detailed characteristic of included studies are listed in Table 1. Table 1 shown that the demographic characteristics are varied which is characterized by the distribution of study locations in almost all continents. However, the variation of design intervention, the measurement instrument, population, age, and gender increase the heterogeneity of this study.

3.2. Study Outcome

3.2.1. Model of Online-Based Intervention for Anxiety

The model of online-based intervention for anxiety utilizes various digital devices, including mobile phones, web-based applications, video-based, mobile applications, and virtual live meetings. The delivery service is an online-based intervention consisting of the self-screening of anxiety and therapy programs. Therapy is carried out by two methods (self guided/self-help and therapist guided), including cognitive behavioral therapy (CBT), mindfulness therapy, relaxation therapy, acceptance and commitment therapy (ACT), and solution-focused support programs. The efficacy of each intervention and model is shown in Table 2 and forest plot of meta-analysis if the study is eligible (Figures 2–5). Table 2 shows that almost all studies show a decrease in pre- and post-intervention anxiety scores and there are mean differences between the intervention and control groups. However, the model, the number of samples, the instrument for measuring outcomes, and the differences of the reduction in anxiety scores that varied mean this study has high heterogeneity. In addition, out of 34 studies, only 12 studies were eligible for meta-analysis for measurements using GAD-7 and 4 studies using DASS-21. Due to the high heterogeneity, the pooled effects analysis method uses the random-effect method. The statistically pooled effect and heterogeneity can be seen in the forest plot (Figures 2–5).
Table 1. Characteristic of included studies.

| No | Study                        | Location | Design | Model               | Instrument | Population                  | Age (M, SD) | Gender (Female %) |
|----|------------------------------|----------|--------|---------------------|------------|------------------------------|-------------|------------------|
| 1  | Liu et al. (2021) [14]       | China    | RCT    | m-CBT               | HAMA       | COVID-19 patients            | IG: 43.76 (14.31) | 29.4 |
|    |                              |          |        |                     |            |                              | CG: 42.26 (12.66) |      |
| 2  | Al-Alawi et al. (2021) [15]  | Oman     | RCT    | TGOT                | GAD-7      | General Population           | 28.51 (8.70)   | 78.26 |
| 3  | Zheng et al. (2021) [16]     | China    | RCT    | Digital behavior change | SCAS       | children population       | 13.5 (SD 0.50) | N/I         |
| 4  | Mullarkey et al. (2022) [17] | US       | RCT    | Web-based           | GAD-7      | General Population           | IG: 46.02 (15.65) | 18.39 |
|    |                              |          |        |                     |            |                              | CG: 46.19 (15.71) |      |
| 5  | Suranata et al. (2021) [18]  | Indonesia| RCT    | web tutorials-mindfulness | DASS-21   | children population       | 26.7         | 41.86 |
| 6  | Otared et al. (2021) [19]    | Iran     | RCT    | Online ACT          | BAI        | health care workers         | IG: 33.40 (SD 4.49) | 45  |
|    |                              |          |        |                     |            |                              | CG: 31.50 (SD 5.35) |     |
| 7  | Rackoff et al. (2022) [20]   | US       | RCT    | IBS                 | DASS       | Student                     | IG: 20.24 (4.13) | 51.4 |
|    |                              |          |        |                     |            |                              | CG: 20.65 (4.88) |       |
| 8  | Shabahang et al. (2021) [2]  | Iran     | RCT    | Video-base CBT      | CVAQ       | Student                     | 24.7 (5.4)    | 76.92 |
| 9  | Wei et al. (2020)-a [21]     | China    | RCT    | IBII                | GAD-7      | care provider and COVID-19 patients | IG: 40.8 ± 13.5 | 76.92 |
|    |                              |          |        |                     |            |                              | CG: 48.5 ± 9.5 |      |
| 10 | Wahlund et al. (2020) [6]    | Swedia   | RCT    | OCBI                | GAD-7      | General Population           | TG: 45 (13)   | 83    |
|    |                              |          |        |                     |            |                              | CG: 47 (14)   |      |
| 11 | Fiol-DeRoque et al. (2021) [22] | Spain    | RCT    | A Mobile Phone–Based (PsyCovidApp)—Psycoeducational-mindfullness | DASS-21   |                              | 41.37 (10.4)  | 83.2 |
| 12 | Zengin et al. (2021) [23]    | Turkey   | RCT    | SFSP                | STAI       | Older population            | 33.51 (6.53)  | 77.9 |
| 13 | Brog et al. (2022) [24]      | Switzerland | RCT    | ISF                 | DASS-21    | General Population           | 40.36 (14.59) | 81.3 |
| No | Study                      | Location | Design | Model                           | Instrument | Population                        | Age (M, SD) | Gender (Female %) |
|----|----------------------------|----------|--------|---------------------------------|------------|-----------------------------------|-------------|------------------|
| 14 | Heckendrof et al. (2021)  | Germany  | RCT    | ICBS                            | GAD-7      | General Population                | 42.6 (14.3) | 82.3             |
| 15 | Aminoff et al. (2021)     | Sweden   | RCT    | ICBT                            | GAD-7      | General Population                | 42.7 (17.4) | 71.2             |
| 16 | Kang et al. (2021)        | China    | RCT—single arm | Internet-based MBSR | GAD-7 | Breast cancer                       | 45.9 (5.4)  | 100              |
| 17 | Schleider et al. (2022)   | USA      | RCT    | SSIs                            | GAD-7      | adolescents population            | N/I         | 87               |
| 18 | Fassnacht et al. (2022)   | Australia| RCT    | Internet-based Intervention to promote mental health | GAD-7 | Student                           | 30.65 (10.10) | 81.1             |
| 19 | Mahoney et al. (2021)     | Australia| RCT    | THIS WAY UP (thiswayup.org.au) iCBT | GAD-7 | Adults experiencing symptoms of anxiety | 37.31 (13.53) | 70.1             |
| 20 | Sharrock et al. (2021)    | Australia| RCT    | THIS WAY UP (thiswayup.org.au) iCBT | SHAI | Adults experiencing symptoms of anxiety | 37.76 (12.64) | 67.61            |
| 21 | Ying et al. (2021)        | China    | RCT    | Healthy Psychological Station (iCBT clinician guided) | GAD-7 | Symptoms of anxiety           | 73.39 (7.37) | 68.5             |
| 22 | Nordgreen et al. (2021)   | Norway   | RCT    | Self-guided Internet-delivered intervention integrated with The person-based approach | GAD-7 | Self-reported anxiety symptoms | 40 (14.19)  | 79.26            |
Table 1. Cont.

| No | Study | Location | Design | Model | Instrument | Population | Age (M, SD) | Gender (Female %) |
|----|-------|----------|--------|-------|------------|------------|-------------|------------------|
| 23 | Perri et al. (2021) [34] | Italy | RCT | TF-CBT using skype | STAI-Y1 | People with quarantine, isolation or work in COVID-19 hospital wards | 52.4 (10.6) | 68.42 |
| 24 | Bantjes et al. (2021) [35] | South Africa | RCT | Web-based GCBT | GAD-7 | Students | 22.4 (4.9) | 13.9 |

Note: COVID-19 Anxiety Questionnaire (CVAQ); Short Health Anxiety Inventory (SHAI); Anxiety Sensitivity Index-3 (ASI-3); Somatosensory Amplification Scale (SSAS); Mindfulness-based Stress Reduction (MBSR); Children’s Anxiety Scale (SCAS); Internet-delivered cognitive behavior therapy (ICBT); Randomized Controlled Trial (RCT); Tested online single-session interventions (SSIs); trauma-focused cognitive-behavioral therapy (TF-CBT); Acceptance and Commitment Therapy (ACT); Solution-Focused Support Program (SFSP); Web-based (Microsoft Teams) group cognitive behavioral therapy (Web-based GCBT); Internet-based self help (ISF); internet cognitive-behavioral self-help (ICBS); Online Cognitive Behavioral Intervention (OCBI); Therapist-Guided Online Therapy (internet-based therapy) (TGOT); Internet-based self-help (IBS); internet-based integrated intervention (IBI).

Table 2. Study outcome of included studies.

| Study | Model | Service | Instrument | Sample (n) | Intervention | Control |
|-------|-------|---------|------------|------------|-------------|---------|
| Liu et al. (2021) [14] | Mobile phone | CBT | HAMA | 126 | 14.52 (3.13) | 7.79 (3.60) | 13.97 (2.72) | 13.63 (3.24) |
| Al-Alawi et al. (2021) [15] | Therapist-Guided Online Therapy | CBT | GAD-7 | 22 | 0.02 | GAD < 10 (100) | B 0.02 | GAD < 10 (71) |
| Zheng et al. (2021) [16] | Digital behaviour change | CBT | SCAS | 485 | 3.72 (3.69–3.76) | 3.49 (3.46–3.52) | 3.67 (3.64–3.70) | 3.79 (3.76–3.83) |
| Mullarkey et al. (2022) [17] | Web-based Perceived Control Over Anxiety | CBT | GAD-7 | 261 | 0.75 (0.74) | 0.12 (0.002–0.25) | 0.77 (0.75) | 0.15 (0.03–0.27) |
| Suranata et al. (2021)-a [18] | Web tutorials Mindfulness | DASS-21 | 34 | 16.529 (1.674) | 12.971 (0.627) | 14.875 (2.151) | 16.825 (2.147) |
| Suranata et al. (2021)-b [18] | Web tutorials Relaxation | DASS-21 | 55 | 14.909 (1.898) | 14.418 (2.149) | 14.875 (2.151) | 16.825 (2.147) |
| Otares et al. (2021) [19] | Online ACT ACT | BAI | 20 | 38.90 (12.20) | 20.00 (0.08) | 36.60 (9.01) | 17.80 (5.28) |
| Rackoff et al. (2022) [20] | Internet-based self help | CBT | DASS | 301 | 21.11 (10.81) | 15.82 (10.81) | 19.84 (9.34) | 15.06 (10.14) |
| Shabahang et al. (2021)-a [2] | Video-based | CBT | CVAQ | 75 | 37.68 (1.66) | 30.61 (4.01) | 37.62 (3.21) | 37.25 (3.32) |
| Shabahang et al. (2021)-b [2] | Video-based | CBT | SHAI | 75 | 40.92 (9.24) | 30.21 (10.65) | 40.83 (7.97) | 40.52 (8.31) |
| Shabahang et al. (2021)-c [2] | Video-based | CBT | ASI-3 | 75 | 48.64 (6.56) | 40.73 (8.19) | 48.58 (8.74) | 48.96 (7.84) |
| Shabahang et al. (2021)-d [2] | Video-based | CBT | SSAS | 75 | 35.74 (10.15) | 25.71 (10.36) | 35.58 (10.36) | 35.14 (10.42) |
| Wei et al. (2020)-a [21] | Internet-based integrated intervention | Breath relaxation, mindfulness, refuge skill, butterfly huge method | GAD-7 | 13 | 5.08 (2.75) | 6 (46.2) | 5.92 (2.53) | 10 (76.9) |
| Study | Model | Service | Instrument | Sample (n) | Intervention | Control |
|-------|-------|---------|------------|------------|--------------|---------|
| Wei et al. (2020)-b [21] | Internet-based integrated intervention | Breath relaxation, mindfulness, refuge skill, butterfly huge method | HAMA | 13 | 13 | N/A | N/A | N/A | N/A |
| Wahlund et al. (2020)-a [6] | Internet-based | CBT | GAD-7 | 335 | 335 | 13.93 (4.10) | 8.40 (4.95) | 13.54 (4.34) | 11.25 (5.10) |
| Wahlund et al. (2020)-b [6] | Internet-based | CBT | WSAS | 335 | 335 | 16.28 (7.38) | 11.38 (8.30) | 16.21 (7.27) | 14.78 (8.22) |
| Wahlund et al. (2020)-c [6] | Internet-based | CBT | IUS-12 | 335 | 335 | 37.05 (8.99) | 33.24 (9.23) | 35.81 (9.40) | 34.58 (9.82) |
| Fiol-DeRoque et al. (2021) [22] | A mobile phone–based apps | Mindfulness | DASS-21 | 248 | 234 | 4.35 (3.86) | 2.21 (2.43) | 4.70 (4.25) | 2.84 (3.36) |
| Zengin et al. (2021)-a [23] | Solution-Focused Support Program (SFSP) | SFS | STAI-S | 77 | 37 | 56.10 (10.14) | 43.51 (9.22) | 51.00 (7.25) | 50.45 (8.29) |
| Zengin et al. (2021)-b [23] | Solution-Focused Support Program (SFSP) | SFS | STAI-T | 77 | 37 | 50.08 (9.10) | 14.9 ± 7.28 | 14.60 ± 7.65 |
| Brog et al. (2022) [24] | Internet-based | CBT | DASS-21 | 53 | 54 | 21.53 (9.23) | 20.27 (10.84) | 19.66 (1.34) |
| Heckendorf et al. (2021) [25] | Internet-based | CBT | GAD-7 | 175 | 176 | 11.2 (4.5) | 7.1 (6.0) | 11.4 (4.7) | 39.2 (20.0) |
| Aminoff et al. (2021) [26] | Internet-based | CBT | GAD-7 | 26 | 26 | 11.46 (5.56) | 5.04 (4.61) | 9.54 (3.32) | 7.67 (4.53) |
| Kang et al. (2021)-a [27] | Internet-based | Mindfulness | GAD-7 | 20 | N/A | 13.3 (2.4) | 6.7 (3.2) | N/A | N/A |
| Kang et al. (2021)-b [27] | Internet-based | Mindfulness | GAD-7 | 9 | N/A | 14.9 ± 1.9 | 10.1 ± 3.8 | N/A | N/A |
| Schleider et al. (2022)-a [28] | Tested online single-session interventions (SSIs)—BA SSI | Testing | GAD-7 | 821 | 818 | 2.96 (0.76) | 2.73 (0.82) | 3.01 (0.73) | 2.78 (0.79) |
| Schleider et al. (2022)-b [28] | Tested online SSIs—GM SSI | Testing | GAD-7 | 813 | 818 | 3.00 (0.74) | 2.68 (0.81) | 3.01 (0.73) | 2.78 (0.79) |
| Fassnacht et al. (2022) [29] | Internet-based Intervention to promote mental health THIS WAY UP (thiswayup.org.au) iCBT | CBT | GAD-7 | 75 | 89 | 9.27 (5.06) | 6.46 (4.08) | 8.15 (4.57) | 7.09 (4.11) |
| Mahoney et al. (2021) [30] | THIS WAY UP (thiswayup.org.au) iCBT | CBT | GAD-7 | 5074 | 11.79 (5.20) | 7.28 (4.36) | N/A | N/A |
| Sharrock et al. (2021) [31] | THIS WAY UP (thiswayup.org.au) iCBT Healthy Psychological therapy | CBT | SHAI | 778 | 29.15 (11.13) | 20.54 (10.18) | N/A | N/A |
| Ying et al. (2021) [32] | Station (iCBT clinician guided) | CBT | GAD-7 | 127 | 9.51 (1.31) | 6.18 (2.55) | N/A | N/A |
| Nordgreen et al. (2021) [33] | Self-guided intervention integrated with The person-based approach | CBT | GAD-7 | 82 | 9.40 (4.17) | 6.63 (5.25) | N/A | N/A |
| Perri et al. (2021) [34] | TF-CBT using skype | CBT | STAI-Y1 | 19 | 47.2 (12.2) | 29.8 (11.8) | N/A | N/A |
| Bantjes et al. (2021) [35] | Web-based (Microsoft Teams) group cognitive behavioural therapy | CBT | GAD-7 | 158 | 14.1 (3.5) | 6.9 (4.2) | N/A | N/A |

Note: Anxiety Sensitivity Index-3 (ASI-3); Back Anxiety Inventory (BAI); Cognitive-behavioural therapy (CBT); Control Group (CG); COVID-19 Anxiety Questionnaire (CVAQ); Depression Anxiety Stress Scale (DASS); GAD (General Anxiety Disorder); Intervention Group (IG); Intolerance Uncertainty Scale (IUS); Single-Session Interventions (SSI); Trauma-Focused Cognitive-Behavioural Therapy (TF-CBT); Short Health Anxiety Inventory (SHAI); Children’s Anxiety Scale (SCAS); State-Trait Anxiety Inventory (STAI); Somatosensory Amplification Scale (SSAS); Work and Social Adjustment Scale (WSAS).
3.2.2. Pre- and Post-Online-Based Intervention Efficacy for GAD-7 Score

during COVID-19 pandemic [6,18,22,24].

Figure 2. Pre- and post-online-based intervention efficacy for GAD-7 score during COVID-19 Pandemic [6,25–30,32,33,35].

Figure 3. Post-online-based intervention vs. post-usual intervention efficacy for GAD-7 score during COVID-19 Pandemic [6,25,26,28,29].

Figure 4. Pre- and post-online-based intervention efficacy for DASS-21 score during COVID-19 pandemic [18,20,22,24].

Figure 5. Post-online-based intervention vs. post-usual intervention efficacy for DASS-21 score during COVID-19 pandemic [6,18,22,24].
3.2.2. Pre- and Post-Online-Based Intervention Efficacy for GAD-7 Score

A low anxiety score on the surveys of the relevant standardized tools (GAD-7) served as the efficacy criterion. The results of a meta-analysis evaluating the pre- and post-intervention efficacy of an online-based intervention during the COVID-19 pandemic are depicted in Figure 2 as a forest plot showing a significant effect with a pooled MD of 1.03 (95% CI: 2.83–4.65; \( p = 0.00001 \)). This result shows that online-based intervention was found to significantly reduce GAD-7 scores in patients with anxiety. We also observed considerable heterogeneity (\( I^2 = 97\%; \ p = 0.00001 \)).

3.2.3. Post-Online-Based Intervention vs. Post-Usual Intervention Efficacy for GAD-7 Score

A low anxiety score on the surveys of GAD-7 served as the efficacy criterion. The results of a meta-analysis evaluating the post-online-based intervention (intervention) vs. post-usual intervention efficacy (control) of an online-based intervention during the COVID-19 pandemic are depicted in Figure 3 as a forest plot showing a significant effect with a pooled MD of −7.26 (95% CI: −11.58–−2.95; \( p = 0.001 \)). This result shows that the online-based intervention significantly reduces GAD-7 scores in patients with anxiety. We also observed considerable heterogeneity (\( I^2 = 99\%; \ p = 0.00001 \)).

3.2.4. Pre- and Post-Online-Based Intervention Efficacy for DASS-21 Score

A low anxiety score on the surveys of the other relevant standardized tools (DASS-21) served as the efficacy criterion. The results of a meta-analysis evaluating the pre- and post-intervention efficacy of an online-based intervention during the COVID-19 pandemic are depicted in Figure 4 as a forest plot depicting a significant effect with a pooled MD of 0.05 (95% CI: −2.63–2.72; \( p = 0.97 \)). This result shows that online-based intervention was found to insignificantly reduce DASS-21 scores in patients with anxiety. We also observed considerable heterogeneity (\( I^2 = 98\%; \ p = 0.00001 \)).

3.2.5. Post-Online-Based Intervention vs. Post-Usual Intervention Efficacy for DASS-21

A low anxiety score on the surveys of DASS-21 served as the efficacy criterion. The results of a meta-analysis evaluating the control group vs. intervention group of an online-based intervention during the COVID-19 pandemic are depicted in Figure 3 as a forest plot depicting a significant effect with a pooled MD of −2.08 (95% CI: −6.71–2.55; \( p = 0.001 \)). This result shows that online-based intervention was found to significantly reduce DASS-21 scores in patients with anxiety. We also observed considerable heterogeneity (\( I^2 = 99\%; \ p = 0.00001 \)).

3.3. Risk of Bias

The majority of the included studies show low bias, with only two studies having strong bias and six out of twenty-two studies having moderate bias problems. In addition, there is a low degree of bias in the selection of the reported results in all studies, a high bias in the randomization process and the absence of outcomes in several studies, and a moderate degree of bias in the deviation from the intended intervention and measurement of the outcomes in several studies. Figures 6 and 7 depict the bias risk of the considered studies.
### Figure 6. Traffic light plot risk of bias [2,6,14–35].

| Study                     | D1 | D2 | D3 | D4 | D5 | Overall |
|---------------------------|----|----|----|----|----|---------|
| Liu et al. (2021)         |   |   |   |   |   |         |
| Al-Allweil et al. (2021)  |   |   |   |   |   |         |
| Zhang et al. (2021)       |   |   |   |   |   |         |
| Mullarkey et al. (2022)   |   |   |   |   |   |         |
| Susarani et al. (2021)    |   |   |   |   |   |         |
| Ota et al. (2021)         |   |   |   |   |   |         |
| Rankoff et al. (2022)     |   |   |   |   |   |         |
| Shabahang et al. (2021)   |   |   |   |   |   |         |
| Wei et al. (2020)         |   |   |   |   |   |         |
| Wihlstrum et al. (2020)   |   |   |   |   |   |         |
| Poil-DeRoqua et al. (2021)|   |   |   |   |   |         |
| Zeng et al. (2021)        |   |   |   |   |   |         |
| Brog et al. (2022)        |   |   |   |   |   |         |
| Hackarot et al. (2021)    |   |   |   |   |   |         |
| Aminoff et al. (2021)     |   |   |   |   |   |         |
| Kang et al. (2021)        |   |   |   |   |   |         |
| Schiedler et al. (2022)   |   |   |   |   |   |         |
| Fasolci et al. (2022)     |   |   |   |   |   |         |
| Mahoney et al. (2021)     |   |   |   |   |   |         |
| Sharrock et al. (2021)    |   |   |   |   |   |         |
| Ying et al. (2021)        |   |   |   |   |   |         |
| Nordgreen et al. (2021)   |   |   |   |   |   |         |
| Ponn et al. (2021)        |   |   |   |   |   |         |
| Bamfo et al. (2021)       |   |   |   |   |   |         |

**Domains:**
- D1: Bias arising from the randomization process.
- D2: Bias due to deviations from intended intervention.
- D3: Bias due to missing outcome data.
- D4: Bias in measurement of the outcome.
- D5: Bias in selection of the reported result.

**Judgement:**
- Red: High concern.
- Yellow: Some concern.
- Green: Low concern.
4. Discussion

This meta-analysis is the first meta-analysis to analyze the efficacy of online-based interventions to reduce anxiety during COVID-19 among the global population, respectively. This study also qualitatively identified the model of online-based intervention that was used worldwide. This study shows that several findings. First, the online-based intervention model in this study uses various digital devices, including the self-screening of anxiety and therapy programs. In this study, the online-based intervention significantly reduced the GAD-7 score in patients with anxiety who performed during COVID-19, with a pooled MD of 1.03 ($p = 0.00001$) compared to before using online-based intervention and pooled MD of $-7.26$ ($p = 0.001$) compared with post-usual intervention. Many studies have also assessed GAD using CBT, mindfulness, and testing, also providing significant results with regard to reducing GAD-7 scores. One of the studies was conducted by Bantjes et al. (2021), with a web-based intervention model; the post-intervention mean was 6.9 (SD 4.2), whereas before the intervention this was 14.1 (SD 3.5) [35]. In addition, DASS-21 was also assessed in this study, where this time, the online-based intervention did not provide significant results in reducing the DASS-21 score ($p = 0.97$) in patients with anxiety who performed during COVID-19 compared to before the given intervention. However, compared to patients who received the post-usual intervention, the online-based intervention yielded significant results with a pooled MD of $-2.08$ ($p = 0.001$).

Systematic review and meta-analysis conducted by Ye et al. (2014) associated with internet-based intervention in the population aged <25 years showed significant results in reducing anxiety symptom severity and increasing remission rate [36]. Another study also assessed internet-based interventions that focused on older adults or those >50 years of age. This study found that the intervention was feasible and effective as a treatment for common mental disorder symptoms and stress in older adults [37]. Another study by Komariah et al. (2022) also assessed iCBT in a population with a mean age of 22 during COVID-19 with various standardized instruments as outcomes. The three meta-analyses showed good efficacy of internet-based intervention as a treatment for anxiety and depression [13]. Our study was conducted on the global population during COVID-19 and assessed various instruments with different services, including CBT, mindfulness, and testing. The results of our study are not only investigated the intervention and control performed on the pre- and post-intervention, but also investigated post-intervention and post-usual intervention.

Several meta-analyses have assessed the effectiveness of an online-based intervention, with the results being feasible and may be used as a promising treatment for anxiety and depression. A study conducted by Tzelepis et al. (2021) on the long-term effectiveness of internet-based interventions on multiple health risk behaviors found significant results on overall SNAP (tobacco smoking, poor nutrition, risky alcohol use, and physical inactivity) behaviors with a standardized mean difference of $-0.12$ ($p = 0.01$) [38]. Another study is a scoping review conducted by Williams et al. (2019) regarding internet-based intervention to support recovery and self-management. Its use is well-integrated and can support recovery and a sense of working in partnership [39]. From these two studies, what is interesting...
is that online-based methods are not only effective for anxiety or depression, but also for health promotion and disease prevention. During a pandemic, access to traditional therapies may be difficult due to several obstacles supported by the requirement of social distancing to prevent disease transmissions, such as the lack of therapists, financial limitations, and the stigma of over seeking mental health treatment. The online-based intervention has various advantages. During COVID-19, the internet helps minimize contact between people. In a study conducted by Andersson and Titov (2014) about the advantages and limitations of an internet-based intervention for common mental disorders, the gap between treatment and demand can be reduced in patient recruitment because many people with anxiety disorders are hesitant to see a clinical specialist and mention the problem. In addition, it was also mentioned that internet-based interventions have the advantage of cost-effectiveness compared to face-to-face meetings. In this case, the patient can also access information according to the patient's wishes to help in learning and remembering [40]. Another study on internet-based methods used for health promotion during COVID-19 shows that the methods used have enormous potential in disseminating information related to COVID-19 and wellness education to the public [41]. From the two studies, the internet-based intervention has enormous potential, supported by the ease of accessing the internet and the tendency of people with anxiety who are hesitant to meet clinicians.

The use of services in the delivery of interventions plays an important role; in this study, several services were proven effective in reducing anxiety. Compared to face-to-face meetings, which are more expensive to access online, an online-based intervention is cost-effective. Additionally, the ease of access and the tendency of patients with anxiety who are hesitant to meet clinicians, and with the COVID-19 pandemic, online-based interventions can be an effective method to help patients. Despite the advantage of using technology, there are also several problems, the use of the internet is still not evenly distributed among the population in rural areas, and its use requires an understanding of technology. In terms of ethics, professionalism, as one of the codes of ethics in the use of online health-based services, is something that must continue to be considered, which in practice, clinicians must continue to explain the limitations of diagnosis or therapy carried out online so that they can remain obedient to the code of ethics [42–44].

The RCTs of this study have a variety of therapies and different durations of time with various instruments as outcomes. For all studies, the Cochrane Risk of Bias 2.0 returned mostly low rating for risk of bias and concerns, with two studies have high concern risk of bias due to bias in randomization process and missing outcome data. This study also presents several studies show bias and high bias as well as considerable heterogeneity that can affect the results of the study. The limitations of this study are, first, only taking English-language studies. Second, only take published studies. Finally, the heterogeneity found is quite large. Therefore, heterogeneity is also discussed to ensure that the data taken are correct and have a random effect.

Increasing demand for anxiety treatment is a public health challenge. Many people will need therapy for anxiety at some point. Online-based interventions are an excellent therapy for anxiety, but for the best results, physicians and nurses should combine it with medication therapy. Mental health nurses must consult psychiatric patients on treatment options. Physicians should work with behavior therapists to implement and track online-based intervention. Psychotherapy and psychopharmacology might be ineffectual, and finding a diagnosis and accessing treatment can be challenging. An online-based intervention can be a solution with enough evidence. Recent studies on the efficacy of an online-based intervention as routine care can alleviate certain implementation problems, including the need to strengthen informal integration of healthcare systems to overcome general practitioners’ skepticism about an online-based intervention. Second, stable patient recruitment as referral models to maintain effective communication methods and develop online-based intervention work programs. Third, therapists’ working circumstances should include developmental training, standards, and peer feedback. Long-term sustainability
is the most crucial feature of national service. An online-based intervention can have the reverse impact in some circumstances, affecting therapy–patient interactions. Using the internet decreases face-to-face encounters, which may aid people with comorbidities, demotivating conditions, etc. Increasing doctor–patient engagement can reduce this risk and improve patient care. Other aspects are intervention methods, module number, and session length.

5. Conclusions

This systematic review and meta-analysis found that the online-based interventions are effective to reduce anxiety among the global population during COVID-19. The interventions include CBT, relaxation, mindfulness, SFS, refuge skill, and butterfly huge method. An online-based intervention positive findings show the benefits of technological advancement in psychotherapy. Follow-ups, patient feedback, and research in developed and under-developed nations with defined protocols or assessments can improve clinical trial quality. Anxiety is very common during pandemics and must be addressed. The public must be aware of how the COVID-19 pandemic affects mental health. By raising awareness, individuals can understand that anxiety need to be treated early, and an online-based intervention can be an economical alternative. In the future, a comprehensive approach to anxiety and online-based intervention is needed, starting with increasing awareness, educating patients and families, and offering information to increase an online-based intervention as an alternative therapy. We suggest a systematic review including meta-regression to assess online-based intervention moderation. Long-term findings with a six-month follow-up are needed to evaluate the online-based intervention for anxiety.

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