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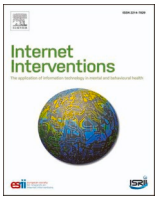

Internet-delivered cognitive behavioral therapy for anxiety among university students: A systematic review and meta-analysis☆

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ABSTRACT

University years are marked by multiple stressors. Consequently, university students often report anxiety symptoms or disorders, but most remain untreated. Internet-delivered cognitive behavioral therapy (ICBT) has been proposed as an alternative to address known help-seeking barriers, which were aggravated during the COVID-19 pandemic. This meta-analysis aims to evaluate the efficacy of ICBT for university students with anxiety. A systematic search on three databases, EBSCOhost, PubMed, and Web of Science, and a manual search were performed. Fifteen studies were identified, including a total of 1619 participants. Seven studies evaluated ICBT treatment for both anxiety and depression, three for social anxiety, two for generalized anxiety, while the remaining ($k = 3$) only targeted anxiety, test anxiety, and comorbidity between anxiety and insomnia. Analyses were performed based on a random-effects model using the metafor package in *R*. The results indicated that ICBT had a significant and positive effect on university students with anxiety compared to controls at post-test ($g = -0.48$; 95 % CI: −0.63, −0.27; $p < .001$, $I^2 = 67.30$ %). Nevertheless, more research is required to determine the intervention components that are more relevant for therapeutic change, how much guidance is required to produce better outcomes, and how patient engagement can be improved.

1. Introduction

University years are a distinct developmental period marked by the transition from late adolescence to emerging adulthood. During this time, university students face multiple stressors because of major life events, such as leaving parents' homes (Sussman and Arnett, 2014). In addition, they experience changes in romantic relationships, peer groups, academic skills, and career choices (Auerbach et al., 2018).

Hence, many university students report mental health disorders, with onset mostly occurring at the time of college-entry (Auerbach et al., 2016). A recent systematic review, based on data on university students from 40 countries, identified anxiety, along with depression, as the most prevalent mental disorder (24.5 %) (Paula et al., 2020). Students in the health professions (e.g., medicine) suffer the most (e.g., January et al., 2018). Anxiety disorders involve excessive fear or anxiety, out of proportion to the circumstances or age, and avoidance of situations that trigger or worsen symptoms (American Psychiatric Association [APA], 2013).

To illustrate, a study based on 611 Australian university students found that 17.5 % met the clinical criteria for a diagnosis of generalized anxiety disorder (GAD), which was significantly associated with homesickness, financial hardship, and difficulty coping with studies (Farrer et al., 2016). A study conducted on 231 students from Saudi Arabia found that approximately 68 % had mild, moderate, or severe anxiety according to the total scores on the GAD scale (GAD-7), which was associated with high average grades and low family income (Alatawi et al., 2020). According to Beiter et al. (2015), pressure to succeed and concerns about post-graduation plans were other factors contributing to the core symptoms of anxiety (e.g., autonomic arousal and subjective experience of anxious affect) during the college years of 374 students attending a university in the United States (USA). Abadi et al. (2021) found that 30.1 % of 550 students had clinical symptoms of anxiety according to the Social Phobia Inventory (SPIN). Being young and living alone were risk factors. Although less prevalent, panic disorder symptoms were also identified in a sample of first-year Spanish university students ($N = 2118$) (Ballester et al., 2020).

Since the COVID-19 pandemic, university students' generalized anxiety levels have been increasing (e.g., Amendola et al., 2021). In

☆ The study was conducted according to APA ethical standards.

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addition to measures implemented to contain the disease, including suspension of studies and stay-at-home orders, being at risk of COVID-19 infection, being exposed to an infected person, or using the Internet during the pandemic are significant predictors of anxiety. Moreover, changing social norms (e.g., mask-wearing and online classes) and prolonged social distancing may be associated with high social anxiety during and after COVID-19, respectively (e.g., Arad et al., 2021).

Nevertheless, most students do not receive or seek treatment. Despite the effectiveness of several psychological treatments, such as cognitive behavioral therapy (CBT) (e.g., James et al., 2020), evidence suggests that only one-fifth of university students, even in high-income countries, have access to help (Auerbach et al., 2016; Bruffaerts et al., 2019). According to Jenkins et al. (2020), when left untreated, anxiety symptoms (measured using GAD-7) significantly impact students' quality of life. Impaired social functioning and academic performance, delayed studies or college dropout (e.g., Bruffaerts et al., 2017), alcohol abuse, depression, and suicidal behaviors are reported repercussions (e.g., Coentre et al., 2016).

Known barriers to help-seeking include, more recently, the lockdown and social measures implemented during COVID-19, because access to treatments, normally delivered face-to-face, has been severely compromised (Warnock-Parkes et al., 2020). Previously, most students already had difficulties accessing face-to-face treatments due to long waiting times, high costs, large geographic distances, or lack of trained health professionals (Vidourek et al., 2014). Stigma of seeking help or being face-to-face with a psychologist, when they are a source of anxiety, as in social anxiety disorder, are other reasons reported in the literature (Andersson et al., 2013). University students may also not receive help because they may be unaware that psychological support services are available (Dalky and Gharaibeh, 2019), may prefer to deal with their problems alone and talk with friends and relatives instead, or they do not recognize their symptoms as serious (Ebert et al., 2019).

Internet interventions have been proposed as an alternative for individuals to access psychological treatment, including university students who have depression or anxiety symptoms/disorders (Becker and Torous, 2019) and those who are facing barriers in seeking help. Because they can be remotely delivered, these interventions may be easily accessible, customizable, stigma-reducing, and low-cost for both patients and clinicians. In addition, they may often allow flexibility in scheduling therapy sessions and patients to have their own pace (Ebert et al., 2018). Thus, although few still seem to be involved in these interventions (only 3 %, according to Dunbar et al., 2018), most students report being open to doing so. CBT, as a structured and modular-based treatment, is easily delivered via the Internet (Richards et al., 2018).

Internet-delivered CBT (ICBT) involves the delivery of CBT through an online platform using a computer or laptop, a smartphone, or a tablet. Text materials for participants to read, but also audio or video files, and interactive activities to do in real life may be part of ICBT programs. Typically, the active treatment mechanisms of ICBT are not very different from those of the traditional CBT, as ICBT programs usually start with education elements (e.g., psychoeducation) and end with relapse prevention, with modules based on treatment protocols for specific disorders such as depression and anxiety being introduced into the middle (Andersson et al., 2013). Briefly, it is mainly the administration format that varies (e.g., contents delivered via a face-to-face session vs. via text/audio/video), as well as the level of guidance. ICBT can be guided or unguided, although differences between authors can be found in the literature. According to Matsumoto et al. (2018), ICBT can be divided into three categories depending on how the therapist participates in the treatment: no therapist assistance; with minimal assistance; and with full assistance (i.e., using videoconference). Harrer et al. (2018) divide the types of guidance into unguided, reminders, and feedback. Andersson et al. (2013) clarify that ICBT is guided when the treatment is conducted in real time (where therapist and patient communicate using web cameras) or there is minimal contact with the therapist (10–15 min per patient each week), who provides support in the form of answers to questions, encouragement, and feedback. A recent study (Maguire et al., 2019) reports that guided ICBT involves some kind of human support (and communication) from a therapist or a trained coach. In unguided ICBT, the patients are told about the website and independently guide themselves through the program, which may sometimes offer technical support (e.g., reminders).

Growing evidence of the effectiveness of ICBT in treating a broad range of mental health problems, including anxiety symptoms/disorders, has been reported in community samples. A review (based on a meta-analysis) that evaluated the efficacy of internet-delivered interventions for generalized anxiety, most of which (9 of 11) were ICBT, found statistically significant improvements on self-reported generalized anxiety symptoms, confirmed by large effect sizes ($d = -0.91$) (Richards et al., 2015). In 2020, a meta-analysis of the efficacy of ICBT for adults with social anxiety found that ICBT positively impacted patients compared with the control groups ($g = -0.55$) maintained at a 12-month follow-up (Guo et al., 2020).

Evidence on internet interventions such as ICBT for university students is also rapidly accumulating. In 2013, a systematic review by Farrer et al. on technology-based interventions for mental health in tertiary students found large effect sizes ($g = 0.84$) for ten interventions targeting anxiety symptoms and disorders. While their findings were relevant, several new studies have been published since then. In addition, their findings included the effects of interventions employing universal and selective programs targeted at all or those at risk of a mental health condition (i.e., not only effects derived from treatment programs targeting individuals diagnosed with a mental disorder) (Farrer et al., 2013). A 2014 systematic review and meta-analysis that focused on web-based and computer-delivered interventions targeting multiple aspects of psychological well-being suggested that this type of interventions can be effective in improving students' anxiety ($SMD = -0.56$), even when compared to inactive controls. Although most of the interventions found were CBT-based (13 of 17), this finding included the effects of interventions based on mindfulness, stress management and cognitive learning theories, as well as lucid dreaming (Davies et al., 2014). Meanwhile, a 2018 meta-analysis of internet interventions for mental health in university students found small intervention effects for anxiety ($g = 0.27$), and that additional research was required to determine the types of interventions that best fit these students. While these authors' findings are relevant, some of the eligibility criteria were too broad. For example, they included studies concerning psychological interventions via the Internet that followed theoretical frameworks beyond traditional CBT (e.g., ACT-based intervention) and were targeted at multiple mental health outcomes rather than only anxiety (e.g., eating disorders, well-being, and sleep). This led to a large number of studies, although their searches focused only on works published in English and German (Harrer et al., 2018). A 2019 systematic review of digital mental-health interventions for the treatment of depression and anxiety among college students gathered 89 studies. Most of these studies reported that digital mental-health interventions were delivered via websites (80 %), were ICBT interventions (28.31 %), had human support, and were effective (42.47 %) in producing beneficial changes in the main psychological-outcome variables. These findings were identified because the authors did not limit the review to randomized controlled trials (RCTs) of computer- and web-based programs, and instead included multiple trial designs. Although this study much more broadly considered the types of digital mental-health programs that were available to students and the adoption of such interventions, the authors could not perform a meta-analysis due to the heterogeneity of the data included. In addition, the true effectiveness of most interventions was unclear, as were the intervention features that were relevant to achieving behavior change (Lattie et al., 2019).

Given the current evidence, we examined the efficacy of ICBT interventions for treating anxiety among university students. To the best of our knowledge, there has been no systematic review and meta-analysis including recent studies (at least from the last five years) specifically on

ICBT targeting anxiety symptoms and disorders in university students. Particularly, our review focused on published randomized trials, highlighting the differences between ICBT interventions and control groups.

2. Method

This systematic review and meta-analysis was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (Page et al., 2021).

2.1. Search strategy

Studies were identified through an online search of the following databases: EBSCOhost, PubMed, and Web of Science. The keywords for the search were derived from the abstract and/or title, and included references to internet interventions, cognitive behavioral therapy, and university students. With appropriate adaptation to each database, the search expression was as follows: AB (telehealth OR telepsychology OR tele* OR "distance counseling" OR "distance therapy" OR "remote therapy" OR videoconferencing OR videoconference OR videoconference-assisted OR videoconference-delivered OR videoconference-delivered treat* OR "online counselling" OR internet OR "internet treatment" OR "internet therapy" OR "internet-delivered" OR "internet-delivered therapy" OR "internet-delivered treatment" OR "internet-based" OR "internet-based therapy" OR "internet-based treatment" OR "guided internet-delivered" OR "guided internet-delivered therapy" OR "guided internet-based treatment" OR computerized OR computerised OR "computerized therapy" OR "computerised therapy" OR "online treatment" OR web-based OR "digital mental health" OR "digital mental health intervention" OR eHealth) AND AB (cognitive behavi* therapy OR cognitive behavi* intervention OR CBT OR videoconference-delivered cognitive behavi* therapy OR "videoconference-delivered CBT" OR internet cognitive behavi* therapy OR "internet CBT" OR "online CBT" OR internet-delivered cognitive behavi* therapy OR internet-based cognitive behavi* therapy OR guided internet-delivered cognitive behavi* therapy OR iCBT OR computerized cognitive behavi* therapy OR "computerised CBT") AND AB (university students OR college students OR graduat* OR graduat* students OR undergraduate students OR freshmen OR university OR college OR college mental health). Specific terms referring to anxiety symptoms/disorders, which were targeted in this analysis, were not included to accept many references for screening. To avoid publication bias, a manual search was also conducted by examining the bibliographies of each selected article and locating other studies on other electronic databases. The searches were performed from inception to January 2022.

2.2. Eligibility criteria

Search results that fulfilled the following eligibility criteria were considered for review: We included (a) RCTs in which (b) ICBT targeted (c) symptoms of anxiety or anxiety disorders in (d) students of any age if they were enrolled at a university, college, or a comparable post-secondary higher education at the time of the intervention. Indeed, to be included, studies had to address (e) ICBT as a primary treatment modality (f) when compared to a control condition (e.g., wait-list, no treatment, or placebo). Primary intervention was only defined as eligible when the Internet was used as delivery method, regardless of the platform or device used (e.g., computer, tablet, or mobile). Studies that addressed more than one outcome (e.g., depression and anxiety) were included, but only the analysis of the interest outcome (some kind of anxiety symptoms) was considered.

No temporal, geographical, or language restrictions would have been applied; however, (g) the selected studies had to be published in academic and peer-review journals. We excluded case studies, narrative reviews, systematic reviews and meta-analyses, information from books, reports, news, dissertations, theses, unpublished full manuscripts, and other theoretical studies.

2.3. Study selection

The study selection began with the titles and/or abstracts of all the eligible papers that were screened. The studies were then retrieved and assessed through full-text analysis. Both steps were performed by two independent reviewers (CO and MP) and one senior researcher (AS). The trained researcher was involved to resolve any disagreements through discussion and, consequently, reduce the probability of missing a study or errors in classification (Page et al., 2021). Cohen's Kappa revealed an almost perfect agreement index between reviewers ($K = 0.83$, $p < .05$) (Kundel and Polansky, 2003).

2.4. Data extraction

The following data were systematically extracted from each article, where applicable: (a) bibliographical information (author(s), year of publication, and country); (b) study design features (primary outcome/target condition(s), measures used, time and points of assessments); (c) sample characteristics (sample size, *mean* age, % of females, and *N* for each group/condition); (d) intervention features, such as treatment content and length, number of sessions/modules, guidance; and (e) data required to calculate effect sizes (*means* and *standard deviations* of anxiety symptoms scores after ICBT and control). When relevant information could not be extracted, the corresponding authors were contacted. When they did not respond or the information provided was insufficient to perform a meta-analysis, the respective articles were excluded.

2.5. Quality assessment

All included studies were assessed by two researchers (the first and second authors) in terms of the risk of bias, considering the information provided in each article. The Cochrane Collaboration's risk-of-bias tool for RCTs (Sterne et al., 2019) was used, which covered the studies' risks of bias in the following domains: (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 the measurement of outcomes; and (5) bias in the selection of the reported results. Studies were rated as showing either "low" or "high" risk of bias on each of these criteria. Otherwise, when there was insufficient information on the bias indicators in an article, the risk was rated as "unclear" (Higgins et al., 2016). Disagreements between researchers were resolved through discussion.

2.6. Statistical analyses

Data analysis was performed using the metafor package (version 3.0.2) (Viechtbauer, 2010) in *R* version 4.0.5 (R Core Team, 2020). For each study, between-group effect sizes were calculated, considering the primary intervention (ICBT) and control group at post-treatment. Because the included studies used different scales for continuous data, the standardized mean difference (*SMD*), yielding Hedges' *g*, was used as a measure of effect size. The *SMD* (Hedges' *g*) was obtained by dividing the post-intervention mean difference between the two groups by the pooled standard deviation for both. Hedges' *g* was interpreted using Cohen's *d* conventions, which are still widely used today. According to Cohen (1992), an effect size of 0.2 can be classified as a small effect, of 0.5 as a moderate effect, and of 0.8 as a large effect. As lower scores of the continuous outcomes indicated better results (i.e., less anxiety), negative effect-size values favored the intervention.

We anticipated that the included studies estimated different yet related intervention effects (Deeks et al., 2019); thus, a random-effects pooling model, using a 95 % confidence interval (CI), was fitted to the data. Using the restricted maximum-likelihood estimator (Viechtbauer, 2005), the heterogeneity between the studies (τ^2) was calculated. In

addition to the estimate of τ^2, the *Q*-test for heterogeneity (Cochran, 1954) and I^2 statistic (Higgins and Thompson, 2002) were reported. Regardless of the *Q*-test results, $I^2 > 50$ % may suggest moderate heterogeneity (Higgins et al., 2003). In case any amount of heterogeneity was detected, a prediction interval for the true outcomes was also provided (Riley et al., 2011). To determine the source of the between-studies heterogeneity, we examined whether some studies might be considered outliers (i.e., studies with extreme effect sizes) and/or influential cases (i.e., studies that heavily pushed the effect of the analysis in one direction). Studentized residuals and Cook's distances were used to identify potential outliers and influential cases, respectively (Viechtbauer and Cheung, 2010).

The presence of potential publication bias was examined through a visual check for funnel plot asymmetry and statistically tested using the rank correlation (Begg and Mazumdar, 1994) and Egger's regression (Sterne and Egger, 2005) ($p < .05$ indicates statistically significant publication bias) tests. In addition, subgroup analyses were performed for control groups (passive vs. active), types of student samples (general vs. other), and intervention features, namely, guidance during treatment (guided with human feedback, unguided with no support, or only automated support) and length (short: ≤4 weeks; medium: 5–8 weeks; long: ≥9 weeks).

3. Results

A total of 855 studies, published between 1993 and 2022, were identified from all the electronic databases and manual search methods. Of these, 318 were duplicated studies, and were thus excluded. After a review of the titles and/or abstracts, 32 were retained for full-text analysis. A further 17 articles were excluded. Finally, 15 qualified electronic and manual studies were assessed (Fig. 1).

3.1. Studies characteristics

Table 1 provides the detailed characteristics of each study. Overall, a total of $k = 15$ studies were included, all of which were RCTs and referred to ICBT interventions for the treatment of symptoms of anxiety among university students. The studies were published between 2007 (Orbach et al., 2007) and 2021 (Newman et al., 2021). Most of them were conducted outside Europe ($k = 9$) and were written in English ($k = 14$), except one written in Chinese (Liu et al., 2020).

Sample sizes ranged from 38 (Sethi et al., 2010) to 232 (Newman et al., 2021), comprising a total of 1619 participants. The mean age ranged from 18.7 (Melnyk et al., 2015) to 26.7 (Kählke et al., 2019). Of all the participants, 72 % were female and the remainder male. A total of 11 studies (73.33 %) were performed on general university students, while four (26.66 %) were performed on samples of psychology (Ellis et al., 2011; McCall et al., 2018), technology, and health-science college students (e.g., Newman et al., 2021).

Some kind of anxiety symptoms and/or of depression were primary outcomes of seven studies, followed by social anxiety disorder ($k = 3$) and GAD ($k = 2$). Test anxiety was assessed in one study ($k = 1$). One ($k = 1$) reported anxiety symptoms and insomnia as primary outcome measures. Anxiety, depression, and stress were the targets of another

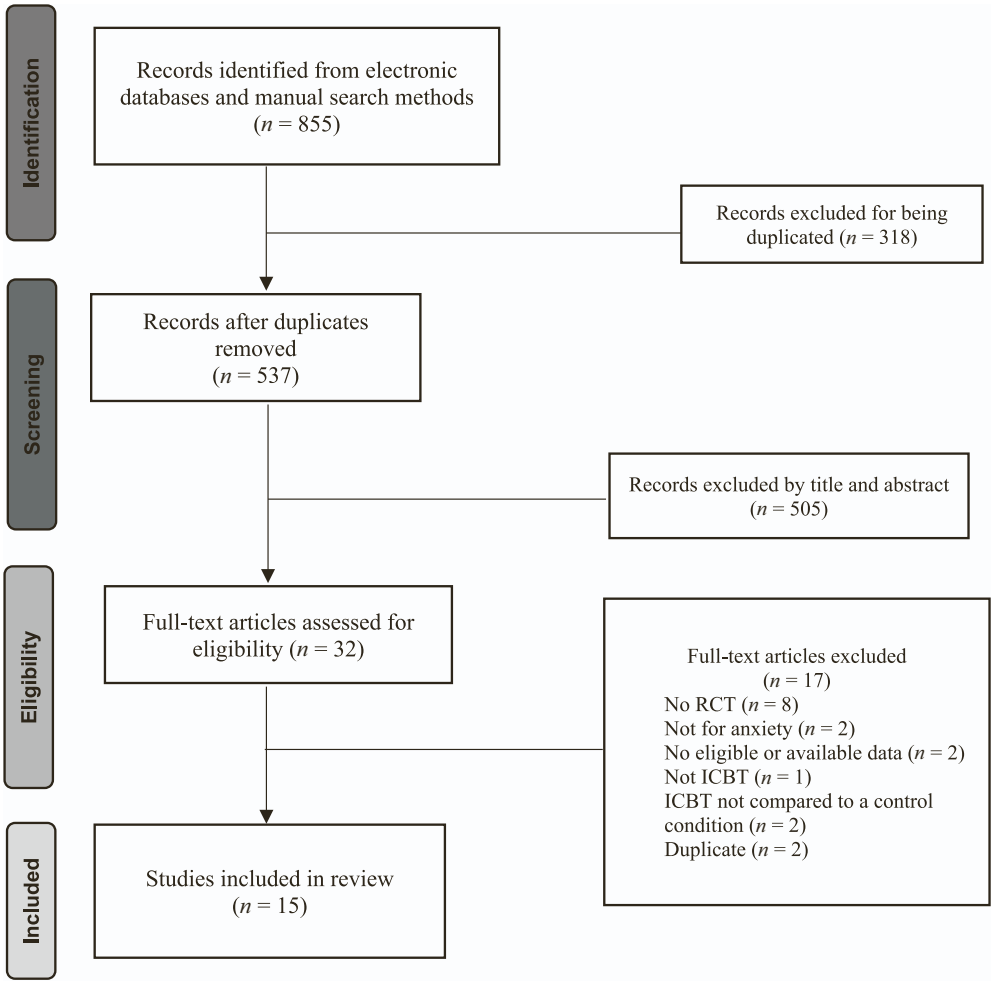

Fig. 1. PRISMA Flowchart of study selection.

Table 1
Study characteristics.

Study	Country	Target outcome/s (instrument)	Student sample			Conditions	*N*	Intervention features			Assessment points/FU (weeks)
			Type	Age (*M*)	Female (%)			Guidance	Sessions/ modules	Length (weeks)	
Botella et al. (2010)	Spain	Social Anxiety Disorder (SAD)	General	24.4	79.2	1. ICBT 2. Face-to-face CBT 3. Wait-list	62 36 29	Unguided (self-administered)	3	8	Baseline, 8-, and 48-weeks follow-up
Day et al. (2013)	Canada	Depression, Anxiety, Stress (DASS-21)	General	23.5	89.3	1. ICBT 2. Wait-list	33 33	Guided (self-help w/ minimal feedback from a coach)	5	6	Baseline, 6-, and 24-weeks follow-up
Ellis et al. (2011)	Australia	Depression, Anxiety (DASS-21)	Psychology	19.7	77.0	1. Online CBT (*MoodGYM*) 2. Online Peer support (*MoodGARDEN*) 3. No treatment	13 13 13	Guided (self-help w/ minimal feedback from a researcher)	5	3	Baseline, 3 weeks
Fitzpatrick et al. (2017)	United States	Depression, Anxiety (GAD-7)	General	22.2	67.1	1. Web-based CBT instant messenger app (*Woebot*) 2. Information about mental health disorders/ Control	34 36	Unguided (fully automated)	Up to 20	2	Baseline, and 2–3 weeks later
Kählke et al. (2019)	Germany, Austria, and Switzerland	Social Anxiety Disorder (SIAS)	General	26.7	62.0	1. Internet-based CBT (*StudiCare SAD*) 2. Wait-list	100 100	Unguided (w/ automatic reminders)	9	10	Baseline, 10-, and 24-weeks follow-up
Liu et al. (2020)	China	Anxiety (STAI-S)	General	22.0	85.2	1. ICBT 2. Wait-list	40 14	Guided (w/ therapist feedback)	8	4	Baseline, 4 weeks
McCall et al. (2018)	Canada	Social Anxiety Disorder (SIAS)	Psychology	21.9	72.0	1. Web-based CBT (*Overcome Social Anxiety*) 2. Wait-list	51 50	Unguided (w/ automatic reminders)	7	16 to 24	
McCloud et al. (2020)	United Kingdom	Anxiety, Depression (HADS)	General	24.3	82.7	1. CBT-based mobile app (*Feel Stress Free*) 2. Wait-list	84 84	Unguided (self-guided, w/ a robot character making recommendations)	4	6	Baseline, 2-, 4-, and 6-weeks follow-up
Melnyk et al. (2015)	United States	Depression, Anxiety (GAD-7)	General	18.7	86.4	1. ICBT skills-training (*COPE*) 2. Standard online freshman survey course curriculum/ Control	82 39	Unguided (online modules were self-directed)	7	7	Baseline, and 10–12 weeks
Morris et al. (2016)	United Kingdom	Anxiety (STAI-S), Insomnia	General	20.5	67.4	1. ICBT for anxiety (*Anxiety Relief*) 2. iCBT for insomnia (*Insomnia Relief*) 3. Wait-list	43 48 47	Unguided (w/ automatic reminders)	6	6	Baseline, 6 weeks
Mullin et al. (2015)	Australia	Depression, Anxiety (GAD-7)	General	27.9	64.1	1. ICBT (*UniWell-being Course*) 2. Wait-list	30 23	Guided (w/ feedback from a therapist and automated emails)	4	17	Baseline, 6, 12 weeks follow-up
Newman et al. (2021)	India	General Anxiety Disorder (GAD-7)	Technology and Science	19.9	31.1	1. Internet-Delivered Guided Self-Help CBT 2. Wait-list	117 105	Guided (self-help w/ minimal feedback from a coach)	8	12	Baseline, and post-treatment
Orbach et al. (2007)	United Kingdom	Test anxiety (TAI)	General	23.7	72.5	1. ICBT 2. Placebo with similar content received by the other group/ Condition	47 43	Unguided (w/ an introduction to the program in person or over the phone)	6	6	Baseline, 6-, and 16-weeks follow-up
Richards et al. (2016)	United Kingdom	General Anxiety Disorder (GAD-7)	General	23.8	77.4	1. ICBT (*Calming Anxiety*) 2. Wait-list	70 67	Guided (w/ feedback from a "supporter" and automated emails)	6	6	Baseline, 6 weeks
Sethi et al. (2010)	Australia	Depression, Anxiety (DASS-21)	Health Sciences	19.5	65.8	1. ICBT (*MoodGYM*) 2. Face-to-face CBT 3. Combined CBT 4. No treatment	9 10 9 10	Guided (self-help w/ minimal feedback from a researcher)	5	3	Baseline, 3 weeks

Note. CBT: Cognitive Behavioral Therapy; **DASS-21**: Depression, Stress, and Anxiety Scale-21; **FU**: Follow-up; **GAD-7**: Generalized Anxiety Disorder-7; **HADS**: Hospital Anxiety and Depression Scale; **ICBT**: Internet-based or Internet-delivered Cognitive Behavioral Therapy; **SAD**: Social Avoidance and Distress Scale; **SIAS**: Social Interaction Anxiety Scale; **STAI-S**: State-Trait Anxiety Inventory-state; **TAI**: Test Anxiety Inventory.

study ($k = 1$). GAD-7 was the most used scale to assess the intervention effects, followed by the Depression, Anxiety and Stress Scale-21 (DASS-21).

A total of 11 studies (73.33 %) each had two arms as the ICBT intervention was compared to a passive ($k = 8$) or an active control group ($k = 3$). Meanwhile, three studies (20 %) were three-armed RCTs because in each, in addition to a passive control group, the ICBT intervention was compared to ICBT for insomnia (Morris et al., 2016), an online peer-support intervention (Ellis et al., 2011), and a face-to-face CBT (Botella et al., 2010). Only one four-armed RCT was found ($k = 1$; Sethi et al., 2010). In sum, among the passive controlled studies, all employed waitlists or no treatment conditions ($k = 12$), while evidence-based information about mental-health disorders among college students, a standard online survey course on college life, and a placebo package with procedures for test anxiety were used as active control conditions ($k = 3$).

Of the 15 studies, eight reported unguided interventions (53,33 %): those without support ($k = 4$) and those with only automated/technical support to promote adherence (i.e., reminders) (k = 4); seven (46.67 %) were guided interventions in which feedback from a therapist, a trained coach, a researcher, or "supporter" was provided to participants during the self-help program. The ICBT interventions lasted 2–24 weeks. The number of sessions and/or modules ranged from 3 to 20. In 13 studies (86.66 %), interventions were delivered through a website, or an online software accessed on a computer or laptop. Mobile apps as a delivery method were used in two studies (13.33 %). One used an automated conversational agent within an instant messenger app (Fitzpatrick et al., 2017), while the other created an app for Apple or Android, also available on the Web (McCloud et al., 2020). It is important to highlight that some interventions used e-mail (e.g., McCall et al., 2018), text messages (e.g., Newman et al., 2021), and/or phone calls (e.g., Day et al., 2013) as a way of staying connected with participants.

3.2. Quality assessment and publication bias

The results from the risk-of-bias assessment are shown in Fig. 2. In total, nine articles (60 %) received a low risk-of-bias rating on all five criteria, and were thus coded as high-quality studies. Some concerns with one criterion were raised in five articles (33.33 %); more specifically, bias arising from the randomization process was identified in four studies, and bias due to deviations from intended interventions was identified in one study. These studies were, therefore, rated as unclear. One study (6.67 %) was rated as low-quality because bias in the measurement of the outcome was identified (McCloud et al., 2020).

Neither Egger's regression test ($p = .12$) nor the rank correlation test ($p = .09$) was significant; thus, there was no evidence of publication bias. Moreover, Fig. 3 does not show funnel plot asymmetry.

3.3. Effects of ICBT on anxiety

A forest plot showing the individual observed effects from each study as well as the overall effect size of ICBT on anxiety is presented in Fig. 4. The observed effects ranged from −1.26 to 0.80, with most estimates being negative (93 %). The estimated average effect size based on the random-effects model was $g = -0.48$ (95 % CI: −0.68, −0.27; $p < .001$). Heterogeneity was moderate ($Q\ (df = 14) = 36.62$, $I^2 = 67$ %, $p < .001$), and the 95 % prediction interval for the true outcomes ranged from −1.14 to 0.18. Thus, there is evidence of a significant effect of ICBT in reducing anxiety symptoms/disorders among university students compared with control groups.

An outlier was found (Fitzpatrick et al., 2017). However, according to Cook's distances, none of the studies was considered overly influential. Thus, the analyses performed included the study that was considered an outlier.

3.4. Subgroup analyses

3.4.1. Control group

A significant between-group difference was found for the control-group subgroup analysis ($p < .001$). The effects were higher when ICBT-treated groups were compared with passive controls ($g = -0.52$, 95 % CI: −0.66, −0.39; $n = 12$) than with active control groups ($g = -0.36$, 95 % CI: −0.89, 0.16; $n = 3$). The forest plot is shown in Fig. 5.

3.4.2. Student sample

Effects were greater in studies performed on specific samples of university students, such as psychology, technology, and health-science students ($g = -0.70$, 95 % CI: −1.14, −0.26; $n = 4$) than in those performed on samples of general university students ($g = -0.41$, 95 % CI: −0.66, −0.17; $n = 11$), although this difference was nonsignificant ($p = .26$).

3.4.3. Guidance

The analyses showed that studies in which guidance (i.e., with human feedback, e.g., from a therapist) was provided to participants during ICBT obtained greater effect sizes ($g = -0.56$, 95 % CI: −0.81, −0.31; $n = 7$) than those in which ICBT was unguided (i.e., with no supported or with automated support) ($g = -0.37$, 95 % CI: −0.70, 0.04; $n = 8$), although this difference was nonsignificant ($p = .28$).

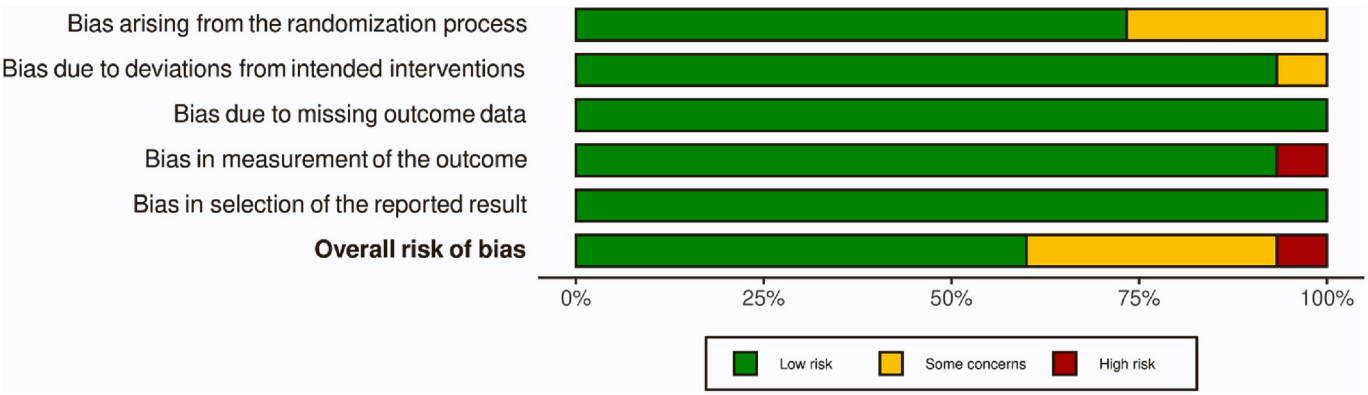

Fig. 2. Risk of bias summary of all included studies.

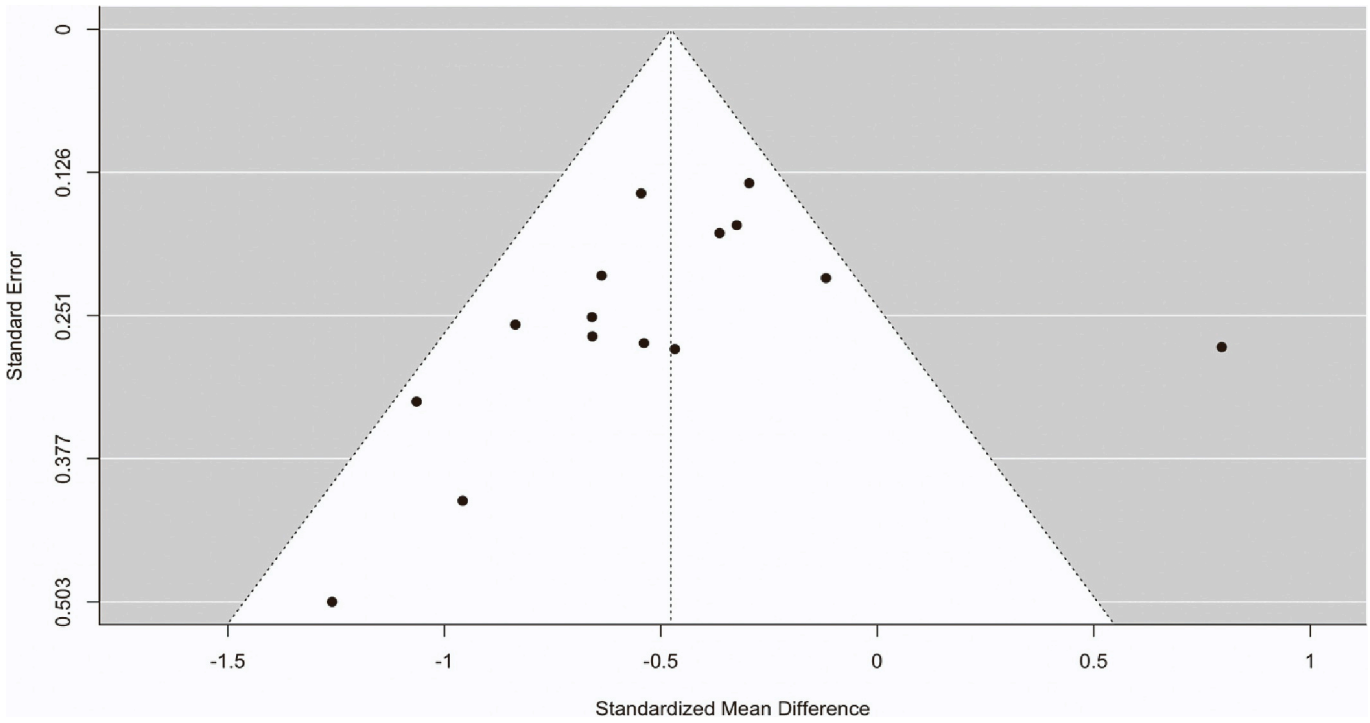

Fig. 3. Funnel plot for accessing publication bias relating effect sizes of the studies to standard errors.

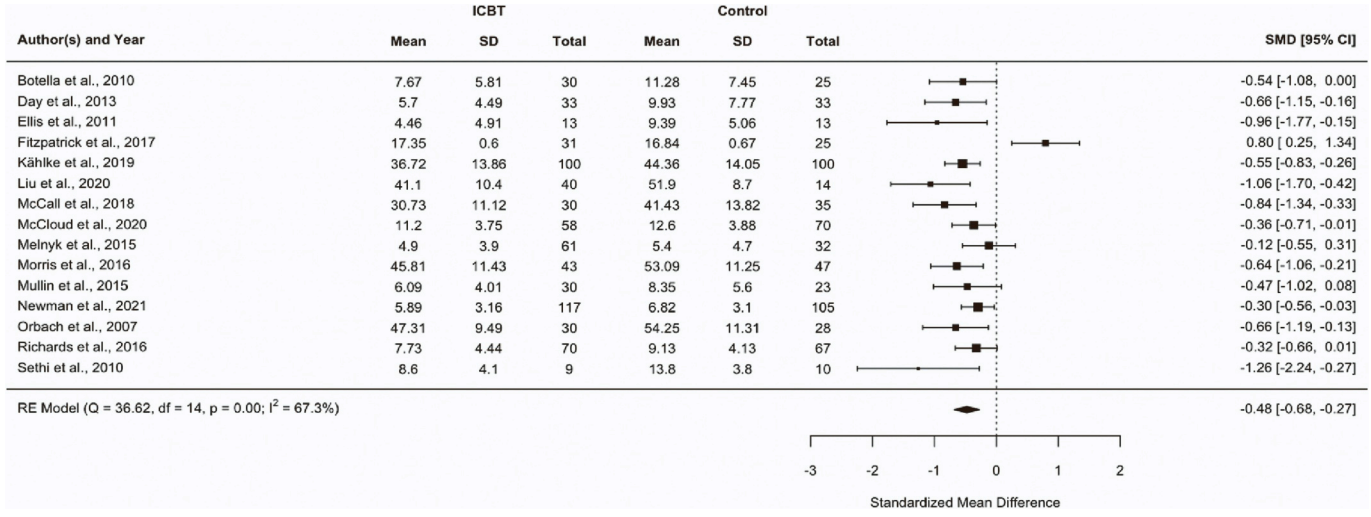

Fig. 4. Forest plot of iCBT effects on anxiety at post-treatment.

3.4.4. Length

There were no significant subgroup differences in the length of the interventions ($p = .98$). A significant medium effect size was found for short interventions ($g = -0.58$, 95 % CI: −1.56, 0.39; $n = 4$). Medium ($g = -0.43$, 95 % CI: −0.59, −0.27; $n = 7$) and long interventions ($g = -0.48$, 95 % CI: −0.70, −0.27; $n = 4$) produced small, nonsignificant effect sizes.

4. Discussion

To our knowledge, this is the first meta-analysis to examine the efficacy of ICBT for anxiety in university students. A search on online databases and a manual search in January 2022 identified 15 eligible RCTs with data on outcomes for 1619 participants. Most of the studies were conducted outside Europe and had two arms. The meta-analytic results suggested that ICBT produced significant effects in treating anxiety symptoms or disorders when compared to a control group, with no indication of a publication bias. The GAD-7 scale was the most used by the authors. Subgroup analyses were significant only for the type of control group (passive vs. active).

Seven of the fifteen studies reported symptoms of anxiety and depression as primary outcome measures. This is consistent with the findings of previous research (e.g., Becker and Torous, 2019) and is relevant as evidence suggests that anxiety and depression are disorders with high comorbidity and prevalence among university students (January et al., 2018). Most students were female (72 %), which might be explained by gender differences in help-seeking behavior as well as in the prevalence of anxiety. Women are more inclined than men to seek help for psychological issues (Liddon et al., 2018), and they have a higher prevalence of mental disorders such as anxiety, depression, or

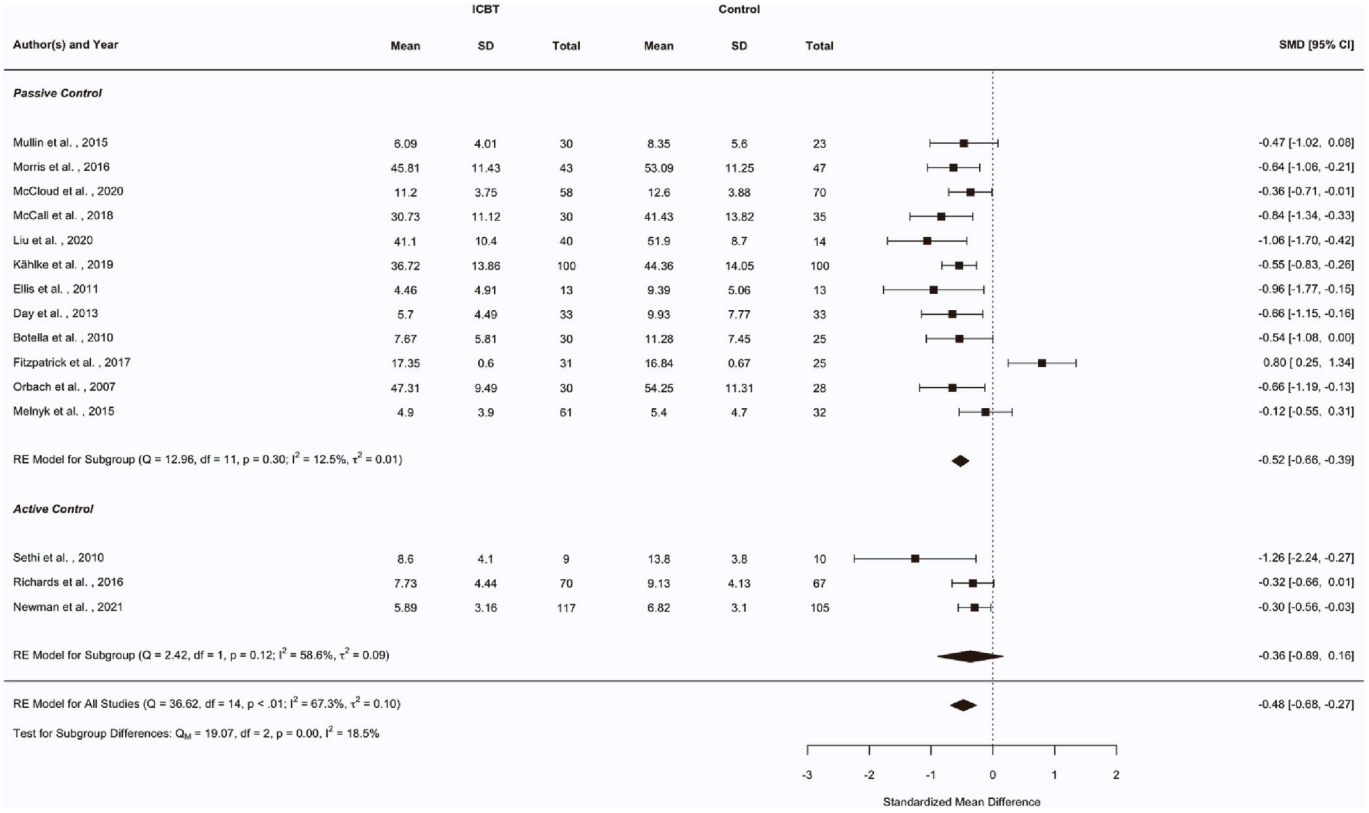

Fig. 5. Forest plot of ICBT vs. passive control or active control for anxiety at post-treatment.

suicidal ideation symptoms (Paula et al., 2020). Our result is consistent with those obtained by Etzelmueller et al. (2020).

Regarding the effects on symptom change, the main analysis of the 15 studies showed that ICBT produced a small to moderate effect on anxiety among university students ($g = -0.48$, $p < .001$). A 2014 meta-analysis found that web-based and computer-delivered interventions, mostly CBT-based, were effective in improving university students' anxiety symptoms ($SMD = -0.56$), but with a slightly greater effect than that found in our study (Davies et al., 2014). Similarly, a recent meta-analysis reported a significant improvement of anxiety symptoms in university students, but with a lower effect size ($g = 0.27$) (Harrer et al., 2018). These contrasting findings regarding effect size can be explained by differences in the intervention approach, such as including other interventions in addition to CBT, or in participants' characteristics, such as differences in the severity of symptoms at the baseline.

In a subgroup analysis, we found that effects were significantly higher ($p < .001$) for ICBT relative to passive controls (i.e., no-treatment or wait list) than relative to active controls, which has been corroborated by Davies et al. (2014) and Harrer et al. (2018). One possible explanation for this is that, somehow, active control participants were still receiving and/or doing something, whereas inactive control participants were not (Davies et al., 2014), which may be sufficient to produce an improvement in their symptoms. As we have seen, active control participants received evidence-based information about mental-health disorders among university students, a standard course on college life, or a placebo with procedures for anxiety. However, as there were only three comparisons available for active control groups, this finding must be interpreted with caution.

Treatment effects depend on many factors (Lambert et al., 2002), and the interventions in this analysis varied considerably in terms of the samples of students recruited, guidance, and length. Therefore, further subgroup analyses were performed. First, we found that effects were greater for interventions performed on specific samples of students (i.e., who were enrolled in a specific higher education course, such as health sciences and psychology) ($g = -0.70$) than for those performed on recruited university students from several courses ($g = -0.41$). Although this finding was important as students in the health professions suffer the most from mental-health disorders, including depression and anxiety (Paula et al., 2020), the between-group difference was nonsignificant ($p = .26$). Note that there were only four comparisons available for the student-specific samples and eleven for samples of general university students. Furthermore, such a result may be explained by the fact that students in the health professions had higher symptoms (i.e., higher anxiety scores) before the intervention; moreover, these students (e.g., psychology students) may be more knowledgeable about mental health and therefore more receptive to interventions.

We then investigated the effect of guidance. There is clear evidence of the important role of a therapist in the outcomes of traditional therapy (Norcross and Lambert, 2018). This is not different for internet-delivered psychotherapy, particularly in programs employing human support (Pihlaja et al., 2018), such as those presented before (e.g., Newman et al., 2021). Providing support to patients, in terms of progress feedback, clarification of information about the program, or even encouragement to complete modules by a therapist or even a trained coach, for example (Young et al., 2018), may enhance adherence to the intervention and thus improve treatment effects (Mohr et al., 2011). We found that guided interventions somehow produced greater effects ($g = -0.56$) than unguided ones ($g = -0.37$); however, this result was statistically nonsignificant. Examining the literature, a meta-analysis on web- and computer-based interventions for stress also suggested that guided interventions were more effective than unguided ones, although this outcome was statistically significant (Heber et al., 2017). Harrer et al. (2018), through a meta-analysis of internet interventions for mental health (e.g., anxiety, depression) in university students, suggested that guidance did not significantly moderate the efficacy of the interventions.

Finally, we examined the effect of the length of the interventions. No significant subgroup differences were found ($p = .98$), although short

interventions ($\leq$ 4 weeks; $g = -0.58$) produced higher effects than medium (5–8 weeks; $g = -0.43$) to long interventions ($\geq$ 9 weeks; $g = -0.48$). On the one hand, as suggested by Heber et al. (2017), it may be more difficult for participants to engage in longer interventions than to engage in shorter ones. On the other hand, it is not safe to say that shorter interventions have an advantage over longer ones because we take the risk of providing too little treatment when a patient requires more. Indeed, in face-to-face therapy, the length of interventions is adjusted to the patients' characteristics; thus, for ICBT, the evidence suggests an adequate assessment before recommending ICBT to someone or adapting the length according to what the patient is likely to be able to master (Andersson et al., 2013). Furthermore, the literature is inconsistent, as some studies report significant differences for the length of an intervention (e.g., Heber et al., 2017), while others suggest that there is no association between treatment outcome and therapy length (e.g., Farrer et al., 2013).

5. Limitations

This study had some limitations. First, although knowledge and time spent on the Internet by younger generations, including university students, is high, and internet interventions such as ICBT are rapidly emerging (Becker and Torous, 2019), the number of interventions found was still relatively small. We did not include unpublished data, and since our last search, new research may have been published, which was naturally excluded. Second, we are aware that the ability to obtain reliable estimates of treatment effects and subgroup analyses with sufficient power may be a limitation. In this regard, the number of comparisons in some subgroups was small (e.g., 3 vs. 12 comparisons for control groups). Third, a high risk of bias was detected in one study (McCloud et al., 2020), while some concerns regarding two types of bias (i.e., from the randomization process and due to deviations from intended interventions) were detected in five studies. Therefore, some results must be interpreted with caution. In addition, we did not analyze differences in effects between ICBT and face-to-face CBT because we did not find a sufficient number of studies to conduct such comparisons. Only two of our studies included a face-to-face CBT group (Botella et al., 2010; Sethi et al., 2010). We are aware that this may be interesting to discuss as some authors believe that there is no significant difference between ICBT and CBT, while others maintain that ICBT may be more advantageous as a psychologist can be a source of anxiety for some individuals, such as those with social anxiety, and it not only offers greater opportunities for patient support by overcoming help-seeking barriers, but also faster feedback to the patient than usual CBT. For example, in ICBT, clients can quickly obtain feedback on their homework or answers to their questions, whereas in CBT they only obtain it in the next session (Andersson et al., 2013).

6. Conclusions

Despite the limitations discussed, this study provides evidence that supports the efficacy of ICBT interventions for treating symptoms of anxiety among university students. As they can be delivered remotely, they offer an opportunity for patients to overcome help-seeking barriers and to access timely and effective therapy (Young et al., 2018), especially during the COVID-19 pandemic. In particular, interventions that include guidance appear to lead to better effects; however, more research is required.

7. Future recommendations

Despite the results suggesting a slight advantage for guided interventions, it is unclear how much guidance and through what mechanism it produces greater adherence and, therefore, better outcomes. Recent evidence is still unfolding; however, some human factors, such as having a fixed schedule for support, have been reported to be crucial in predicting adherence to and the efficacy of internet interventions for the treatment of depression and anxiety (Shim et al., 2017). In addition, it is highlighted that the need for support may vary by client (Pihlaja et al., 2018). Indeed, in some of the revised guided interventions, a therapist, a trained coach, or a researcher provided individual support, feedback, or encouragement to participants each week or each session. Nevertheless, further research on the type of guidance required in such interventions would be useful. Furthermore, future research should further examine the length of ICBT interventions.

As the interventions in this analysis also varied considerably in terms of content, it was difficult to determine which elements of the ICBT contributed to better effects. In our study, ICBT programs usually started with education elements, such as introduction and psychoeducation, including cognitive restructuring, activity scheduling, relaxation training, graded exposure, social-skills training, and problem-solving strategies, and ended with relapse prevention, which is consistent with Andersson et al.'s (2013) assertions. In addition, evidence suggests that ICBT content should be easy to understand, mainly if delivered through self-help texts, and it attempts to fit all clients, as there are individuals with limited technological skills, such as the elderly (Andersson et al., 2013). Therefore, future research should also focus on determining which intervention components are most relevant to therapeutic change, and how they should be delivered. Most of the interventions (13 out of 15) were delivered via a computer or laptop, with only two delivered via a smartphone. Thus, future studies should analyze the effect of the delivery method on the main outcome. Moreover, most of the interventions were delivered to female students; thus, future research should focus on ways to attract males to use ICBT interventions and analyze their effects in treating a wide range of mental-health disorders, including anxiety.

Finally, future studies should analyze the effect of potentially relevant moderators of the treatment effect, such as the effect of adherence to an intervention on the main outcome. This was not the focus of the present research; however, the evidence is clear that most university students are hesitant to seek help in the case of an emotional problem (Ebert et al., 2019), and few engage in internet interventions such as ICBT (Dunbar et al., 2018). As a conclusion from the prior evidence, some suggestions on how patient engagement can be improved are presented: (1) providing high-intensive feedback to participants, or guiding them in some way during therapy, appears to reduce the treatment duration and dropout rates (Janse et al., 2020); (2) establishing a clear deadline for completing treatment and providing an associated interview at the end of therapy may also promote adherence and reduce dropout or, at least, the risk of patients postponing the most challenging phases of therapy (Andersson et al., 2013); and (3) last, providing financial incentives or course credit rewards to participants appears to be associated with greater effects and may also influence student adherence to internet interventions (Davies et al., 2014).

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Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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