



Key Components and Content of Effective Evidence-Based Digital Prevention Programs for Anxiety and Depression in Children and Adolescents: A Systematic Umbrella Review

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Abstract

Anxiety and depression are among the most common mental health problems in children and adolescents, and evidence-based digital programs may help in their prevention. However, existing reviews lack a detailed overview of effective program elements, including structural features and supporting content. This umbrella review synthesizes the main elements of effective, evidence-based digital programs which facilitate the prevention of anxiety and depression in children and adolescents. Based on an analysis of 11 existing reviews that describe 45 programs, key components and content contributing to program effectiveness were identified. These included a focus on modular and linear structure, which means organizing the program in a clear and sequential manner. Additionally, approaches based on cognitive behavioral therapy and gamification to engage and motivate users, were identified as effective components. The findings provide a better understanding of what makes digital programs effective, including considerations for sustainability and content, offering valuable insights for the future development of digital programs concerning the prevention of anxiety and depression in children and adolescents. Critically noted is that the differentiation between prevention and intervention in the program description is not always clear and this could lead to an overestimation of prevention effects.

Keywords Digital prevention programs · Internalizing disorders · Youth · e-Mental health · Digital mental health

Introduction

The global government measures and restrictions introduced in 2020 to control the spread of COVID-19, such as enforced isolation and school closures, have led to an increase in the risk of mental health problems (Wade et al., 2020). The prevalence of mental disorders among children and adolescents has reached 20.95% during the COVID-19 pandemic, as shown by a meta-analysis (Raccanello et al., 2023). Research had previously indicated that there has been

a significant increase especially in anxiety and depression during the past years (Durbeej et al., 2019). For approximately 50% of individuals with mental disorders, the onset of the disorder falls into adolescence (Casanas et al., 2018; Kim-Cohen et al., 2003) and mental health problems in this age group may further deteriorate over the long term (e.g., Kauhanen et al., 2023). Due to their relatively elusive nature, internalizing disorders, such as anxiety and depression in children and adolescents, require special attention. As parents and friends are frequently unable to detect the existence of such problems (McGinnis et al., 2019) the resulting lack of awareness can lead to a delay in diagnosis and may thus cause significant harm and distress among the individuals affected. Efforts aimed at preventing anxiety and depression are thus of tremendous importance. The aim of this umbrella review is to synthesize key findings from current reviews of effective digital programs in the prevention and early intervention of anxiety and depression in children and adolescents to highlight and emphasize their potential.

Prevention plays a pivotal role in mitigating the impact of risk factors by enabling individuals to strengthen necessary

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skills and foster the resources needed in managing mental health (Domschke et al., 2021; Hugh-Jones et al., 2021; Tomb & Hunter, 2004). Therefore, it is essential to focus on preventing anxiety and depression to improve individual wellbeing and reduce the social burden of mental illness among young people. As usual, prevention is seen as more promising than cure. It is cost-effective and entails less stress for those involved than dealing with illness and disorder after it has developed (Bennet et al., 2015; Gladstone & Beardslee, 2009; Hugh-Jones et al., 2021).

Digital programs have been identified as one possible tool in the prevention and early intervention of mental health problems in children and adolescents. Such programs have a relatively wide reach and tend to be more flexible and accessible than traditional face-to-face treatment (Bergin et al., 2020). Although there is a plethora of programs and an extensive body of research systematically analyzing their effectiveness (e.g., Campisi et al., 2022; Das et al., 2016), such research remains relatively disjointed and difficult to survey. Therefore, it is important to pay special attention to the key components of such programs, including intervention type, mode of delivery, availability, structural features, and content in order to identify potential patterns of effectiveness and best practice. These can then be used in guiding recommendations and support for future program development.

Anxiety and Depression in Children and Adolescents

Current research indicates that mental health challenges among children and adolescents have increased significantly. In particular, internalizing disorders such as anxiety and depression have become widespread during the COVID-19 pandemic (Dale et al., 2023). Studies investigating depressive symptoms during the pandemic have reported alarming prevalence rates ranging from 23 to 64% (Dale et al., 2023; Samji et al., 2022; Theberath et al., 2022). Pooled estimates indicate that globally, 25% of young people are currently experiencing symptoms of depression, while 20% are experiencing symptoms of anxiety (Racine et al., 2021).

Anxiety and depression are characterized by disruptions in emotions and moods that are directed inwardly. Consequently, they may be challenging for others to recognize (Danneel et al., 2020). Anxiety disorders can manifest in various forms among children and adolescents. Their characteristics vary considerably, as does their age of onset. The common characteristic of many forms of anxiety is that it leads to a high level of physiological arousal in a very short time, causing intense stress for the affected children (APA, 2022).

Depression in children and adolescents is also a complex condition and is not to be equated with the typical experience of a low mood or occasional sadness. It cannot be

controlled through the mere exercise of willpower or effort (Essau, 2007) and it is accompanied by a marked lack of motivation and energy. Such emotional states may be typical responses to specific circumstances, such as loss, failure, or disappointment. However, a certain level of symptom stability over time and associated functional impairment are critical factors in identifying the presence of a clinically significant depressive disorder (Essau, 2007). Similar to anxiety, depression is categorized as an internalizing disorder and both occur together very frequently (APA, 2012). According to DSM-5-TR (APA, 2012), depression can be categorized into three principal disorders: major depressive disorder, disruptive mood dysregulation disorder, and persistent depressive disorder (APA, 2012). In the absence of effective coping strategies, anxiety and depression can have substantial and long-lasting effects on the well-being of children and adolescents. These effects can impact their social-emotional and academic functioning even beyond their transition into adulthood (APA, 2012; Beames et al., 2021; Donovan & Spence, 2000; Klicpera et al., 2019).

Differentiation of Types of Prevention Targeting Anxiety and Depression in Children and Adolescents

Basically, prevention can be differentiated in three approaches regarding the aim it is seeking to achieve (Commission on Chronic Illness, 1957). Primary prevention aims to reduce the incidence of a disorder by lowering the likelihood of new cases. Secondary prevention aims to lower the prevalence of a disorder by reducing the rate of established cases. Tertiary prevention aims to decrease the amount of disability and maladjustment associated with a disorder (Ogden & Hagen, 2019). This classification scheme was expanded by Gordon in 1987, adding a risk-benefit perspective. This allows for further differentiation between universal, selective, and indicated prevention (Ogden & Hagen, 2019). Universal prevention aims to prevent or delay the occurrence of a disorder for an entire population, selective prevention targets groups of individuals at risk of developing a disorder, while indicated prevention focuses on individuals who already exhibit early signs of a disorder (Ogden & Hagen, 2019).

Thus, prevention aims to foster well-being and to reduce the occurrence or development of illness, symptoms, problems, or maladjustments. In contrast, intervention involves treatment or other actions taken after such illnesses have already developed. The goal of intervention is to alleviate or reduce these issues (Ogden & Hagen, 2019). However, the application of conventional public health classification systems, such as primary, secondary, and tertiary prevention, and Gordon's differentiation in universal, selective, and indicated prevention, faces challenges and appears to be not so clear in the field of mental health (Institute of Medicine,

1994). The complexity arises from the fact that symptoms and dysfunctions may occur even when not all diagnostic criteria for a mental disorder are met, blurring the distinction between prevention and treatment (Institute of Medicine, et al., 1994). Furthermore, it may occur that individuals may not be receptive to an intervention program but could be engaged in prevention programs that teach preventive topics and coping strategies.

The prevention of anxiety and depression has been recognized internationally as a public health priority (Bennet et al., 2015; Hugh-Jones et al., 2021; WHO, 2019; UNICEF & WHO, 2022) and various prevention programs have been developed. These programs are based on the same body of evidence as intervention programs and aim to reduce anxiety and depression symptoms, strengthen stress management skills, promote problem-solving skills and relaxation techniques, and train social skills (Klicpera et al., 2019; Schulte-Körne & Schiller, 2012).

Program Characteristics

Cognitive behavioral therapy (CBT) is an important component of mental health programs. CBT is a comprehensive and dynamic approach that has been developed and utilized for a wide range of mental health issues and is widely used for the prevention and early intervention/treatment of anxiety and depression. CBT utilizes the interrelation between cognition and emotions in order to change negative feelings. The primary goal of CBT is to reassess and change cognitive and thinking processes, target symptoms, reduce distress, and promote positive behavioral responses (Leichsenring et al., 2006). In addition to CBT, only relatively few further types of intervention have been explored to the same extent as CBT. Although some alternative methods have been attempted in various cases (e.g., psychoanalytic therapy, self-expression through play), the large body of evidence suggests that CBT is quite successful in treating anxiety and depression. CBT-based interventions are therefore widely used and have been shown to be beneficial not only for individuals at risk but also for the general population of adolescents (e.g., Schneider, 2014; Ye et al., 2014).

One of the most well-known programs, the Coping Cat program, introduced by Philipp Kendall (1994), can be considered a pioneering CBT intervention for children and adolescents with anxiety disorders. The evidence for its effectiveness is impressive (Schneider, 2014). It is a 16-week school-based program and has four components: (1) recognizing anxiety and its physical signs, (2) identifying and labeling emotions in anxiety-provoking situations, (3) learning coping strategies (e.g., self-talk, problem-solving and relaxation) and (4) practicing self-praise for progress (Schneider, 2014). Previous research shows that the development of coping mechanisms is of tremendous importance, as

anxious children tend to automatically resort to avoidance, which is an unfavorable strategy in the long term (Klicpera et al., 2019; Scaini et al., 2016; Schulte-Körne & Schiller, 2012; Warwick et al., 2017). When symptoms are clearly present, elements of behavioral therapy for symptom-oriented anxiety reduction (e.g., relaxation training, desensitization, exposure training) have been proven to be most effective (Klicpera et al., 2019; Scaini et al., 2016). For example, to gradually confront anxiety-provoking situations, participants are encouraged to create an exposure hierarchy, starting with mildly anxiety-provoking situations, and progressing to highly anxiety-provoking situations (Schneider, 2014). This enables participants to gradually become accustomed to and thus overcome anxiety-inducing situations in a controlled manner. Additionally, guided visual imagery can be used to prepare for exposure (Schneider, 2014).

CBT is also the most widely used and best studied type of intervention for depression prevention and typically involves a standardized, protocol-based approach (Williams & Cranford, 2015). In particular, the improvement of various forms of distorted thinking is enforced in CBT-oriented programs for the prevention of depression in adolescents (Schneider, 2014). This means that cognitive restructuring is a central component (e.g., learning how to identify and correct negative or irrational thoughts) (Schneider, 2014). Additionally, the promotion of coping, problem-solving, social and communication skills, psychoeducation, assertiveness training and relaxation training may be considered the most useful components of preventive interventions. Although interpersonal psychotherapy tradition (IPT) has not yet been as extensively evaluated as CBT-oriented programs, this approach, which focuses on interpersonal relationship problems, also seems promising (Bernaras et al., 2019; Garber, 2006; Gladstone & Beardslee, 2009; Hetrick et al., 2015; Klicpera et al., 2019; Schneider, 2014). Since effective prevention of anxiety shares many components with effective prevention of depression, e.g., positive thinking, stress management, cognitive problem solving, enhancing social skills etc., it seems useful to combine prevention programs for these two disorders.

Digital Programs

Children and adolescents often prefer digital technologies and enjoy using them. Thus, well-designed digital programs tailored to the target population can promote the application of specific skills and strategies in children's and adolescents' daily lives. Such programs are conducive to encouraging engagement by the target group (Lucas-Thompson et al., 2019; Richardson et al., 2010). Moreover, digital programs serve a dual purpose of providing support and raising awareness among children and adolescents about mental health issues such as depression and anxiety. Through

psychoeducational content, these platforms can provide valuable information and resources, helping young individuals understand and navigate the complexities of their mental health (Bevan Jones et al., 2018; Lucas-Thompson et al., 2019). Digital programs offer a significant advantage in terms of accessibility (Ashford et al., 2016), allowing young people to seek help or engage in self-help activities at their convenience. Such flexibility is particularly critical, given that only a small percentage of young people with mental health issues, such as anxiety and depression, have access to, or receive in-person/face-to-face treatment (Grist et al., 2019; Reyes-Portillo et al., 2014; Richardson et al., 2010). Moreover, these programs can be adaptable to individual needs and self-directed. Digital programs also provide the advantage of anonymity. Adolescents, who are often hesitant to seek support due to stigma or privacy concerns, can maintain confidentiality through digital programs (Murray, 2012).

Despite the advantages, studies indicate that the majority of available online programs require user registration and/or payment, vary significantly in length and number of modules, and lack public research evidence of intervention efficacy, making it difficult to identify appropriate programs (Ashford et al., 2016). Nevertheless, initial systematic reviews have confirmed the effectiveness of digital mental health interventions for anxiety and depression in children and adolescents (Calear & Christensen, 2010; Grist et al., 2019; Hollis et al., 2017; Wright et al., 2023). Similarly, Buttazoni et al. (2021) found small but significant effects when investigating smartphone-based interventions for internalizing disorders in adolescents. Studies investigating Serious Games have reported promising results (Fleming et al., 2014), but limited to depression-focused programs, excluding anxiety (Townsend et al., 2022). It has also been emphasized that, similar to offline programs, cognitive-behavioral programs can be effective in adolescents, but only a few exhibit good acceptance and sustainability (Carnevale, 2013), consequently limiting their widespread availability (Grist et al., 2019).

Programs for the prevention and early intervention of anxiety and depression in young individuals can be effective, but the active ingredients of these programs remain unclear (Beames et al., 2021). Based on these findings, there is a consensus that more comprehensive research is needed to identify the conditions for the efficacy of digital programs for the prevention and intervention of anxiety and depression in children and adolescents (Calear & Christensen, 2010).

Current Study

While various studies have examined the efficacy of digital programs in fostering mental health as well as addressing anxiety and depression in children and adolescents, a

comprehensive, detailed, and structured summary of the key components and detailed information about the structural features and content that determine their effectiveness is still lacking. This study aims to bridge this gap by outlining evidence-based digital programs for the prevention and early intervention of anxiety and depression in childhood and adolescence, in order to derive recommendations for future program development. Thus, the first aim is to investigate which digital evidence-based programs are effective in combatting anxiety and depression in childhood and adolescence. The second aim is to systematically examine specific components of these effective programs. Important features are the type of intervention, age or target group, mode of delivery, availability, and possibility of access, as well as structural features and the predominant content.

Methods

In order to obtain a suitable overview of existing effective digital programs for the prevention and early intervention of anxiety and/or depression in children and adolescents, an umbrella review was conducted. Through the umbrella review, it was possible to combine the results of existing studies narratively. An umbrella review is a systematic method of reviewing secondary research to provide an overall picture of the findings related to a specific phenomenon (Aromataris et al., 2015; Grant & Booth, 2009).

Search Strategy

The literature search in the present study followed a systematic approach and used the recommendations of the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) statement (Page et al., 2021). The primary search was conducted in November–December 2022 using the electronic databases PubMed, Cochrane, PsycInfo, PsycArticles and, in addition, using the University Library Search Tool, the databases Scopus, Web of Science, ProQuest, Springer Online Journals, ScienceDirect Journals and Wiley were used. The databases were selected on the basis of their relevance and coverage of psychological, educational, and preventive interventions. Table 1 lists the search strings used for each database. The aim was to find (systematic) reviews of digital programs for the prevention/intervention of anxiety and depression in children and adolescents. Based on the results of the primary search, effective (preventive) intervention programs were identified (Table 5) and then summarized (in a structured spreadsheet). Subsequently, the corresponding studies of the identified programs were examined and an additional search was conducted (January–March 2023) to obtain more detailed information on the intervention type, age/target group addressed, mode of

Table 1 Search strings

PubMed and Cochrane	PsycINFO and PsycArticles	Scopus, WoS, ProQuest, Springer, ScienceDirect, Wiley
(Depression OR anxiety) AND (children OR adolescent) AND (online OR digital) AND (program OR prevent OR intervent)	Review and (depression or anxiety) and (youth or children or adolescent or student) and (intervention or prevention or program) and (online or digital or web)	Review (in title) AND depression AND anxiety AND children OR adolescents AND prevention OR intervention AND digital
Limit to: articletype: review, systematic review	Limit to: (180 school age < age 6 to 12 yrs > or 200 adolescence < age 13 to 17 yrs >)	Limit to: article type: systematic review

delivery, availability and access, structural features, and content of the effective programs.

Eligibility Criteria

Inclusion and exclusion criteria (Table 2) for the primary search were determined with regard to the target group, publication type and intervention type in order to ensure evidence-based results. Systematic reviews and reviews were included if they described the effectiveness of digital/online prevention/intervention programs for anxiety and/or depression in children and adolescents aged 11 to 18 years. Although the World Health Organization (WHO, 1986) recommends that individuals between the ages of 10 and 19 should be considered adolescents, in most countries, those who reach the age of 18 are considered adults. Furthermore, in most countries, children move on to the next level of schooling at the age of 11, which is also a particularly vulnerable transition period (Mackenzie et al., 2012). Therefore, the age range selection for this study is 11–18. As many reviews targeted individuals aged 15–24 years, which is consistent with the developmental psychological perspective that assumes that the period of adolescence is extending (Slater & Bremner, 2003), exceptions were made if the reported results were identifiable for the age group of interest and were reported appropriately, or if the pooled mean age of the meta-analysis fell within the age range of interest.

Reviews were excluded, if they were aimed at adults or targeted a clinical sample, if they did not address the prevention or early intervention of depression and/or anxiety, if the publication type was not a (systematic) review, and if they

were not written in English. The restriction to publications in English is due to the fact that English is the most widely used language in the scientific community. This restriction may help to make the results more internationally relevant, and it can enhance the comparability of studies by ensuring a clear and consistent explanation of the methodology and results of the included articles. Restrictions to one language also increase the efficiency of the review process as fewer translations are needed. Reviews published before 2000 were not included in order to avoid the risk of relying on outdated or unavailable technologies. On the basis of these criteria, articles were selected or eliminated for further investigation.

Data Extraction and Synthesis

The Rayyan QCRI application was used for collaborative selection of articles (Ouzzani et al., 2016), which provides a streamlined platform for systematic review article selection. This web and mobile tool allows multiple reviewers to access articles independently and blinded, ensuring transparency and consensus in the screening process (Ouzzani et al., 2016). Two reviewers independently and blinded screened and assessed the articles. Unanimous agreement between authors was required for an article to be included. For data extraction, summarizing and analyzing a structured template spreadsheet was used. Extracted data included: authors, year of publication, article type, studies/interventions included in analysis, intervention types, outcomes, and key findings. Results were collated into additional structured template spreadsheets and synthesized into written summaries. The lead author analyzed the results of the articles with a focus

Table 2 Inclusion and exclusion criteria

	Inclusion criteria	Exclusion criteria
Target group	Children/adolescents aged 11 to 18 years	Clinical sample, adults (> 18 years)
Intervention	Digital (preventive) interventions for anxiety and/or depression	Clinical trials; therapy
Article type	Review, systematic review	No review
Publication	Peer-reviewed; between 2000 and 2022	Prior to 2000
Language	English	Not English

on identifying effective digital/online programs for anxiety and depression for the interested age group and listed them in a separate spreadsheet, which was reviewed by a second reviewer. For the purpose of this article, preventive and early interventions were defined as any planned intervention or program that was undertaken with the aim of improving mental health conditions or modifying its determinants. Only those programs that were identified as effective based on at least one review from the primary search, addressed anxiety and/or depression and were developed for children and adolescents in the age category of interest (11–18) were included. In a next step, the programs were analyzed in detail with a special focus on the main categories: intervention type, age/target group, mode of delivery, availability and access, structural features (e.g. following a modular/session-based, linear/self-directed order, etc.), and content. If some information (the structure or content of the program) was not elaborated in the respective identified reviews, an additional

search of the program was conducted (January–March 2023) to collect all necessary information. Within this additional search it was also checked whether the programs were still available/online and accessible.

Results

In the primary search (November–December 2022) a total of 758 articles met the search criteria and were screened against the inclusion and exclusion criteria. The final sample consisted of 11 articles. Figure 1 provides a PRISMA flow diagram (Page et al., 2021) of the search history and the selection process. The additional search (January–March 2023) concerning program details and specifics resulted in screening and analyzing 71 articles describing the identified 45 programs.

Fig. 1 PRISMA flow diagram for systematic reviews

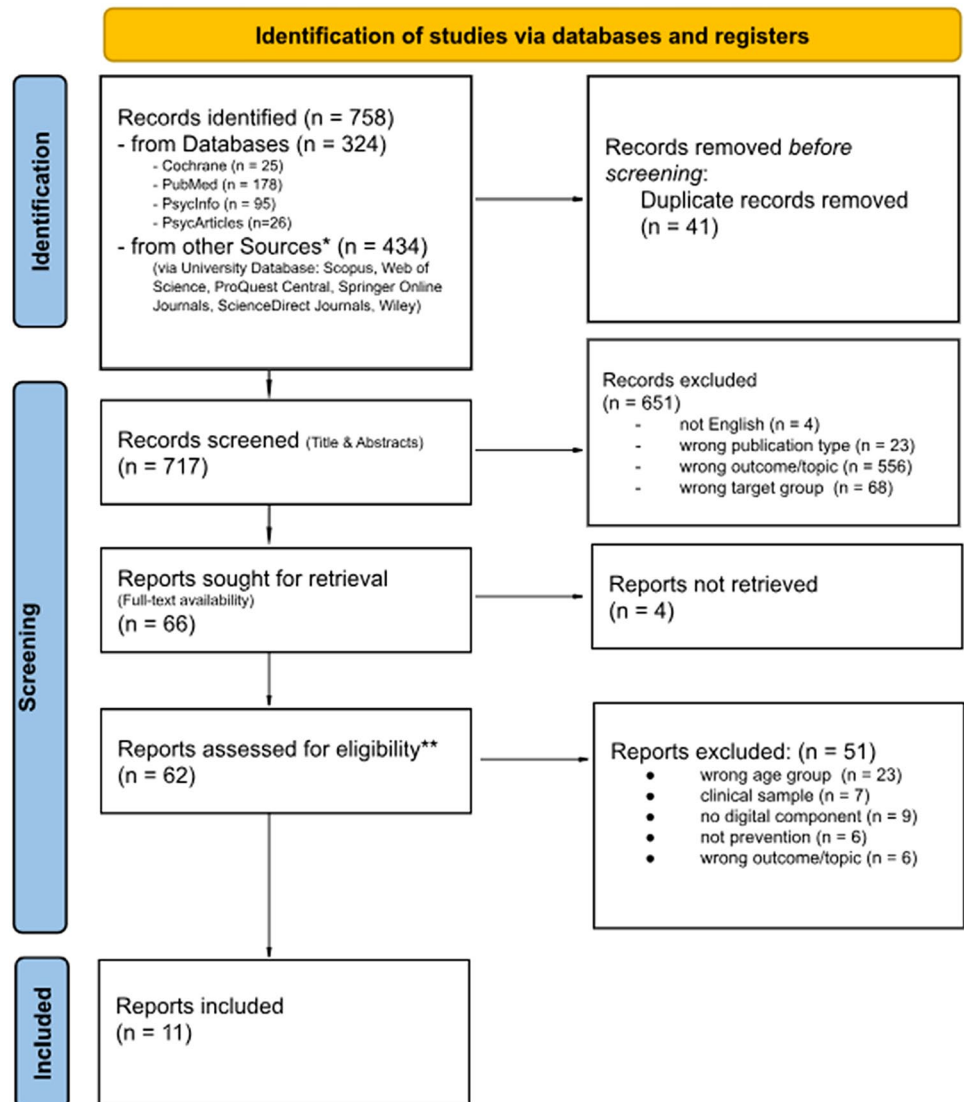


Table 3 Overview of reported effective preventive (intervention) programs (n = 45)

P#	Program name (References)	Country	Mental Health Domain	Intervention Type
1	MoodGYM (e.g., Calear et al., 2009, 2013)	Australia	☒ Depression ☐ Anxiety	CBT
2	CATCH-IT (e.g., Van Voorhees et al., 2008, 2009)	Netherlands	☒ Depression ☐ Anxiety	CBT, Interpersonal Psychotherapy, Community Resiliency concept model
3	SPARX (Bobier et al., 2013; Merry et al., 2012)	New Zealand	☒ Depression ☐ Anxiety	CBT
4	Grip op je Dip—Master your Mood (Gerrits et al., 2007; Van der Zanden et al., 2012)	Netherlands	☒ Depression ☐ Anxiety	CBT
5	BRAVE (e.g., Spence et al., 2006, 2008, 2011)	Australia	☐ Depression ☒ Anxiety	CBT
6	Mobilitytype (Reid et al., 2011, 2013)	Australia	☐ Depression ☐ Anxiety ☒ Mental Health	CBT-oriented
7	Think, Feel, Do (Attwood et al., 2012; Stallard et al., 2011)	UK	☒ Depression ☒ Anxiety	CBT
8	Cool-Teens (Cunningham et al., 2009; Wutrich et al., 2012)	Australia	☐ Depression ☒ Anxiety	CBT-principles (cognitive restructuring and graded exposure exercises, goal setting relapse prevention)
9	Pesky gNATs (Chapman et al., 2016; Coyle et al., 2011)	UK	☒ Depression ☒ Anxiety	CBT
10	The Journey (Stasiak et al., 2014)	New Zealand	☒ Depression ☐ Anxiety	CBT
11	ACT-CL (Levin et al., 2014)	US	☒ Depression ☒ Anxiety	Acceptance & Commitment Therapy (ACT)
12	Bite-Back (Burckhardt et al., 2015; Manicavasagar et al., 2014)	New Zealand	☒ Depression ☒ Anxiety	Positive Psychology
13	Blogging Intervention (Boniel-Nissim & Barak, 2013)	Israel	☐ Depression ☐ Anxiety ☒ Mental Health	Therapeutic Blogging Intervention
14	Blues Blaster (Makarushka, 2011)	US	☒ Depression ☐ Anxiety	CBT
15	Ching Ching Story (Li et al., 2013)	China	☐ Depression ☐ Anxiety ☒ Mental Health	CBT
16	Climate Schools (Vliet & Andrews, 2009)	Australia / New Zealand	☐ Depression ☐ Anxiety ☒ Stress	Psychoeducation
17	Cognitive Behavioral Analysis (ePREP) (Braithwaite & Firtham, 2007)	US	☒ Depression ☒ Anxiety	CBT

Table 3 (continued)

P#	Program name (References)	Country	Mental Health Domain	Intervention Type
18	Cognitive Behavioral Skills Training Program (Clarke et al., 2009)	US	☒ Depression ☐ Anxiety	CBT
19	COPE (Melnik et al., 2015)	US	☒ Depression ☒ Anxiety	CBT
20	eBridge (King et al., 2015)	US	☐ Depression ☐ Anxiety ☒ Suicide	Motivational Interviewing
21	EmoWM (De Voogd et al., 2016)	Netherlands	☒ Depression ☒ Anxiety	Emotional working memory
22	EpxDepression (Chen et al., 2017)	US	☒ Depression ☐ Anxiety	Referral to care
23	eSMART-MH (Pinto et al., 2015)	US	☒ Depression ☐ Anxiety	CBT
24	Young People FACE-IT (Williamson et al., 2019)	UK	☐ Depression ☒ Anxiety	CBT
25	Grasp the opportunity (modified from CATCH-IT) (Ip, 2016)	China	☒ Depression ☐ Anxiety	CBT
26	Headspace (Flett et al., 2020)	Australia / New Zealand	☐ Depression ☐ Anxiety ☒ Distress	Mindfulness
27	In One Voice (Livingston et al., 2013)	Canada	☐ Depression ☐ Anxiety ☒ Mental Health	Social-Media Campaign / Psychoeducation
28	Internet-Problem-Solving Therapy (Hoek et al., 2012)	Netherlands	☒ Depression ☒ Anxiety	Problem-Solving Therapy (PST)
29	Kindertelefon Online-Chat (Fukkink & Hermanns, 2009)	Netherlands	☐ Depression ☐ Anxiety ☒ Mental Health	Online-Chat support-service
30	LEAP Project (Rickhi et al., 2015)	Canada	☒ Depression ☐ Anxiety	Spiritual health
31	Maya (Carrasco, 2016)	Chile	☒ Depression ☐ Anxiety	CBT & Interpersonal psychotherapy
32	Mayo Clinic Anxiety Coach (Whiteside et al., 2014)	US	☐ Depression ☒ Anxiety	CBT
33	MEMO (Whittacker et al., 2012, 2017)	Australia / New Zealand	☒ Depression ☐ Anxiety	CBT
34	Mobile Tracking of Young People's Experiences (Kaur et al., 2012)	Australia	☒ Depression ☐ Anxiety	ESA (Emotional Self-Awareness)

Table 3 (continued)

P#	Program name (References)	Country	Mental Health Domain	Intervention Type
35	My body my life (Heinicke et al., 2007)	Australia	☒ Depression ☐ Anxiety ☒ Disordered Eating	CBT
36	Nod (Bruehlmann-Senecal et al., 2020)	US	☒ Depression ☐ Anxiety ☒ Loneliness	CBT, Social Learning Theory
37	Rainbow SPARX (Lucassen et al., 2015a, 2015b)	New Zealand	☒ Depression ☐ Anxiety	CBT
38	Reach out, Rise up (Anstiss & Davies, 2015)	New Zealand	☒ Depression ☐ Anxiety	CBT
39	Rebound (Rice et al., 2016)	Australia	☒ Depression ☐ Anxiety	Moderated Online Social Therapy (MOST)
40	Reframe-IT (Robinson et al., 2014a, 2014b, 2014c)	Australia	☒ Depression ☒ Anxiety ☒ Suicide	CBT
41	RESPOND (Cook et al., 2019)	UK	☒ Depression ☐ Anxiety	CBT
42	Stressbusters (Smith et al., 2015)	UK	☒ Depression ☐ Anxiety	CBT
43	The Feeling Better program (Bradley et al., 2012)	Canada	☒ Depression ☒ Anxiety	CBT
44	TOPS (Wade et al., 2012)	US	☒ Depression ☐ Anxiety	Problem Solving
45	www.losetheblues.ie (Horgan et al., 2013)	Ireland	☒ Depression ☐ Anxiety	Peer support

Article Characteristics

Table 5 (Appendix 1) summarizes the main characteristics of the articles included based on the primary search ($n = 11$) and provides information on authors, publication year, article type, number of studies/interventions analyzed, program intervention types, outcome measures, the identified effective programs for the interested age group (11–18), and key findings on the effectiveness of the programs. 55% ($n = 6$) of the articles included were systematic reviews, 27% ($n = 3$) were systematic reviews with meta-analyses and 18% ($n = 2$) were (exploratory) reviews. Of the 11 articles included, 36% ($n = 4$) were published between 2020 and 2022 and 64% ($n = 7$) between 2011 and 2019. All the included articles ($n = 11$) were published in peer-reviewed journals, reported methods and data sources meeting the methodological quality standards and reported no conflicts of interest on the part of the authors. A total of 291 studies were assessed and included in the narrative synthesis of the 11 articles reviewed. 82% ($n = 9$) of the articles addressed mental health interventions for both anxiety and depression. One article (Rice et al., 2014) only addressed depression and one (Tozzi, et al., 2018) only addressed anxiety. Since not all reviews conducted a meta-analysis, the findings on program effectiveness and relevant factors of influence are presented in a narrative summary. A brief synopsis of the findings and evidence found in the articles is also provided in order to highlight the most important aspects.

Positive outcomes were consistently reported for digital CBT-oriented programs, and no differences in effect sizes were found when compared with traditional (offline) CBT interventions. There were fewer reports of effectiveness for anxiety than for depression. There were mixed results regarding the selection of the target group (universal vs. indicated): In some studies, no differences were found in the effectiveness of programs when they were implemented universally or selectively. However, the “MoodGym” program was found to be more effective when implemented as a universal program. One article also found that indicated/targeted interventions showed larger effect sizes for depression (Siemer et al., 2011).

In terms of the design and usability of the programs, it became quite clear that the following components were crucial for the adherence and acceptance by the target group: Gamification programs were highly regarded (Garrido et al., 2019), psychoeducational content had to be kept as short and relatable as possible (Gilbey et al., 2020), and homework-like experiences were rated negatively (Gilbey et al., 2020). Multimedia-rich programs were also found to be more appropriate for children and adolescents from low socio-economic and educational backgrounds (Kuosmanen et al., 2019).

With regard to supervision by others (e.g., mental health professionals or teachers), it was shown that supervision or the implementation in a school setting resulted in larger effect sizes (Garrido et al., 2019; Kuosmanen et al., 2019) than those found in a leisure-based setting with no supervision. In contrast to this, one review showed that the program with the lowest level of interactivity in the program had the largest effect sizes (Siemer et al., 2011).

Program Characteristics

Table 3 lists the 45 effective prevention intervention programs identified via the systematic analysis of the review articles included ($n = 11$) and provides an overview of the primary mental health conditions addressed, as well as of the intervention type/the (therapeutic) approach followed in the programs. To enhance readability, the identified programs are cited numerically according to Table 3 in the following. References to program-related studies are provided as examples. A detailed list of the studies associated with the programs can be found in Table 6 (Appendix 2). The majority of programs (^{1, 3, 5, 6, 8, 10, 12, 16, 26, 33, 34, 35, 37, 38, 39, 40}) were developed in Australia and New Zealand ($n = 16$; 36%), eleven programs (24%) in the United States (^{11, 14, 17, 18, 19, 20, 22, 23, 32, 36, 44}), five programs (11%) were each developed in the Netherlands (^{2, 4, 21, 28, 29}) and the United Kingdom (^{7, 9, 24, 41, 42}), three programs (7%) were developed in Canada (^{27, 30, 43}), two (4%) in China (^{15, 25}) and one (2%) each in Israel (¹³), Chile (³¹) and Ireland (⁴⁵).

Mental Health Conditions

While effectiveness in relation to anxiety and depression was examined in all programs, not all programs focused primarily on these two mental health domains or had these constructs as their primary topic. 22% ($n = 10$) of the programs focused on both the mental health domains of depression and anxiety (^{7, 9, 11, 12, 17, 19, 21, 28, 38, 43}), 44% ($n = 20$) focused specifically on depression (^{1, 2, 3, 4, 10, 14, 18, 22, 23, 25, 30, 31, 33, 34, 37, 39, 41, 42, 44, 45}), 9% ($n = 4$) focused specifically on anxiety (^{5, 8, 24, 32}). In addition, five programs (^{6, 13, 15, 27, 29}) had their main focus on general mental health, (11%), and additional individual programs focusing on specific topics such as suicide prevention (²⁰), suicide, depression & anxiety (⁴⁰), loneliness & depression (³⁶), stress (¹⁶), distress (²⁶) and eating disorders & depression (³⁵).

Intervention Type

Given the strong evidence for the widespread successful use of cognitive-behavioral therapy (CBT) interventions for the prevention of internalized disorders (Rice et al., 2014), the most commonly used intervention type was

CBT (65%/n = 29)^(1–10, 14, 15, 17–19, 23–25, 31–33, 35–38, 40–43). Two programs employed problem solving therapy (PST)^(28,44), and two programs provided psycho-educational content only^(16, 27). There were also individual programs covering each of the following approaches: positive psychology⁽¹²⁾, therapeutic blogging⁽¹³⁾, motivational interviewing⁽²⁰⁾, emotional working memory⁽²¹⁾, referral to care⁽²²⁾, mindfulness⁽²⁶⁾, chat support⁽²⁹⁾, spiritual health⁽³⁰⁾, emotional self-awareness⁽³⁴⁾, moderated online social therapy (MOST)⁽³⁹⁾, peer support⁽⁴⁵⁾, and acceptance & commitment therapy⁽¹¹⁾.

Age/Target Group

As the programs targeted children and adolescents of different age groups, a categorization (8–18 years) was made on the basis of the minimum age of the sample used to evaluate each program. As can be seen in Fig. 2, more than half of the programs (55.6%; n = 25) were developed for children and adolescents with a minimum age of 12–14 years^(1,2, 3, 6, 8,9, 10, 12, 13, 16, 24, 25, 26, 27, 28, 30, 31, 33, 34, 35, 36, 37, 38, 40, 42). For 15.6% (n = 7) of the programs, no categorization could be made owing to the lack of specific sample information^(11, 17, 19, 20, 21, 22, 32). It was only stated that the target population included undergraduate students, young adults or students, i.e., those who belong to the upper age group of the target group of interest in the present study (18 years old).

Program Structure/Design

Mode of Delivery

The majority of 62% (n = 28) of the programs was delivered online via a website^(1, 2, 4, 5, 11, 12, 13, 14, 16, 17, 18, 19, 20, 21, 23, 24, 25, 28, 29, 30, 31, 35, 39, 40, 41, 43, 44, 45) and 13% (n = 6) via an

app^(3, 9, 26, 32, 36, 37). 11% (n = 5) of the programs required a mobile phone (e.g., messenger services)^(6, 22, 33, 34, 38), 9% (n = 4) were delivered via CD-ROM^(7, 8, 10, 42) and two programs (4%) via social media^(15, 27).

Availability and Access

To obtain information on the availability of the programs at the time of the analysis for this article, an additional search was carried out using Google, based on the information provided in the associated studies. At the time of the synthesis undertaken for this study (March 2023), 69% (n = 31) of the programs were not available/could not be found. Three programs^(1, 12, 26) were available without any limitations, six programs (13%) were only available in certain countries/languages, and five programs (11%) were only available with the invitation/support of a (mental) health practitioner/professional.

Structural Features

73% of the programs (n = 33) followed a modular/session-based structure^(1–5, 7–11, 14–19, 21, 23–25, 28, 30, 32–44). The number of modules ranged from 2⁽¹¹⁾ to 14⁽²⁾. As can be seen in Fig. 3, most modular programs had between 6 and 8 modules.

Like educational programs, intervention programs can be structured in either a linear or self-directed way. In self-directed learning, learners structure their own learning path. In contrast, linear structuring provides a predetermined, logical structure for learners to follow (Crick et al., 2014). In this sample, 65% (n = 29) of the programs followed a linear structure^(1–5, 7, 9, 10, 11, 14–17, 19, 21, 23, 24, 28, 31–34, 37, 38, 40–44) and 31% (n = 14) were designed to be self-directed by the users^(6, 8, 12, 13, 18, 20, 22, 26, 27, 29, 30, 36, 39, 45).

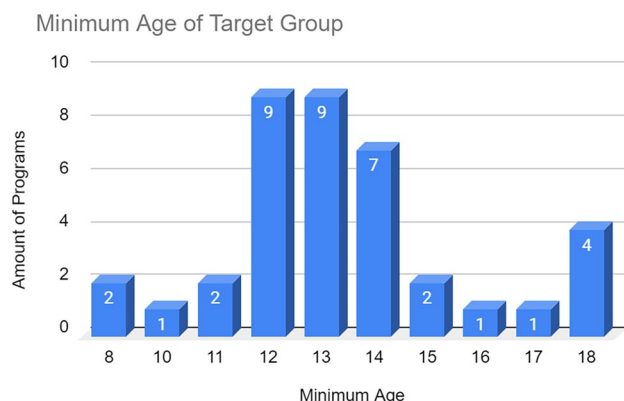


Fig. 2 Overview of reported minimum age of target group (n = 45)

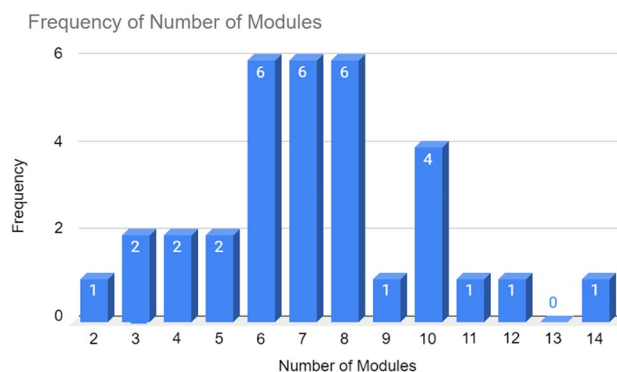


Fig. 3 Frequency of number of modules of the modular-based programs (n = 33)

Program Content

CBT Elements

As mentioned above, most of the programs followed a CBT-oriented approach. In order to categorically elicit the CBT elements of the programs for the purposes of this umbrella review, the checklist for CBT components by Oud et al. (2019) was used. This checklist distinguishes between four pillars: psychoeducation, cognitive restructuring, behavioral activation, and relaxation. Table 6 (Appendix 2) provides an extensive and comprehensive summary of the content of the programs and the CBT elements they contain, including details of the general structure (i.e., modular and/or session-based), duration, delivery method, and references to any relevant studies that have examined the programs.

36% ($n = 16$) of the programs addressed all four categories of CBT elements, 20% ($n = 9$) addressed three categories, 22% ($n = 10$) addressed two categories and 4% ($n = 2$) addressed only one category—psychoeducation. 18% of the programs ($n = 8$) either did not include any CBT components, or these could not be identified from the information available. Of the programs specifically designed for the prevention/intervention of depression, 15 (75%) followed the CBT approach. The others used approaches such as referral to care⁽²²⁾, spiritual health⁽³⁰⁾, emotional self-awareness⁽³⁴⁾, problem solving⁽⁴⁴⁾ and peer support⁽⁴⁵⁾. All four programs that were specifically designed for the prevention/intervention of anxiety^(5,8,24,32) followed the CBT approach and included two to four CBT components. The specific content of the programs is outlined in the following sections. This information was extracted from the respective program articles included in the sample of this umbrella review. To aid understanding, an overview of the main content techniques is given in Table 4.

Content Addressing Depression

Out of the 20 programs that explicitly target depression, the narrative analysis showed that eight of them provided psychoeducational content about depression^(3,4,14,18,37,39,42,45) and four programs provided information about CBT^(3,10,18,37). In addition, six programs emphasized that their content specifically addressed the connection between thoughts, feelings, and behavior^(1,3,4,10,33,37). 80% of the programs ($n = 16$)^(1,2,3,4,10,14,18,25,30,31,33,37,39,41,42,44) taught strategies for identifying and changing dysfunctional/negative thoughts. 50% of the programs included mood monitoring features^(3,4,10,14,18,22,34,37,41,42), and nine programs taught strategies for raising awareness of and planning pleasant activities^(1,3,4,10,14,18,30,33,37). Another important topic was

the introduction of relaxation techniques, which, according to the information available, was an integral part of seven programs^(1,3,10,30,37,39,41). Relapse prevention skills, such as identifying relapse risk situations (covering both internal and external experiences) or documenting potential negative feelings and strategies for dealing with them, were also included in the content of five programs^(3,4,10,37,42).

Six of the programs^(2,25,30,33,41,42) used narrative teen stories/vignettes to convey the content, and four programs used characters to present the main topics^(1,3,14,37). Four programs^(14,33,42,44) used video testimonials (e.g., teen actors, peers, national celebrities) to deliver content to the users (e.g., psychoeducational content, own experience with depressive). Four of the programs featured user avatars that progressed through a story-driven game and completed specific tasks/missions^(3,10,23,37). Two other programs were also based on a storyline^(31,33) but did not include user avatars.

Content Addressing Anxiety

All programs that focused specifically on anxiety included graded exposure techniques as part of their content^(5,8,24,32). Three programs provided psychoeducational content about anxiety and CBT^(5,8,32); two programs explained the relationship between feelings, thoughts, and behavior and included relaxation techniques in their content^(5,24). Cognitive restructuring was part of two programs^(5,8), goal setting was addressed in three programs^(5,8,24) and one program provided assessment/monitoring of anxiety symptoms⁽³²⁾. Two programs^(5,8) also included content regarding relapse prevention.

Due to the large number of depression programs identified, comparing programs for depression and anxiety was quite challenging. However, one notable finding is that case vignettes and testimonials were used less frequently in programs for anxiety. Only one program used case studies of adolescents which were presented as a video⁽⁸⁾ and another program used testimonials to deliver the content⁽²⁴⁾.

Discussion

Mental health problems in children and adolescents are a growing concern. Specifically, anxiety and depression are the most commonly reported mental health problems in this age group, with significant increases in prevalence rates compared to the pre-pandemic period (Dale et al., 2023; Racine et al., 2021; Samji et al., 2022; Theberath et al., 2022). These findings highlight the urgent need for preventive interventions to address mental health challenges faced by young people. Preventive interventions can reduce risk factors and support mental health. Digital interventions have emerged as a potential means of reaching a wider population

Table 4 Overview and short explanation of techniques used in programs for anxiety and depression

Technique	Explanation
Cognitive restructuring/Identifying and changing dysfunctional thoughts	Cognitive restructuring, a key component of cognitive therapy, is considered an effective treatment approach for mental disorders, particularly anxiety and depression. It involves a structured and collaborative process in which individuals learn to identify, evaluate, assess, and modify the distorted thoughts, evaluations, and beliefs that contribute to their psychological distress. Cognitive restructuring therefore aims to explore, evaluate, and replace maladaptive automatic thoughts, appraisals, and beliefs that perpetuate psychological disturbances (Clark, 2013; Wenzel et al., 2016)
Mood Monitoring	Mood monitoring by individuals themselves provides a real-time assessment of mood by collecting data on multiple occasions and may therefore be better suited to document and understand daily changes in mood (Dubad et al., 2018)
Awareness of pleasant activities	Engagement in pleasurable activities is linked to mood, and individuals with depression tend to participate in fewer enjoyable activities. Therefore, several programs addressing depression include activities such as "The Pleasant Events Schedule" developed by MacPhillamy & Lewinsohn. This program involves listing various activities and events that are commonly considered pleasurable and encourages users to rate the frequency and subjective enjoyment of these activities. The aim is to encourage users to reflect on activities that bring them joy and to motivate them to engage in these activities more frequently (Lewinsohn & Graf, 1973)
Relaxation	Relaxation techniques, such as progressive muscle relaxation or breathing relaxation, are taught, and used to reduce the level of physiological arousal (Leichsenring et al., 2006)
Relapse prevention	A key principle of CBT is to equip individuals with the skills and knowledge necessary for independent application, i.e., without relying on mental health professionals. To this end, they are encouraged during the program to understand the cognitive and behavioral principles of change so that they can apply these principles in their daily lives outside of the program. This step also includes activities such as developing a relapse prevention plan (Wenzel et al., 2016)
Graded Exposure	Graded exposure techniques, including self-exposure hierarchies, are commonly used in the treatment of phobias (Foa & Kozak, 1985). In the strictest sense, exposure involves repeatedly exposing/confronting the individual with an anxiety- or stress-inducing stimulus, while refraining from avoidance behaviors or tension-reducing rituals; he or she experiences the rise, peak and fall of anxiety, allowing a process of emotional habituation to occur (Leichsenring et al., 2006)

and of providing accessible and effective support. This article recognizes the importance of developing and implementing digital prevention programs that not only target existing mental health problems, but also focus on prevention and early intervention. To ensure that these programs are accessible and effective for youth (Grist et al., 2019), it is important to have knowledge of the active ingredients of effective digital prevention programs (Beames et al., 2021; Calear & Christensen, 2010). Thus, the aim of this study was to identify effective digital prevention programs for anxiety and depression in children and adolescents, and to examine their structural and content characteristics. The method used included a systematic umbrella review to provide an overview of existing evidence-based programs. The inclusion criteria were stringent, focusing on systematic reviews and

reviews published between 2000 and 2022 that evaluated the effectiveness of digital prevention/intervention programs for anxiety and/or depression in children and adolescents.

Eleven articles were identified that met the inclusion criteria, describing a total of 45 effective digital prevention and/or intervention programs. A narrative analysis was conducted to examine the characteristics of these programs, covering the mental health conditions addressed, intervention types, target groups, as well as program structure and content. It became evident that it is difficult to establish a clear distinction between prevention programs and intervention/treatment programs. The dividing line between these two program types is often blurred (Institute of Medicine, 1994). Some of the identified programs served both preventive and interventive/treatment purposes, despite the search

criteria clearly excluding clinical samples. However, prevention and intervention programs are often rooted in the same theoretical foundations, and in the field of mental health, it is not uncommon for symptoms to be present without clinical significance or formal diagnosis. Therefore, both preventive and interventional measures can be viable and relevant to the general population. Having said that, the results indicate that selective/targeted programs and those that specifically addressed anxiety or depression as their primary purpose were found to be more effective than those that targeted a variety of psychological outcomes. While this may, to some extent, be due to the higher level of symptoms among those initially targeted, it still seems important that specific content be tailored to match the needs of children and adolescents in order to increase the effectiveness of the program. For this purpose, implemented screening procedures identifying those at risk, or mood monitoring procedures, can contribute to a rule-based allocation of individual modules/activities and thus deliver targeted content to users.

The programs covered in this umbrella review varied in terms of their target age group, but the majority focused on children and adolescents with a minimum age of 12–14 years. The programs were predominantly delivered online via websites or apps. This approach provides ease of accessibility and flexibility for users (Ashford et al., 2016; Grist et al., 2019; Murray, 2012; Reyes-Portillo et al., 2014; Richardson, 2010). Unfortunately, a significant number of the identified programs were no longer available or accessible by the time the analysis was undertaken, which is in line with prior findings (Ashford et al., 2016; Carnevale, 2013; Grist et al., 2019). Therefore, it is essential to consider program sustainability and maintenance both during and after program development. Failure to do so could result in the loss of valuable, evidence-based and effective programs. There is a clear need for sustained availability, ongoing adaptation to new systems, and continuous support of digital interventions to ensure their long-term impact and benefits for the target population. It is crucial to regularly adapt digital programs to new technical requirements to avoid wasting the extensive effort put into their development. It is also essential to ensure the continuity of digital programs, even after the completion of underlying research projects. Developers should carefully consider the viability and continued presence of these programs.

Based on the findings regarding program structure and specifics, it is recommended to use a modular, linear, multimodal approach that incorporates elements of gamification. This is because the majority of the programs followed a modular/session-based structure with a linear or self-directed learning approach. Gamification elements, narrative stories and avatars were used to engage users and enhance their experience. The findings highlight the importance of

considering factors such as program interactivity, supervision and multimedia-rich content to improve engagement and acceptability (Lucas-Thompson et al., 2019; Richardson et al., 2010). In order to take account of the specific preferences of the target group, it is strongly recommended that psychoeducational content and information be kept as brief and concise as possible.

It is also recommended that CBT should be recognized as a powerful theoretical framework. As was found in previous research (e.g., Ye et al., 2014; Schneider, 2014; Williams & Crandall, 2015), the majority of programs used a cognitive behavioral therapy (CBT) approach. CBT interventions were found to be effective in reducing symptoms and promoting positive behavioral responses. Nonetheless, individual programs based on concepts derived from interpersonal therapy, positive psychology, mindfulness, social therapy, and acceptance & commitment therapy were also found to be effective. What all programs had in common, however, was that they included at least some elements of CBT.

The programs' content analysis revealed the inclusion of various CBT elements, such as psychoeducation, cognitive restructuring, behavioral activation, and relaxation techniques. Most programs included psychoeducational and informational content about CBT (if the program was based on it). According to the analyzed reviews' results, psychoeducational and informational components should be kept as short and relatable as possible in order to maintain high adherence. Furthermore, explaining and understanding the connection between thoughts, feelings and behavior should be considered a fundamental component of the content for anxiety and depression. Many activities build on this knowledge to enable a more advanced understanding of mental health support, and exercises are better internalized or transferred to everyday life.

The analysis indicated that when developing digital prevention programs, it is important to consider several factors beyond the inclusion of CBT elements, such as the inclusion of mood monitoring activities. It was found that about half of the effective programs included some kind of mood monitoring activities, such as a daily assessment of mood using a predetermined scale. While strategies for identifying and changing negative/dysfunctional thoughts seem to be crucial in programs for depression, teaching graded exposure techniques seems to be highly relevant in programs for anxiety. In addition, content on relaxation procedures/relaxation techniques also seems to be important. As already mentioned in the section "Study characteristics", gamification-oriented programs can have a positive impact on user adherence and acceptance. This was shown in the effective programs by the fact that there were both fully game-based or storyline-driven programs, and that the majority used gamification elements (quizzes, animations, action tasks, missions, audio/video).

When interpreting the results, it is important to consider the limitations of this study. The search was conducted using specific databases, so there may be relevant reviews or programs that were not included in this umbrella review. Additionally, it is worth noting the temporal limitation, as only programs examined until December 2022 were included. The limited availability of programs posed a challenge, as a significant proportion of the identified programs were no longer accessible in detail, preventing a complete mapping of the programs. Nevertheless, important content and design features of digital programs for the prevention of anxiety and depression in children and adolescents could still be identified based on the available study articles and reviews.

Conclusion

In light of the pressing increase in mental health issues in children and adolescents, there is a clear need for tailored and effective programs for their prevention. Despite various studies on the effectiveness of digital prevention programs for anxiety and depression in children and adolescents, there is no synthesis of the active components that contribute to their effectiveness. This umbrella review aims to address this gap by conducting a systematic and detailed review of

effective evidence-based digital programs for the prevention of anxiety and depression in children and adolescents, summarizing their structural features and content. The results demonstrate that utilizing cognitive behavioral therapy (CBT) within a modular, linear, and multimodal approach, along with gamification elements significantly improves user engagement and acceptability. Additionally, it is recommended to implement specific content elements relating to the disorder addressed, i.e., mood monitoring activities, negative thought identification and modification strategies for depression, graded exposure techniques, and relaxation content for anxiety. However, it is important not only to consider these specific content components in future development processes, but also emphasize the sustainability and continuity of the programs to ensure that they can be offered over the long term, equipping young people with the necessary skills and resources they need to proactively manage their mental health.

Appendix 1

See Table 5.

Table 5 Main content of included reviews (n=11)

Authors (year) [sample #]	Article type	Studies interventions included in analysis (n)	Intervention types	Outcomes	Identified effective programs for interested age group (11–18)	Key findings
Clarke et al., (2015) [1]	Systematic review	28 studies 15 interventions	• Computerized Cognitive Behavioral Therapy (cCBT) (8) • Online stress management program (1) • Depression information intervention (1) • Mobile phone self-monitoring mood app (1) • Blogging intervention (1) • Online support or therapy (3)	Anxiety Depression	• Think, Feel, Do • MoodGYM • Kindertelefon • Online Chat • Blogging Intervention • Mobile Tracking of Young People's Experiences—self monitoring program • Grip op Je Dip—Master Your Mood Online • CATCH-IT • Ching Ching Story • In One Voice • Online stress prevention and coping skills training • Internet-based programme for the management of stress	• cCBT intervention outcomes were positive • monitoring of mood increased emotional self-awareness which in turn decreased depressive symptoms for youth • stress management intervention and health-cards produced fewer positive outcomes • MoodGym was effective when implemented as a universal intervention with adolescents (12–17)

Table 5 (continued)

Authors (year) [sample #]	Article type	Studies interventions included in analysis (n)	Intervention types	Outcomes	Identified effective programs for interested age group (11–18)	Key findings
Garrido et al., (2019) [2]	Systematic review & meta- analysis	41 studies (Narrative Synthesis) 15 Studies (Meta-Analysis)	32 Digital Mental Health Inter- ventions • CBT (28) • Other: Psychoedu- cational, positive psychology, emotional working memory, spiritual health	Anxiety Depression	• Reach Out, Rise Up • SPARX • The Feeling Better program • Bite Back • MoodGYM • Maya • Pesky gNATs • EpxDepression • EmoWM • Master your Mood • CATCH-IT • Reframe-IT • www.losetheblues.ie • Grasp the opportunity (modi- fied from CATCH-IT) • eBridge • ACT-CL • COPE • eSMART-MH • Mobilettype • Rebound • LEAP Project • Stressbusters • The Journey • TOPS • Mayo Clinic Anxiety Coach • MEMO	• lack of comparable RCTs for anxiety, thus meta-analysis focused on depression • pooled effect size on depres- sion: Intervention-Group (IG) vs. no Intervention Control- Group (CG): small • pooled effect size on depres- sion: IG vs. ActiveInter- ventionCG: no significant difference • higher effect sizes when: supervision • game-like feel & relatable, interactive content liked by users • educational materials were boring • non-appealing interfaces and technical glitches put-off users
Gilbey et al., (2020) [3]	Systematic review	38 studies 24 Interventions/ programs • 5 mental health- related issues • 2 focusing on inter- nalizing symptoms reduction	CBT principles • Behavioral activa- tion • Cognitive restruc- turing • Problem solving	Anxiety Depression other: Psy- chological distress Well-being Drug abuse Smoking cessation Sexual health	• Rainbow Sparx	<u>Effectiveness:</u> digital health interventions dem- onstrated preliminary effective- ness in reducing internalizing symptoms such as depression and psychological distress <u>Acceptability/Feasibility:</u> • Gamification stood out as a component that tended to be highly regarded by participants • information presented with brevity and in a relatable way tended to receive greater ratings of acceptability • social aspects of interventions (e.g., ability to share experi- ences with others) were highly rated • negative: when tasks feel too laborious or homework-like • in-person component (collect- ing rewards earned in the web- based component) reported low user engagement

Table 5 (continued)

Authors (year) [sample #]	Article type	Studies interventions included in analysis (n)	Intervention types	Outcomes	Identified effective programs for interested age group (11–18)	Key findings
Kuosmanen et al., (2019) [4]	Systematic Review	66 studies 16 interventions • 12 in school- setting o 6: Social Emo- tional Learning (SEL) o 2: Depression & Anxiety o 2: Community- based o 2: cCBT	• SEL (whole- school, curricu- lum) • cCBT • Group-CBT • Awareness training • Parent skills training	Depression Anxiety other: Substance misuse, problem behavior, bullying, suicide, SES	• MoodGYM • SPARX	• CBT-based anxiety prevention program FRIENDS, has been shown to reduce symptoms of anxiety when delivered in both targeted and universal matter • CBT-based Penn Resilience Programme was shown to reduce symptoms of depression when delivered in a targeted manner in schools but not as universal classroom-based program • MoodGym has been shown to reduce symptoms of anxiety in comparison to CG when delivered as universal intervention in schools • SPARX has been shown to be non-inferior to treatment as usual and feasible when delivered with more disadvantaged young people • digital interventions were successfully delivered in the school-setting by teachers • multimedia-rich SPARX may be more suitable than MoodGYM for youth from disadvantaged socio-economic and educational backgrounds • training and on-going support for program moderators may be required to improve cCBT implementation in school and community settings
Leech et al., (2021) [5]	Systematic Review & Meta Analysis	11 studies/Rand- omized Controlled Trials (RCTs)	• CBT (5) • Mindfulness (3) • Emotional Self- Awareness (2) • Cognitive remedia- tion (1)	Anxiety Depression other: Mental Health Well-being Stress	• Nod • Headspace • mobiletype	• App interventions produced significant symptom improvement across multiple outcomes, compared to wait-list or attention control conditions (depression $g = 0.52$ [CI: 0.18–0.84], $p = .01$, $k = 8$; stress $g = 0.30$ [CI: 0.06–0.53], $p = .02$, $k = 2$)
MacDonell & Prinz (2016) [6]	Review	30 interventions, 44 RCTs • 19 parent/family- based interventions (32 studies) • 11 youth-focused interventions (13 studies) o 12 stud- ies: > 10–16 year olds	• n.m	Anxiety Depression other: Disordered Eating Substance use ASD-related Self-esteem	• The cool teens CD-Rom • MoodGYM • My body, my life • SPARX	<u>Child and Youth focused inter- ventions</u> • 7 interventions assessed reductions in depression symptoms with mixed results - o only 2 studies reported significant positive changes - o remaining 5 studies: nonsignificant or unclear results • 6 interventions (8 studies) assessed changes in anxiety symptoms - o only 2 reported significant changes <u>Depression:</u> • My Body My Life & SPARX reported significant positive changes with effect size ranging from medium to large <u>Anxiety:</u> • MoodGYM: small effect sizes • CoolTeens: large effect sizes

Table 5 (continued)

Authors (year) [sample #]	Article type	Studies interventions included in analysis (n)	Intervention types	Outcomes	Identified effective programs for interested age group (11–18)	Key findings
Noh & Kim (2022) [7]	Systematic Review & Meta-Analysis	19 studies (RCTs) • qualitative synthesis: 19 • quantitative synthesis: 16 • Universal: 12 interventions - o 9 in schools • Selective: 7 interventions (at-risk)	• CBT (6) • family-based intervention (5) • family-based CBT (2) • cognitive training (e.g., attentional bias modification training, emotional working memory training) (3) • health behavior training (e.g. eating, physical activity) (3) • ACT (2) • Mindfulness-based intervention (1) • Problem-Solving Program (1)	Anxiety Depression other: Stress	• FACE-IT	Stress: • no significant difference in change in stress-scores between Intervention-group (IG) and Control-group (CG) • universal and selective interventions showed no significant difference in stress change compared with the CG Anxiety: • no significant difference in change in anxiety scores between IG & CG • universal and selective interventions showed no significant difference in change in anxiety scores compared with CG Depression: • significant difference in change in depression scores for online interventions • universal and selective programs showed no significant difference in change in depression scores compared with CG
Rice et al., (2014) [8]	Systematic Review	Search 1: 15 studies / 9 interventions • focused on RCTs • target group: 12–25 years • Prevention (9 studies) • Intervention (5 studies) • Prevention & intervention (1 study) Search 2: 22 studies all study design types, not restricted in terms of age	Search 1 (15 studies) • All CBT based (15) • Relationship therapy (1) • Coping-course (1)	Depression	• Blues Blaster • Cognitive Behavioral Analysis • MoodGYM • CATCH-IT • Cognitive Behavioral Skills Training Program • SPARX • Computerized CBT • Master your Mood	With the exception of 1 combined study (preventive & interventive) all studies reported positive findings Prevention studies: • prevention studies were effective among university, secondary students and adolescents at risk of depressive disorder Intervention studies: • demonstrated superiority of online intervention in comparison to treatment Combined prevention and intervention • no difference/efficacy • but depression and anxiety symptoms declined in both IG & CG, no added benefit from problem-solving intervention
Siemer et al., (2011) [9]	Systematic Review	20 studies, 12 interventions • 5 studies on depression • 3 studies on anxiety	Depression interventions: • CBT • Interpersonal psychotherapy components (CATCH-IT) Anxiety interventions: • CBT • animation to illustrate CBT • animated narratives (Climate Schools)	Anxiety Depression other: Eating disorders Substance Abuse Health promotion	• MoodGYM • CATCH-IT • BRAVE-Online • Climate Schools	Depression: • mean between-group effect sizes are small • reduced range of pre-/post-effects • larger for samples with depression symptoms/targeted intervention than for universal prevention Anxiety: • interventions without face-to-face therapeutic contact report small effect sizes • intervention with least interactivity (Spence) had the largest effect size • mean between group effect size = .24 • pre/post-effect size: .64

Table 5 (continued)

Authors (year) [sample #]	Article type	Studies interventions included in analysis (n)	Intervention types	Outcomes	Identified effective programs for interested age group (11–18)	Key findings
Tozzi et al., (2018) [10]	Exploratory Review	33 studies, 19 programs therapeutic treatment or prevention	• CBT (14) ◦ 7 for 6–12 years old • Biofeedback (2) • Problem-solving therapy (1) • Solution-focused therapy (1) • Mindfulness-based (1)—only adults	Anxiety other: Stress	• BRAVE web-based • Cool Teens • Think, Feel, Do • Pesky gNATs Island • MoodGYM	• all 7 CBT-based programs showed positive effects in reducing anxiety, no differences when compared with traditional interventions • Biofeedback-based programs provided some evidence of stress reduction ◦ neurofeedback: no efficacy results • problem-solving and solution-focused-therapy did not demonstrate efficacy
Zhou et al., (2021) [11]	Systematic Review	45 studies (RCTs) participants: n = 13,291 37 studies: student population 23 studies: universal sample 22 studies: selected samples with symptoms	<u>35 Web-based self-help platforms</u> • CBT (14) • ACT (5) • Mindfulness (4) • Positive Psychology (2) • Other (4) (present control therapy, psychodynamic therapy, social cognitive theory, religious beliefs) • combined (6) (self-help & psychological interventions) <u>6 Apps</u> • CBT, mindfulness, attention bias modification training, coping strategies and social learning theory • 1 web-based synchronous chat • 3 AI-based conversational agents	Anxiety Depression other: Stress Mental Health Well-being QoL Life Satisfaction Psychol. distress, insomnia, sleep quality	• RESPOND • MoodGYM • SPARX	<u>Web-based self-help platforms:</u> • 11 out of 14 CBT interventions proved effective in reducing depression, anxiety, stress compared with CG • 3 out of 5 acceptance commitment therapy interventions proved effective in reducing depression, stress • 3 out of 4 mindfulness interventions proved effective in reducing stress, anxiety and depression • 1 of 2 positive psychology interventions proved effective • 1 combination of psychoeducation, CBT, relaxation skills and physical activity had no impact on anxiety and depression • 1 combination of CBT and mindfulness was effective in reducing depression and anxiety • 1 combination of psychoeducation and coping strategies training was not effective in reducing anxiety and depression • 1 combination of behavioral activation strategies and interpersonal psychotherapy techniques was not effective in reducing anxiety or symptoms of depression • 1 combination of psychoeducation, self-regulation was effective in reducing depression but not social anxiety • 1 combination of motivational interviewing and CBT was not effective in reducing anxiety <u>Apps:</u> • 3 out of 6 demonstrated effectiveness in reducing anxiety, depression and stress • 1 out of 6 found that interventions were not effective in reducing depression or anxiety

Appendix 2

See Table 6.

Table 6 Content and CBT elements of reported effective preventive (intervention) programs (n = 45)

P#	Program [References]	Content	CBT elements
1	MoodGYM [Calear, et al., 2009; Calear, et al., 2013; Christensen, et al., 2002; Lillevoll, et al., 2014; Linvett, et al., 2013; Neil, et al., 2009; O’Kearney, et al., 2006, 2009; Ren, et al., 2016; Sethi, et al., 2010]	Module 1: Feelings: Why you feel the way you do (20 Min) • Connections between thoughts and feelings • Identifying the emotional consequences of negative thoughts • Understanding WUTIUF (What you think is what you feel) Module 2: Thoughts: Changing the way we think to feel better (25 Min) • Types of dysfunctional thinking and how these might be contested • Common problem areas such as authority and intimate relationships • improving self-esteem Module 3: Unwarping: Changing warped thoughts (30 Min) • different ways to change dysfunctional thoughts • identifying personal vulnerabilities • more help with self-esteem through actively increasing positive events Module 4: Destressing: Knowing what makes you upset (individual, depending on relaxation exercises) • identifying situations or events which might trigger stress or warped thoughts • relaxation methods (includes downloads) • problem-solving Module 5: Relationships: Break-ups and how you were raised (25 Min) • how to cope with and grow from relationship break-ups • mum and dad issues (or how you were raised) Workbook: Easy access to quizzes and diaries (29 Exercises and assessments) • re-take quizzes and compare your results over time • access exercises and diaries from each of the modules Module 1 introduces the site “characters” (who model patterns of dysfunctional thinking) and demonstrates the way in which mood is influenced by thinking, using animated diagrams and interactive exercises. Module 2 describes types of dysfunctional thinking, the methods used to overcome them, and provides self-assessment of “warpy” (dysfunctional) thoughts. Module 3 provides behavioral methods to overcome dysfunctional thinking, and includes sections on assertiveness and self-esteem training. Module 4 assesses life-event stress, pleasant events, and activities, and provides 3 downloadable relaxation recordings. Module 5 covers simple problem solving and typical responses to relationship breakup. Workbook exercises are integrated seamlessly into each of the modules. Each module was designed to take from 30 to 45 min to complete, but users can opt to skip sections. Module 1 has approximately 30 “pages” but many of these contain browser-supported interactive features (creating additional pages) and supplementary pop-up windows. Module 3 has over 60 pages, but users are directed to specific sections depending on their scores on earlier tests and thus may not need to access all pages.	☒ Psychoeducation ☒ Cognitive Restructuring ☒ Behavioral Activation ☒ Relaxation
2	CATCH-IT [Saulsberry, et al., 2013; Van Voorhees, et al., 2009; Van Voorhees, et al., 2008]	Competent Adulthood Transition with Cognitive-behavioral, humanistic and interpersonal training (CATCH-IT) is a preventive and primary care/Internet-based behavioral training intended for adolescents exhibiting an elevated risk of depression. CATCH-IT teaches resiliency skills through web-based modules, with motivational support provided through the primary care setting and includes 14 Modules based on Behavioral Activation, CBT, Interpersonal Therapy (IPT) and a community resiliency concept model. CATCH-IT teaches adolescents how to reduce behaviors that increase vulnerability for depressive disorders (e.g., procrastination, avoidance, rumination, pessimistic appraisals, and indirect communication style) and how to increase behaviors that are thought to protect against depressive disorder (e.g., behavioral scheduling, countering pessimistic thoughts, activating social networks, and strengthening relationship skills). Each module included learning goals, reviews, core concept explanations, adolescent stories to illustrate the lessons, skill building exercises, a summary, feedback on the experience and an Internet-based reward. After describing the core concepts, recall, understanding and retention are stimulated via narratives (“teen stories”) based on the principles of vicarious learning theory, illustrating the concept in realistic situations and reflection exercises. The teen stories were written in first person or intimate third person style so as to connect directly with the experience of the reader. The Internet site is open for public viewing at http://catchit.bsd.uchicago.edu. [website not available; 09.05.2023]	☒ Psychoeducation ☒ Cognitive Restructuring ☒ Behavioral Activation ☒ Relaxation

Table 6 (continued)

P#	Program [References]	Content	CBT elements
3	SPARX [Bobier, et al., 2013; Merry, et al., 2012]	SPARX (Smart, Positive, Active, Realistic, X-factor thoughts) is an interactive novel-game, where the avatar's mission is to rid the world of gloom and negativity brought about by GNATs (gloomy negative automatic thoughts) and to restore 'the balance' in the virtual world. SPARX contains a range of challenges and puzzles as well as psychoeducation on mood management techniques 7 Modules delivered over a period of between four and seven weeks (1 Module = 30 Min) Level 1—cave province: finding hope • Psychoeducation about depression and an introduction to the cognitive behavioral therapy model • Introducing GNATs (Gloomy Negative Automatic Thoughts) • Introducing "hope" (people recover from depression) • Relaxation: controlled breathing • Level 2—ice province: being active • Activity scheduling and behavioral activation • Relaxation: progressive muscle relaxation • Basic communication and interpersonal skills • Level 3—volcano province: dealing with emotions • Dealing with strong emotions: anger and hurt feelings • Interpersonal skills: assertiveness, listening, and negotiation • Level 4—mountain province: overcoming problems • Problem solving using STEPS: Say the problem, Think of solutions, Examine the pros and cons, Pick one and try it. See what happens • Cognitive restructuring-identifying SPARX: Smart, Positive, Active, Realistic, X-factor thoughts • Level 5—swamp province: recognizing unhelpful thoughts • Cognitive restructuring—recognizing different types of GNATs • Level 6—bridgeland province: challenging unhelpful thoughts • Cognitive restructuring—learning to challenge or "swap" negative thoughts for helpful ones • Interpersonal skills continued: negotiation skills • Level 7—canyon province: bringing it altogether • Recap of all skills • Mindfulness: tolerating distress • Relapse prevention: knowing when to ask for help At the beginning and end of each module, the user interacts in the first person with a "guide," who puts the game into context, provides education, gauges mood, and sets and monitors real-life challenges, equivalent to homework. Young people who exhibit no improvement are prompted to seek help from their referring clinicians. SPARX is supplemented by a paper notebook with summaries of each module and spaces to add comments about the challenges completed (a trailer of SPARX is available at www.sparx.org.nz)	☒ Psychoeducation ☒ Cognitive Restructuring ☒ Behavioral Activation ☒ Relaxation

Table 6 (continued)

P#	Program [References]	Content	CBT elements
4	Grip op je Dip—Mastert your Mood [Gerrits et al., 2007; Van der Zanden, et al., 2012]	2012: Version: The online MYM course is a structured form of CBT for depression. At the core of MYM is the cognitive restructuring of thinking patterns. Course participants are encouraged to detect their own unproductive, unrealistic thoughts, and they are then taught to transform these into realistic, helpful thoughts. Performance of pleasant daily activities is also encouraged, and a mood measure is filled in daily to help understand the connection between pleasant activities and mood level. 6 sessions of 90 Minutes each + homework (Session 6&7 not included anymore) Sessions are structured around six themes: 1) Your mood: Learning to understand the relationship between feelings, thoughts and actions 2) Your mood and being active: Becoming aware of the influence that activities have on your mood and starting to be more active 3) Tracing negative thoughts: Becoming aware of negative thoughts and starting to understand what they do to your mood and self-esteem 4) New ways of thinking: Challenging the negative thoughts and changing them into more positive (but realistic) ones 5) More action with positive thinking: Combining the new way of thinking with being more active. Becoming more aware of positive things about yourself and others 6) The future: Making a plan to prevent relapse into depressive moods in the future. Learning the personal signals of a coming depression and knowing how to address that threat. Making a personal plan for the future, to include wishes about schooling, jobs, and relationships and ways to achieve those wishes During the sessions, course material was introduced by the facilitators and displayed in the chat room using text and images. Participants could respond, share experiences, and ask questions. Emoticons could be used to express feelings. Participants and professionals could read through the session transcripts afterward. The course was guided by one or two trained professionals, depending on group size (6 participants was the maximum) Prior to every session you are encouraged to complete homework so you are familiar with each weekly topic and discussions are more helpful Available on homepage: [09.05.2023] - Dip-test: (without registration—access through website) to get insight in feelings—not diagnosis, screening, finding out about mood - Dip-info: psychoeducational material, Signals, causes, ... - Where to get help/info 2007 Version: 8 Sessions 1) Your Mood—Understanding how the relationship between feelings, thoughts and actions works 2) Your mood and being active: Becoming more active and more aware of the importance of the influence that activities have on your mood 3) Tracing negative thoughts: Becoming aware of negative thoughts and what they do to your mood and self-esteem 4) New ways of thinking: Changing the negative thoughts into more positive (but realistic) thoughts 5) More action with positive thinking: Combining the new way of thinking with being more active 6) Stand up for yourself: Becoming more assertive 7) Handling conflicts: Resolving conflicts in an assertive way 8) The future: Making a plan to prevent falling back into depressive moods in the future	☒ Psychoeducation ☒ Cognitive Restructuring ☒ Behavioral Activation ☐ Relaxation
5	BRAVE [March, et al., 2009; Spence, et al., 2006; Spence, et al., 2008; Spence, et al., 2011]	BRAVE is a program designed to treat childhood anxiety issues and provide participants with psycho-educational information. Child sessions contain modules based on CBT and anxiety reduction strategies. Parent sessions are focused on psychoeducation regarding child anxiety, and strategies for overcoming it Anxiety management strategies within the online program include recognition of the physiological symptoms of anxiety, relaxation strategies (progressive muscle relaxation, guided imagery, and deep breathing), cognitive strategies for coping, self-talk and cognitive restructuring, graded exposure, problem-solving techniques, and self-reinforcement of “brave” behavior. Parent sessions focus on strategies such as psychoeducation about child anxiety, contingency management, relaxation training, and information about cognitive restructuring, graded exposure, and problem solving. In this way, the parents are empowered to help their children acquire and use the skills presented in the program, and to assist more effectively in situations where their children become anxious The online intervention mirrors the clinic-based program, comprising 10 weekly, 60-min child sessions and 6 weekly, 60-min parent sessions. Two booster sessions conducted 1 and 3 months following the end of treatment focus on consolidation and prompting of previously learned skills, as well as relapse prevention strategies Session 1: Getting started Session 2: The way we think and feel Session 3: Body signs & relaxation Session 4: Activate helpful thoughts Session 5: Victory over fears Session 6: Creating BRAVE ladders Session 7: Problem solving Session 8: Enjoy! Embrace the positives Session 9: Practice Session 10: Preparing for the future Session 11: Booster 1: Refresh key concepts Session 12: Booster 2: Identify goals and achieve them	☒ Psychoeducation ☒ Cognitive Restructuring ☒ Behavioral Activation ☒ Relaxation

Table 6 (continued)

P#	Program [References]	Content	CBT elements
6	Mobiletype [Reid, et al., 2011; Reid, et al., 2013]	Phone/Text-Messages The Mobiletype program monitors a young person's mood, stress, coping strategies and daily activities a number of times per day, plus their eating, sleeping, exercise patterns and alcohol and cannabis use once per day. This information is then uploaded to GPs, via a secure website and displayed in summary reports for review, in a manner similar to a pathology or radiology report. It is a self-monitoring tool, and prompts users 4 times a day to record current activity, mood, stressful events, alcohol use, cannabis use, quality and quantity of sleep, quantity and quality of exercise, and diet.	☐ Psychoeducation ☐ Cognitive Restructuring ☒ Behavioral Activation ☐ Relaxation ☒ Psychoeducation ☒ Cognitive Restructuring ☒ Behavioral Activation ☒ Relaxation
7	Think, Feel, Do [Attwood, et al., 2012; Stallard, et al., 2011]	6-session CD-ROM based on the workbook: Think Good—Feel Good (Stallard, 2004) each session: 30–45 min + Homework has to be facilitated by a professional (psychology assistant, teacher, nurse) 1. Introduction (Psychoeducation, assessment positive diary, link between thoughts, feelings and behavior) Homework: find two positive things that happen 2. Emotional recognition (Emotional recognition, identifying body signals, examine how feelings change in different situations) Homework: Identify one situation that made you feel good and one that made you feel bad 3. Thoughts (Link between thoughts and feelings, identifying positive and negative thoughts, understand there are different ways of thinking) Homework: Identify one thought that makes you feel good and one that makes you feel bad 4. Thinking positively (Identify thinking traps such as 'negative glasses' and blowing things up, learn how to change negative thoughts to positive thoughts) Homework: Identify two negative thoughts and change them into more helpful ones 5. Emotional management (Learn about and experiment with different techniques to control unpleasant emotions and feelings, e.g. deep breathing, mind games, special place. ...) Homework: Try some of these ideas and see what works for you 6. Problem solving (Learn about different approaches to problem solving, such as Stop, Plan, Go. Summary and review progress)	☒ Psychoeducation ☒ Cognitive Restructuring ☒ Behavioral Activation ☐ Relaxation
8	Cool-Teens [Cunningham, et al., 2009; Wuthrich, et al., 2012]	8–12-week program 8 multimedia modules (30–60 min) + engaging homework Cool Teens is a multimedia program incorporating text, graphics, video, voiceover and graphics. Cognitive restructuring and graded exposure exercises to improve anxiety symptoms. Users also learn about goal setting and relapse prevention. After completion of each module, a clinician contacts each user to encourage continued program engagement and the application of skills to users' life. The program includes six video case studies of adolescents discussing different anxiety problems and applying relevant skills to their particular problem Module 1: Psychoeducation Module 2: Goal Setting Module 3: Cognitive Restructuring Module 4: Exposure Module 5: Cognitive Restructuring Module 6: Exposure Module 7: Coping Skills Module 8: Maintenance Content is based on the Cool Kids anxiety program that delivers these same cognitive behavioral skills through 10-week therapist-guided group therapy	☒ Psychoeducation ☒ Cognitive Restructuring ☒ Behavioral Activation ☐ Relaxation

Table 6 (continued)

P#	Program [References]	Content	CBT elements
9	Pesky gNATs [Chapman, et al., 2016; Coyle, et al., 2011]	Pesky gNATs is a seven-level 3-D computer game for Mac or PC that provides a psychometric assessment of symptoms, supports CBT intervention, and coaches mindfulness and self-regulation skills for young people aged 9–12 years with anxiety or low mood. Pesky gNATs assists therapy with 3 pieces of technology: 1.) Website (www.peskygnats.com) providing therapists with online training and a possibility of downloading the game 2.) computer game for therapists to use in face-to-face sessions with young people, so the game is played by a young person alongside their therapist during the course of their regular therapy session. It's a 3-D World called gNATs Island, where the player meets a team of wild-life explorers. Each member of the team introduces a single CBT concept, illustrated through conversation, embedded animations, videos, and questions using examples from a young person called Shona who has also experienced difficulties with anxiety and low mood and played the game before. While playing the game a young person first meets a character called 'David gNATenborough', a wildlife documentary filmmaker who thinks gNATs are such extraordinary creatures that he set up the world's first gNAT laboratory on a distant tropical island in order to study them. The young person then progressively learns how to trap and swat gNATs (observe and challenge negative thoughts) and hunt them back to their homes for some hive splatting (identifying and challenging negative core beliefs) as they work with David and his team of assistants while exploring gNATs Island. Each level of the game also presents the young person with the opportunity to learn a relaxation, mindfulness or activity scheduling skill, designed for young people aged 9–12 years. 7 levels [Chapman et al., 2016], each designed to be the equivalent of a standard treatment session and supports a single component of an appropriate CBT intervention. [6] Levels in Coyle et al., 2011] Level 1: Thoughts feelings & behavior: Session concept: Thinking-Feeling-Behavior (TFB) go together. Young person with assistance from a therapist creates a positive and a negative TFB from the last 24 h. Level 2: Cognitive monitoring: Session concept: Some thoughts are unhelpfully negative and we usually do not notice them. Negative Automatic Thoughts (NATs) animated as gNATs or little flies and the young person reviews six different types (species) of gNATs and learns how to record them using a gNAT trap. The young person reviews their negative TFB to see if it contains a gNAT. Between-session tasks to trap some gNATs focusing on times of anxiety or low mood Level 3: Cognitive monitoring: Session concept: Young person is introduced to five more common species of gNAT. They review their gNAT trapping t-date. Young person responds to their gNATs with some PATs (positive automatic thoughts). Between-session task to trap some more gNATs focusing on times of anxiety or low mood Level 4: Cognitive restructuring: Session concept: Introduction of cognitive restructuring presented as gNAT swatting. Young person applies four gNAT swatting questions to: (i) consider evidence for and against their thoughts, (ii) to consider alternative ways of looking at things, (iii) to brainstorm alternative plans for similar situations and (iv) to pick and test a new plan. Between-session task to trap and swat gNATs focusing on times of anxiety or low mood Level 5: Negative core belief identification: Session concept: Introduction of negative core beliefs and review of common examples. Young person gathers up all of the gNATs they trapped so far and hunts them back to a suitable hive (core belief). Between-session task to hunt gNATs back to a hive Level 6: Negative core belief re-appraisal: Session concept: Socratic questioning of identified core belief. Young person considers evidence for and against their core belief in the areas of self, family, school, friendships and other. Young person decides whether core belief is true or not (hive splatting) and builds a positive belief called a 'Bee Unself Hive'. Continued as a between-session task Level 7: Relaxation prevention: Session concept: Relaxation prevention. The young person identifies signs of relaxation and plans their response. The young person also develops a healthy life plan setting positive goals in the areas of: 1. Fun, 2. Personal Goals, 3. Having a Purpose, 4. Emotional and Physical Health, 5. Being Me, 6. Having People in My Life - Negative Automatic Thoughts are presented as little creatures called gNATs that can sting people - Cognitive monitoring becomes gNAT trapping - cognitive restructuring becomes gNAT swatting - core beliefs are discovered through hunting gNATs back to their hives - relapse prevention takes place at a future-world cinema Relaxation, mindfulness & activity scheduling content: Awareness of your body 1. Paced breathing: A self-regulatory breathing exercise. The players try different paces for breathing-in, holding their breath, and breathing out. They reflect on their physical experience of pacing their breathing and changing their breathing. Aims to increase awareness of your breathing and physical self-regulation 2. Relaxation: A progressive muscle relaxation exercise. The players work their way around their body tensing and releasing muscles noting what they experience as they do so. They also engage in some relaxation visualization. The aim of this skill is also self-regulation and anxiety/stress relief 3. Body Scan: A mindfulness exercise. The players deliberately and progressively move their attention from the tips of their toes to the top of their head. The aim is to increase physical awareness Awareness of your mind 4. Leaves on a stream: A mindfulness exercise. The players imagine they are sitting on the bank of a stream watching leaves flow past. They begin to notice their own thoughts and imagine placing each thought on a leaf on a stream and allow it to flow on and wait to observe the next thought that comes along. The aim is to notice and refocus shifting attention, increase awareness of thoughts and the awareness that they are passing events 5. What's on your mind: A mindfulness exercise. This skill builds on awareness of thoughts and their passing nature, introduced as leaves on a stream. The players watch a visual display that lists thoughts, imaginations, judgments, memories, feelings, and other things. As they notice one of these things on their mind they acknowledge their awareness of it and allow it to pass. The aim is to notice and refocus shifting attention, to increase awareness of the content of your mind and its transitory nature Awareness of your world 6. Mindfulness of sounds: A mindfulness exercise. The players listen to the sounds they can hear for one minute. They are invited to notice the difference between the sound they hear and the label/judgment our mind makes of that sound. For example, notice that one hears the sound 'tweet-tweet' rather than reporting the label offered by the mind (birdsong). The aim is to increase awareness of the world, to notice and refocus shifting attention, and to observe non-judgmentally 7. Visual illusion: A cognitive perspective exercise. The player views a single image that some people see as the head of a native American warrior while others see it as the full body of a person who lives in the Arctic. The aim of the exercise is to become aware that how we see something depends on how we observe it and different people can observe different things while looking at exactly the same picture 8. Mindfulness of an object: A mindfulness exercise. The players use all of their physical senses to observe an everyday or familiar item. The aim is to pause and observe in detail something we usually do not take time to pay attention to Activity scheduling 9. Activity scheduling: An activity scheduling exercise. The player plans activities for the week ahead, reviews their completion and rates each activity in terms of self-mastery and pleasurable 3.) Mobile-app for young people to use between sessions online training for professionals who would like to use Pesky gNATs - weekly CBT tasks, mindfulness and relaxation skills, a gNAT gallery, three gNAT-related mini-games, that are unlocked when the young person completes between-session tasks	☑ Psychoeducation ☑ Cognitive Restructuring ☑ Behavioral Activation ☑ Relaxation

Table 6 (continued)

P#	Program [References]	Content	CBT elements
10	The Journey [Stasiak, et al., 2014]	Fantasy game-like environment (user selects and names avatar, follows narrative of a quest through magical lands where the content is linked to a theme (e.g. cognitive restructuring techniques are progressively covered in SKY and STAR CITIES). Players earn points for completing modules and are rewarded with a simple mini-game at the end of each module. 7 Modules, each with different topic (each 25–30 min.) - Beginning with a mood monitor, followed by a quiz to recap the messages of the previous module, agenda setting and a number of interactive exercises, animations and illustrative video clips. Modules end with a summary of content and a challenge (homework) setting. + Guidebook with a summary of each module and a space for the young person to write down her/his goals, answer questions and complete weekly challenges (e.g. through diary) Module 1: Introduction to CBT model: linking thoughts and actions to feelings Module 2: Behavioral activation and pleasant activity scheduling Module 3: Problem solving and conflict resolution Module 4: Cognitive restructuring: identifying unhelpful thoughts Module 5: Cognitive restructuring: challenging unhelpful thoughts Module 6: Cognitive restructuring: thought stopping, Relaxation techniques Module 7: Summary and relapse prevention; knowing how/when to reach for help	☒ Psychoeducation ☒ Cognitive restructuring ☒ Behavioral Activation ☒ Relaxation
11	ACT-CL [Levin, et al., 2014]	3-week program, 2 core multimedia sessions and supplementary emails, web-based resources, text messages to further strengthen and generalize program content Session 1: Exploring your values: Defining values (e.g. values as a direction animation, quiz), clarifying personal values (e.g. via card sorting), reflecting on values (e.g. via journaling, writing a headline exercise), defining effective and value-based goals (e.g. via reading about SMART and BRAVE goals, quiz), goal setting (e.g. setting a values-based goal for the week, worksheet), wrap up (e.g. entailing further content, FAQ, other media, summary of session) <i>Postsession 1 texts:</i> Reflect on actions consistent with values (day 3 text), reflect on important values and a goal for the day (day 6 text) <i>Postsession 1 e-mails:</i> Reminders to work on session 1 goal and to practice reflecting on values you admire in others (day 2 e-mail) or on values experienced that day (day 4 e-mail) <i>Postsession 1 mindfulness resources:</i> Intro and definition of mindfulness, mindful breathing exercise, instructions to practice mindful breathing Session 2: Dealing with barriers: Review of session 1 (e.g. session review animations, homework check-in), Exploring internal barriers—thoughts, feelings, urges—to value based actions (e.g. values bulls eye exercise, internal barriers checklist), problems with control strategies (e.g. passengers on the bus animation, pain vs. suffering exercise), defining and practicing willingness (e.g. and vs. but exercise, leaning in animation, quiz, breath holding to practice willingness), linking willingness to value-based actions (e.g. exploring reasons for choosing willingness, setting a goal related to willingness), wrap up (e.g. entailing further content, FAQ, other media, lesson summary) <i>Postsession 2 texts:</i> Prompts to practice willingness (day 3 and day 6 texts) <i>Postsession 2 e-mails:</i> Reminders to work on session 2 goal and to practice the NAME acceptance technique (day 2 e-mail) or future ways to practice ACT skills (day 4 e-mail) <i>Postsession 2 mindfulness resources:</i> Mindfulness of internal experiences, labeling mindfulness exercise, resources for practicing other exercises (leaves on a stream, tin can monster)	☒ Psychoeducation ☐ Cognitive Restructuring ☐ Behavioral Activation ☒ Relaxation
12	Bite Back [Burckhardt, et al., 2015; Mani-cavasgar, et al., 2014]	The program consists of a range of interactive activities, including making gratitude entries, mindfulness meditations, describing personal stories, and a mindfulness exercise involving taking photos. Online interactive exercises are designed to encourage generalization of online activities to the real world, so that young people benefit from implementing the central tenets of positive psychology into their daily lives. Also included on the site is information about nine positive psychology domains and ways to engage with them outside of the website. These domains are: Gratitude, Optimism, Flow, Meaning, Hope, Mindfulness, Character Strengths, Healthy Lifestyle, and Positive Relationships. Furthermore, the website provides information about the benefits of increasing well-being, methods for developing skills in each of the positive psychology domains, links to other relevant resources, and allows for comments and online discussions. Users are able to comment on activities (such as submitted photos or stories by other users) using their anonymous profile, thereby enabling participation without fear of stigma or judgment. Interactive learning activities (8) Mental fitness challenge = structured journey Information and resources (12 mental health topics) Quizzes to check on wellbeing across a range of topics (track progress & improvement) SWEMWBS = by registration—complete again six weeks after registration—questionnaire is also available within the program any time Referral to other resources "Dealing with the tough stuff" Reminders: users select to receive notifications Supporting resources for teachers and youth educators Mental Fitness Challenge Student Workbook (print) for free https://www.biteback.org.au/Resources/BITE%20BACK%20Youth%20Educator%20Handbook%20-%20Print%20version.pdf [19.06.2023] Youth Educator Handbook for free: https://www.biteback.org.au/Resources/BITE%20BACK%20Student%20Workbook%20-%20Print%20version.pdf [19.06.2023]	☒ Psychoeducation ☐ Cognitive Restructuring ☒ Behavioral Activation ☒ Relaxation

Table 6 (continued)

P#	Program [References]	Content	CBT elements
13	Blogging Intervention [Boniel-Nissim, & Barak, 2013]	Blog/Weblog Personal writing and interpersonal contacts Duration: 10 weeks; at least 2 posts per week; each post: 200–800 words, Content: about thoughts and feelings concerning social circumstances and interpersonal relationships Activity: post messages according to their respective group conditions (4 writing groups) over the course of 10 weeks. The blogs were publicly opened for reading and managed under nicknames in a dedicated blog portal carried over 100,000 personal blogs. Posts were read and responded to (where responses were enabled) by any readers as they wished, reflecting regular and typical experiences in the blogosphere. To further reflect normal blogging experience for participants, it was up to them to share (or not to share) with others about their blogs as long as their personal identity was not revealed.	☐ Psychoeducation ☐ Cognitive Restructuring ☐ Behavioral Activation ☐ Relaxation
14	Blues Blaster [Makrushka, 2011]	6 modules with 5 mini-sessions each (Total: 30 sessions) Daily delivery Modules: - defining depression - mood monitoring - increasing fun activities - increasing positive thinking - recognizing negative thinking - decreasing negative thinking Each session: - a video to introduce the lesson goal along with a graphic illustration of the goal - a flash animation activity to teach the lesson's teaching points - a flash animation activity to reinforce the lesson's teaching points - a comic strip depicting characters role playing the key concept presented in lesson - a video testimonial concerning the topic - the lesson's "key" or summary statement - quiz questions on the lesson's content - a summary video providing positive reinforcement and encouragement	☒ Psychoeducation ☒ Cognitive Restructuring ☒ Behavioral Activation ☒ Relaxation
15	Ching Ching Story [Li et al., 2013]	Role playing game in which the player assumes the role of character (Ching Ching) and moves around different areas of the game to complete all missions by talking to nonplayer characters, exploring different places and objects, and playing various minigames teaching instrumental skills. Program was adopted from a school-based mental health enhancement program (Wong et al. 2012) Duration of intervention: 3 weeks "Ching Ching Story" consisted of 10 topics: (1) identifying stressors and how to handle stress, (2) understanding the relationship between stress and coping, and the consequence of depression, (3) understanding what goal-directed thinking is, (4) affirming existing strengths and acknowledging the concept of "self", (5) cognitive restructuring, (6) advanced cognitive restructuring, (7) understanding others' feelings, (8) communication skills, (9) conflict resolution based on a problem-solving approach, and (10) anger management	☒ Psychoeducation ☒ Cognitive Restructuring ☒ Behavioral Activation ☒ Relaxation

Table 6 (continued)

P#	Program [References]	Content	CBT elements
16	Climate Schools [Vliet & Andrews, 2009]	The program content is presented in an online cartoon format. 6 lessons The course was presented as a cartoon narrative that followed the adventures of two characters called Mia and Ben. Students were exposed to examples of stressful events in the lives of both characters and saw both trying to cope using a number of different strategies. Buddy, the tutor, and his assistants, were deliberately drawn to look like aliens to avoid gender or ethnic stereotyping. The narrative unfolded across six lessons that each ran for approximately 30 min. Each lesson included a revision of the previous lesson (pre-testing in lesson 1) and new content activities. Related classroom learning activities were provided to reinforce the knowledge and skills taught on the computer. The first lesson contained information about how to define stress, the common causes of stress, the negative and positive effects of stress and factors that protect against the negative effects of stress. This lesson delivered the message that it is possible for people to learn how to manage stress more effectively. Lesson 2 introduced the concept of coping. Helpful and unhelpful coping strategies were presented. Avoidance of stressful places, people or things was explored as an example of an unhelpful coping strategy. Helpful coping strategies included talking about problems with a trustworthy person, problem solving, challenging unhelpful thoughts and managing time effectively. Lesson 3 explored how particular styles of thinking influence stress levels and taught the process of thought challenging. Lesson 4 taught the skill of structured problem solving as well as the skills needed to analyze and achieve a goal by breaking it down into smaller, more manageable steps. Lesson 5 presented ways to restore and maintain calm, including progressive muscle relaxation and breathing exercises. Lesson 6 taught the benefits of daily planning and gave information about seeking help. This final lesson also explored the connection between mental well-being and lifestyle factors such as regular exercise, spending time with friends, getting enough rest and making time for fun activities.	☒ Psychoeducation ☐ Cognitive Restructuring ☐ Behavioral Activation ☒ Relaxation
17	Cognitive Behavioral Analysis (ePREP) [Braithwaite & Firtham, 2007]	This study evaluated the efficacy of a computer-based, relationship-focused, preventive intervention (ePREP) in comparison to a depression- and anxiety-focused computer-based preventive intervention (CBASP) and a control group. ePREP is based on PREP—Prevention and Relationship Enhancement Program (Markman, Stanley & Blumberg, 2001) Main Focus: Skills training in effective communication techniques and problem-solving skills; Enhancing positive aspects of romantic relationships 7 Sections: 1. Improving Your Relationship: Explains why it is worth investing time and effort in improving one's romantic relationship, introduces static and dynamic risk factors for relationship distress, communication danger signs, and the Time Out Ground Rule (including when/how to use) 2. Filters: Explains the concept of filters, how these can impair good communication and how to effectively deal with these filters when they arise 3. Communication: Teaches XYZ Communication and the Speaker-Listener Technique 4. Issues and Events: Describes the issues and events model and how to use the ground rules and skills taught in ePREP to effectively deal with issues and events as they arise 5. Problem Solving: Teaches an effective method for problem solving that separates problem discussion (using the Speaker-Listener Technique) and problem solving (which needs to occur after problem discussion) 6. Fun, Friendship and The Foundation of a Good Relationship: Explains sliding versus deciding, key considerations in mate selection, gender differences in patterns of commitment, and a specific method for enhancing fun and friendship in romantic relationships 7. Ground Rules: Reviews content and describes specific ways that the skills and ground-rules taught in the intervention can be optimally employed (e.g. having regular meetings)	☒ Psychoeducation ☐ Cognitive Restructuring ☒ Behavioral Activation ☐ Relaxation
18	Cognitive Behavioral Skills Training Program [Clarke, et al., 2009]	The program is a pure self-help site which provides self-guided, interactive behavioral and cognitive therapy tutorials to help users overcome depression The website consisted of 4 main sections: 1. Measure Your Mood: permits users to complete a brief, auto-scored depression scale and review their depression scores over time. 2. Facts about Depression: offers general information pages about depression (symptoms, causes, treatments) and associated mental and emotional problems 3. Journal: permits users to record their thoughts and concerns in a private online journal/diary. Users can electively publish journal entries for viewing by other website users, subject to review by research staff for inappropriate content. 4. Improve Your Mood: provides brief, interactive tutorials in cognitive restructuring and behavioral therapy methods (users can choose one or both tutorials) 4.1 Behavioral therapy tutorial: personalized feedback that simulates how behavioral therapy for depression is delivered in conventional, face-to-face sessions. E.g., a website tutorial guides users through identification of 8–12 pleasant activities that matter most to their mood. The website then assists with creating a personalized self-contract to make small but consistent increases in the frequency of these activities. Users are prompted to return to the website every few days to record total daily activities and a daily mood rating (7-point Likert-Scale) for each intervening day. Website algorithms process these tracking data to generate personalized feedback regarding the association (or lack of) between each user's daily mood and his or her pleasant activity level. 4.2 The Thought Helper function is a representative element of the cognitive restructuring (CR) module. After a tutorial on the basics of CR, a user can type a personal negative or irrational thought into a text search box. The program searches a predefined list of more than 300 common negative thoughts and displays the best matches with the negative thought submitted by the user. Each user selects the negative thought closest to the original, and the program then returns a list of several possible realistic counter-thoughts relevant to that belief. Users are encouraged to create a personalized counter-thought using relevant portions of the provided examples and enter it into the website for storage. Later, a user can retrieve these personal counter-thoughts, unrealistic beliefs and activating situations.	☒ Psychoeducation ☒ Cognitive Restructuring ☒ Behavioral Activation ☐ Relaxation

Table 6 (continued)

P#	Program [References]	Content	CBT elements
19	COPE [Melnyk, et al., 2015]	Creating Opportunities for Personal Empowerment—COPE 7 sessions (approx. 30 min. per session) based on the key components of CBT (e.g. self-monitoring, cognitive restructuring, communication training, problem solving, behavior activation, emotional regulation). Throughout the program, the thinking-feeling-behaving triangle is emphasized along with the ABC's (Activator event, Belief that follows, and Consequence of the beliefs). Students are taught how to turn negative beliefs triggered by an activating event into positive beliefs in order to feel emotionally better and behave in healthy ways 1. Introduction & Thinking, feeling, and behaving: What is the connection? 2. Introduction to COPE program and discussion of the thinking-feeling-behaving triangle; the ABC's, how to engage in positive self-talk, and the concept of "staying in the moment" 3. Self-esteem and positive thinking/self-talk 4. Presentation of healthy vs. unhealthy self-esteem and how to work on enhancing self-esteem; additional information on positive thinking and positive self-talk, as well as on the behavior change process information and skill building on how to reduce stress and engage in healthy coping, including how stress affects people and positive ways to deal with stress; overview of signs and symptoms of anxiety and depression 5. Problem-solving and setting goals 6. emphasizing goal setting, four steps used in problem solving, how to overcome barriers in achieving one's goals 7. Dealing with emotions in healthy ways through positive thinking and effective communication 8. How to deal with emotions in healthy ways, think positively and use effective communications; information on mental and guided imaginary and how to practice it 9. Coping with stressful situations 10. Review of ABC's and explanation of the best ways to cope with stressful situations 11. Pulling it all together for a healthier 12. Review and summary of the COPE program content 13. Weekly skill-building homework assignments and goal-setting logs were an important and required part of the program. 14. After completing the baseline assessment, students in each group had the opportunity to review personalized feedback (PF), which included a brief summary of reported emotional distress and alcohol use, and their impact on functioning. 15. Graphics displayed how each student's scores compared with college students in general. Students in the control group completed the screening survey and received feedback. Although information was provided to both groups on all online pages regarding mental health resources (with contact information), students in the control group did not have the option of making contact with the study team (online counseling or otherwise) related to their feedback or mental health resources. This condition was modeled after the online screening and feedback surveys that are relatively common on university websites. For students in the eBridge condition, the PF was provided in keeping with motivational interview (MI) principles: (1) students could choose which, if any, feedback domain they wanted to view; (2) PF statements were in MI-consistent language; and (3) students had an option of linking directly with the eBridge counselor 16. These students could click on any of three topics to start a confidential online exchange with the counselor (who had no information about student identities). These were: "More about my concerns or my survey feedback"; "More about available resources"; or "Other". In addition, they had an opportunity to initiate a real-time chat session with the eBridge counselor during specified hours, which corresponded to peak student usage times observed in feasibility trials. Outside of these hours, they had an opportunity to send a private message to the counselor via a "dialogue page," a private and secure page where students could initiate and respond to counselor communications in a synchronized manner as well as view transcripts of their chat sessions. Counselors had access to students' personalized feedback and responded to student messages within 24 h. Counselors used MI-consistent language (e.g., asking permission, affirming statements, statements supporting choice and autonomy), and had access to MI metrics for students to consider and scale their readiness for change and help seeking. In addition, counselors used the "dialogue page" to initiate communication with students who had not originally elected to communicate or with students who became inactive; up to three messages were sent to encourage student involvement. eBridge counselors were master's level mental health professionals who participated in MI training provided by a member of the Motivational Interviewing Network of Trainers in addition to multiple mock eBridge counseling sessions. Additional opportunities to enhance skills were provided in supervision sessions where online transcripts were reviewed.	☒ Psychoeducation ☒ Cognitive Restructuring ☒ Behavioral Activation ☐ Relaxation
20	eBridge [King, et al., 2015]	8 online sessions (15 Min. per session) The EmoWM training utilized an adapted version of the chessboard task developed by Davis et al. (2012). This task involved manipulating visual information in working memory (WM) while incorporating an emotional component in the form of negative emotional faces (fearful, sad, or angry) as distractors. The training consisted of a relatively small number of sessions (eight) compared to previous WM training studies conducted in a neutral context. In the task, participants were presented with a fixation cross followed by a 4x4 matrix of green and blue squares arranged like a chessboard. Squares within the matrix would light up in a specific sequence, and participants had to reproduce this sequence by clicking on the squares in the correct order, first the green squares and then the blue squares. To ensure WM manipulation, at least one blue square appeared before the final green square. Within this task, a negative emotional face (selected from the NIMH Child Emotional Faces Picture Set) was randomly presented on one of the lit squares and had to be excluded during reproduction. The training started with four practice trials, followed by three training blocks consisting of 12 trials each in the active condition. The sequence length in the active condition depended on the participant's performance, with a minimum of three squares (including the emotional face stimulus). The sequence length increased or decreased by one square after two consecutive correct or incorrect trials, respectively. In the placebo condition, the task was nonadaptive, and all trials presented three squares (including the emotional face stimulus). Feedback was provided after each trial, including information on changes in sequence length for the active condition. A progress bar indicated the remaining number of trials, and participants received feedback on earned points based on their performance. Each training session lasted approximately 15 min.	☐ Psychoeducation ☐ Cognitive Restructuring ☐ Behavioral Activation ☐ Relaxation

Table 6 (continued)

P#	Program [References]	Content	CBT elements
22	EpxDepression [Chen et al., 2017]	EpxDepression prompts the patient or caregiver for subjective mood and sleep ratings on a 10-point rating scale every day and sends a text-based modified PHQ-9 every 2 weeks or month, depending on the provider's assessment of the patient. While the modified PHQ-9 is administered through a text message platform as opposed to in person, its scoring function was adapted to give an equivalent score to the original PHQ-9. Depending on the patient's mood, PHQ-9 score, and self-harm ideation (a positive response on the last question of the PHQ-9), the patient is triaged into a red-yellow-green hierarchy. Patients who are scored as high-risk (red) are automatically reported to the care team. Importantly, patients who report self-harm behavior are automatically directed to a suicide help-line, crisis manager, or entrusted caregiver.	☐ Psychoeducation ☐ Cognitive Restructuring ☐ Behavioral Activation ☐ Relaxation ☒ Psychoeducation ☐ Cognitive Restructuring ☒ Behavioral Activation ☐ Relaxation
23	eSMART-MH [Pinto et al., 2015]	"Electronic Self-Management Resource Training for Mental Health (eSMART-MH)." eSMART-MH is a digital therapeutic that utilizes an avatar-based serious gaming platform to create an immersive digital environment for young adults. It allows them to practice effective communication with virtual healthcare providers concerning their depression symptoms. In this virtual setting, young adults navigate through a virtual healthcare provider's office and interact with three-dimensional avatar healthcare staff, including receptionists, medical assistants, and healthcare providers. A virtual coach provides personalized feedback to support the young adult during the communication process with the healthcare team. The coach helps build the user's confidence in engaging with healthcare providers by offering guidance, such as prompting them to share their concerns with the provider. The communication strategy used in eSMART-MH is SBAR3, which is a cognitive behavioral-structured approach developed to enhance communication between participants and healthcare providers. By incorporating SBAR3 into the virtual environment, eSMART-MH enables young adults to practice effective communication and prepare for an office visit. Participants learned how to • "Share their story" (S) with the healthcare provider (listen to the patient's story so the healthcare provider can better understand the patient), • "bring their background" (B) (keep a record or diary of important information like a mood or sleep) to the virtual office visit, • "Ask the provider for what they need" (A), • "Review" the recommendations that include a treatment plan (R1), • ask themselves if the plan is "Right" for them (R2), and then • "Repeat" the treatment plan (R3) to the avatar healthcare provider (Clochesy et al., in press) 4 sessions (15–20 Min. length)	☐ Psychoeducation ☐ Cognitive Restructuring ☒ Behavioral Activation ☐ Relaxation
24	Young People FACE-IT [Williamson et al., 2019]	Young People Face It (YPFI) was developed by the Centre for Appearance Research, is owned by the University of the West of England, and is hosted by Dataphiles plc (www.dataphiles.co.uk). It is a web-based seven session self-help program plus booster quiz (Session 8), utilizing cognitive behavioral and social skills training for young people (YP) Access via health professional who determines its suitability and remotely monitors clients' usage Session 1: Common problems • 45 Min. session concentrating on some of the common difficulties experienced by young people with visible differences and issues surrounding an altered appearance Session 2: Improve your social skills • 45 Min. session introducing positive body language and talking skills. Illustrates the benefit of good social skills using social scenarios that young people typically experience Session 3: Don't be scared to reach out • 1-h session using the SCARED model to identify why social interactions can sometimes be difficult and how to employ the REACH OUT social skills toolbox to counteract these difficulties. It includes a social skills video to illustrate how young people can manage common challenging situations Session 4: Think, feel, do • 1-h session introducing the link between thoughts, feelings and actions, the common misconceptions young people with visible differences have about the thoughts and actions of others and tips on how to think more positively. Illustrates the benefit of positive thinking using social scenarios young people typically experience Session 5: Smart goals • 45 Min. session outlining the importance of realistic and achievable goal setting to overcome social anxiety and to combat self-imposed limitations. Examples of goal setting and testimonials from positive role models are used to illustrate achievements by individuals with a visible difference. Option to explore romantic relationship issues and use goal setting to overcome romantic concerns Session 6: Beating anxiety • 1-h session providing information about anxiety and techniques to overcome social anxiety, including facing one's fear and remaining in a frightening situation. Young people are introduced to exposure therapy using the fear ladder process Session 7: Looking at your progress • 45 min session which summarizes everything the young person was taught throughout the previous 6 sessions Session 8: YP Face it-Quiz • 40 min quiz focusing on the key learning points of the course. Facility to identify and revisit areas that the young person is struggling with or wishes to revise More detailed information here: https://www.yplacett.co.uk/health-professionals/Health-Professionals-4.aspx#1 [26.04.2023]	☒ Psychoeducation ☒ Cognitive Restructuring ☒ Behavioral Activation ☒ Relaxation

Table 6 (continued)

P#	Program [References]	Content	CBT elements
25	Grasp the Opportunity [Ip, 2016]	Grasping the Opportunity is a Chinese Internet intervention, which was translated and modified from CATCH-IT (Program #2) developed in the West 10 Modules - improve negative cognition - reduce negative behaviors - strengthen resilience - reinforce positive behaviors examples in the form of stories were used to illustrate relevant concepts in the modules	☐ Psychoeducation ☒ Cognitive Restructuring ☒ Behavioral Activation ☒ Relaxation
26	Headspace [Flett, et al., 2020]	Headspace is a mindfulness meditation application that provides guided and unguided mindfulness meditations. Meditation training is provided by Andy Puddicombe, a novice monk in the Theravada Tradition and fully ordained Tibetan Buddhist monk in the Karma Kagyu Lineage (Puddicombe, n.d.). Headspace uses a variety of formal meditation practices to build mindfulness including • mindful breathing (using the breath as an attentional object of intense focus), • body scan (systematically focusing on certain parts of the body), • sitting meditation, • practice of non-judgment of thoughts and emotions, • and other guided meditations that vary - o orientation (inward vs. outward vs. no orientation), - o spatial focus (fixed vs. moving), - o and aperture of attention (narrow vs. diffuse) Headspace is available as an iOS, Android, and web app. The length of meditations vary, however (in validation study), participants completed a 10 min per day 10-day introduction to mindfulness (usually available free of charge), before accessing other meditation training in the app (usually available following purchase; meditations used here ranging from 1 to 20 min). Access to the participants' objective Headspace app use data was provided by Headspace (Memorandum of Understanding available on request) • encouraged daily use (up to 20 min) over 3 months to practice mindfulness skills • Duration: 12 weeks—1 session per day Sessions/Modules: • Home screen: The home screen provides quick access to the different sections of the app, including meditation exercises, courses, and individual exercises. Users can also track their progress and statistics here • Basics: This section provides step-by-step instructions for the basics of meditation and mindfulness. Users can choose from several courses, each consisting of multiple sessions • Courses: Headspace offers several courses for specific topics such as stress management, sleep, anxiety, and depression. Each course consists of multiple sessions and is led by experienced meditation teachers • Individual Exercises: Users can choose from a variety of individual exercises that focus on specific topics such as relaxation, stress reduction, and concentration • Sleep: This section offers a collection of sleep meditations and stories designed to help users fall asleep • SOS: In this section, users will find quick exercises and meditations that can help them deal with acute, stressful situations and anxiety • Headspace for Kids: Headspace also offers a special section for kids that provides age-appropriate meditations and exercises • My Page: Here users can track their progress and statistics, save their favorite exercises and courses, and customize their settings "In One Voice" is a social media campaign to improve awareness and attitudes of youth towards mental health issues with the primary aim to increase awareness and use of a mental health website (mindcheck.ca) aimed at youth, and the secondary aim to improve attitudes towards mental health issues. It was a campaign featuring a prominent male sports figure. It is a brief social media intervention with an emphasis on public education which was developed as part of a multi-component, multi-year strategy to address mental health literacy among youth and young adults in British Columbia (BC), Canada. The campaign was launched 24 Jan, 2012 and ended 19 March, 2012. In One Voice involved the Vancouver Canucks, a Canadian male professional hockey team, and was developed in collaboration with local health authorities and charities. The campaign included a 2-min public service announcement featuring a popular Canucks' hockey player speaking about his teammate, discussing mental health issues, and promoting mindcheck.ca. Those who viewed the video were also encouraged to publicly pledge their support of friends and family members who live with mental health issues by creating and submitting an online video to mindcheck.ca website. Visitors to the website had access to mental health screening tools and educational materials tailored towards youth and young adults, as well as an online platform to submit and view video pledges	☒ Psychoeducation ☐ Cognitive Restructuring ☐ Behavioral Activation ☐ Relaxation
27	In One Voice [Livingston et al., 2013]	"In One Voice" is a social media campaign to improve awareness and attitudes of youth towards mental health issues with the primary aim to increase awareness and use of a mental health website (mindcheck.ca) aimed at youth, and the secondary aim to improve attitudes towards mental health issues. It was a campaign featuring a prominent male sports figure. It is a brief social media intervention with an emphasis on public education which was developed as part of a multi-component, multi-year strategy to address mental health literacy among youth and young adults in British Columbia (BC), Canada. The campaign was launched 24 Jan, 2012 and ended 19 March, 2012. In One Voice involved the Vancouver Canucks, a Canadian male professional hockey team, and was developed in collaboration with local health authorities and charities. The campaign included a 2-min public service announcement featuring a popular Canucks' hockey player speaking about his teammate, discussing mental health issues, and promoting mindcheck.ca. Those who viewed the video were also encouraged to publicly pledge their support of friends and family members who live with mental health issues by creating and submitting an online video to mindcheck.ca website. Visitors to the website had access to mental health screening tools and educational materials tailored towards youth and young adults, as well as an online platform to submit and view video pledges	☒ Psychoeducation ☐ Cognitive Restructuring ☐ Behavioral Activation ☐ Relaxation

Table 6 (continued)

P#	Program [References]	Content	CBT elements
28	Internet-Problem-Solving Therapy [Hoek et al., 2012]	Preventive internet-based (guided) self-help problem-solving therapy (PST) Every week an automated email was sent to participants to explain content and exercises for the coming week Mental health care professionals and authors offered feedback on completed exercises (not therapeutic) 3 Steps: 1. Respondents described what really mattered to them 2. They wrote down their current worries and problems and divided these problems into three categories: a) unimportant problem b) solvable problem c) problems which cannot be solved. For each of these three types of problems a different strategy was proposed to solve the problems or learn to cope with the unimportant and unsolvable ones. This step is the most important element of PST. For the solvable problem the following six-step-procedure was proposed: 2.1. Write a clear definition of the problem 2.2. Generate multiple solutions to the problem 2.3. Select the best solution 2.4. Work out a systematic plan for this solution 2.5. Carry out the solution 2.6. Evaluate as to whether the solution has resolved the problem 3. During the third and last step, the respondents made a plan for the future in which they described how they would try to accomplish those things that matter most to them. The course took 5 weeks and consisted of one lesson a week	☐ Psychoeducation ☐ Cognitive Restructuring ☐ Behavioral Activation ☐ Relaxation
29	Kindertelefon Online Chat [Fukink et al., 2009]	The Kindertelefon follows a conversation model for chat and telephone support consisting of five defined phases, namely: 1. establishing contact, 2. clarifying the child's story, 3. determining the goal of the conversation, 4. developing the goal of the conversation, and 5. closing the conversation. Important themes in the methodology include offering support, providing solutions, taking the child seriously, putting the child at ease, using language that children can understand, and encouraging the child to think along with the volunteer about possible solutions. Basic training of 40 h is followed by 15 h of personal supervision by a professional coach, participation in peer-coaching groups, and supplementary training sessions related to specific topics (e.g., sexual abuse). The training protocol for chat volunteers also focuses on competences that are related to chatting, such as communicating effectively using reading and writing skills in a chat environment. Chat: approx. 30 Min per Chat-Session	☐ Psychoeducation ☐ Cognitive Restructuring ☐ Behavioral Activation ☐ Relaxation
30	LEAP Project [Rickhi et al., 2015]	8-week online program Participants are guided through an exploration of spiritually informed principles (e.g. forgiveness, gratitude, compassion) The content is presented by a professional host who introduces and guides participants through the program materials. The host is an award-winning writer, performer and producer. She was selected based on her ability to openly relate her own experience with clinical depression to the program content, her contribution to script writing, and overall passion for the project/program. Module 1: Self-Acceptance (Breaking Through: Uncovering the REAL You) Offers new ways to deal with negative thoughts and provides tools to help participants see themselves as they are Module 2: Appreciation of Beauty and Creativity (Enjoying Again: Reconnecting with Life) Explores ways to ease the feelings associated with depression, such as isolation and loneliness Module 3: Mystery of Life (Coming Alive: Discovering Your Purpose) Moves participants away from feelings of emptiness and boredom by showing them ways to connect with their passions Module 4: Gratitude (Shifting Gears: Finding the Positive Spin) Shows participants how to stop the downward spiral of "ruminating though patterns" by focusing on the positives Module 5: Compassion and Giving (Reaching Out: Making a Difference) Teaches participants how to handle the amplified feelings of helplessness and powerlessness that overwhelm them when they are depressed Module 6: Acceptance (Moving On: Responding to Setbacks) Provides participant with tools to deal with the inevitable challenges that life presents, despite the best planning Module 7: Forgiveness (Breaking Free: Dealing with Past Hurts) Presents ways to help participants let go of hurt, bitterness, and guilt when either they or someone else has done something they feel is unforgivable Module 8: Celebration (Celebrating Possibilities: Moving Forward) Encourages participants to plan events to celebrate their progress and enjoy the life ahead of them Content: youth autobiographical stories, off-line activities, relaxation techniques, humorous clips and jokes, movie and book suggestion, links to resources (e.g. depression information and support)	☒ Psychoeducation ☐ Cognitive Restructuring ☐ Behavioral Activation ☒ Relaxation

Table 6 (continued)

P#	Program [References]	Content	CBT elements
31	Maya [Carasco, 2016]	Several aspects of cognitive behavioral and interpersonal psychotherapy models for depression guided the video game design. Three objectives were considered in the design of the narrative and the game interaction: (1) recognition and modification of negative cognitive bias; (2) promotion of interpersonal skills and interpersonal problem solving; (3) behavioral activation and healthy living These aspects were included in four ways: - as decisions that the player had to take as the story unfolded; - as a scoring system that tracked and provided immediate feedback cues about the three areas; - as a post-game feedback text; and, - as an information text in the <i>Mind your mind</i> section of the hosting website In overall terms, players had to navigate and make decisions to move forward in the game story. Based in part in the previous ideas, an interactive story was written; the story presented interpersonal situations that required psycho-social reasoning and that allowed the integration of theoretically relevant elements. In the following paragraph a condensed version of the story of the video game Maya is presented: Maya was an average teenager but she was feeling a little sad. During a walk in a park where she used to go, she meets Izel, a girl about her age. Izel is a vivacious girl and after a short talk, Izel invites Maya to participate in an ecological movement and to go to a protest to stop the destruction of the park. Maya realizes that the day of the protest she has an exam at her school, so she goes to talk to her teacher, who denies her permission to go. Maya must ask another teacher to intercede to obtain authorization. She goes to the protest and unexpectedly she runs into her father, a lawyer who is representing the ecological movement. Then the story shows Izel who has information that could stop the destruction of the park. Izel asks Maya if she has a camera and that if she dares to take a risk helping her. Both girls go to photograph a government bureaucrat taking a bribe from an employee of the company that wants to destroy the park to build a production site. The girls are discovered so they flee with the evidence. Later, Maya passes this on to her father and in the end, it helps him to win the case and to save the park Example Exercise/Video Game Scene: Aria is a friend of Maya [Photo of a girl is shown], who criticizes her intention of supporting the social movement to stop the destruction of the park. This scene presents two options to the player. The phrase on top reads: Aria is right, I always think dumb things, there is nothing that I can do to stop company construction. The phrase in the bottom reads: Aria is very pessimistic. I think that I can help. If everyone helped maybe the park could be saved. The bar on the top presents the progress in the game and the score for the three areas that the game explores: behavioral activation and healthy living; recognition and modification of negative cognitive bias; promotion of interpersonal skills and interpersonal problem solving.	☒ Psychoeducation ☒ Cognitive Restructuring ☒ Behavioral Activation ☐ Relaxation
32	Mayo Clinic Anxiety Coach [Whiteside et al., 2014]	Mayo Clinic Anxiety Coach is an application designed to deliver CBT for anxiety disorders, including OCD, via iOS (the operating system for the iPhone, iPad, and iPod Touch) that combines the latest research on ICT and CBT for anxiety. The content consists of three modules: (1) assessment, (2) psychoeducation, and (3) treatment (1) The assessment module measures the frequency of anxiety symptoms corresponding to the criteria listed in the Diagnostic and Statistical Manual of Mental Disorders (DSM) using a self-assessment, Likert-type scale. Patients can track their progress over time by retaking the assessment and providing daily ratings of their symptom severity (2) The second module contains psychoeducational material on the use of the application, the cognitive-behavioral (CB) conceptualization of anxiety, descriptions of each anxiety disorder, explanations of CBT, and guidance for accessing other forms of treatment (3) The central component of the application is the treatment module that guides patients through the use of exposure therapy. Patients can select premade fear hierarchies or enter their own. Patients can then track their anxiety graphically as they complete exposures The family and a therapist can review a patient's engagement in treatment through the history of exposures including time, date, hierarchy item, duration, peak, and final anxiety rating	☒ Psychoeducation ☐ Cognitive Restructuring ☒ Behavioral Activation ☐ Relaxation

Table 6 (continued)

P#	Program [References]	Content	CBT elements
33	MEMO [Whittaker et al., 2012, 2017]	This program was developed from 15 key messages derived from CBT. It was fully automated and delivered 2 messages per day for 9 weeks, with a mixture of text, video and cartoon messages and a mobile website, delivery modalities were guided by social cognitive theory and marketing principles Key CBT-based messages that formed the basis of the MEMO intervention: 1. Your feelings are a result of what you think and what you do 2. You can take control of this 3. Being busy increases happiness generally 4. Do fun stuff 5. Don't procrastinate 6. Relaxation makes you feel good 7. Being with people you like makes you feel good 8. Fighting with people makes you feel bad 9. Sometimes you need to ask for help 10. Noticing only weaknesses and failures makes you feel bad 11. It's not what happens; it's what you think about it that affects feelings 12. We can choose to look at the world in a positive or a negative way 13. We can deal with negative thoughts 14. There are ways of dealing with stress 15. There are problem-solving techniques Storylines were delivered in a series of short videos that illustrate how moods follow thoughts, with negative thoughts leading to low mood, and how the recognition of cognitive distortions (often by a friend) can lead to a more positive mood. Actual techniques, such as a problem-solving mnemonic (STEPS), were demonstrated in use by adolescents dealing with common problems. Video messages from celebrities were included since the focus-group interviews conducted confirmed the importance of celebrities for teenagers. In these short video clips they discussed the same strategies for dealing with difficult times in their own lives. Animations were also popular with our research participants A cartoon was developed with mobisodes (short episodes by mobile phone) about four fictitious adolescents—repeating the key CBT messages in a different format within a different story that might appeal to a different cohort of teenagers. Homework, trying out the techniques in their own lives, is an important part of CBT and was addressed by celebrity video messages setting relevant weekly challenges for participants The program was given identity and coherence with a logo and byline (MEMO: living in a positive space), theme music, and three key words (spot, sort, do). The key CBT messages were reinforced by short memorable text messages that all related to one of the three key words. Website: The website (available only to recognized participant mobile phone numbers) provided a summary of the key messages, information on how to get more help, and a downloadable relaxation audio. New videos were posted on the website monthly. Ringtones, wallpaper images, and music downloads were linked to the mobile website Mobile phone self-monitoring program, where youth monitor their mood, stress and daily activities four times a day for 2 weeks. The intervention group monitored themselves using the complete mobiletype program, which assessed 8 areas of functioning, consisting of current activities, location, companions, mood, recent stressful events, responses to stressful events, alcohol use, cannabis use, quality and quantity of sleep, quantity and type of exercise, and diet.	☒ Psychoeducation ☒ Cognitive Restructuring ☒ Behavioral Activation ☒ Relaxation
34	Mobile Tracking of Young People's Experiences [Kaur et al., 2012]	The program consisted of a guided self-help manual supported through six internet-based group sessions (4–8 participants per group, weekly, 90 Min.) facilitated by a therapist. The program was adapted from the "Set your Body Free Program" (Gollings & Paxton, 2006). Participants were requested to read the material and complete activities corresponding to each session. The manual contained psychoeducational components and self-help intervention activities for each session and the material in each weekly section formed the basis of the group session for that week. Based on CBT-principles: it addressed body image and eating issues and experiences, examined motivations for change, examined unhealthy eating patterns, provided a rationale for normalizing eating, taught self-monitoring, explored relationships between low self-esteem, depression, interpersonal relationships and body dissatisfaction and strategies for change, explored the role of appearance-related social pressures, teasing, fat-talk, and social comparison and challenged irrational beliefs, examined negative body-talk and ways of changing negative thoughts about the body, provided body image enhancement and relapse prevention strategies Online sessions provided a supportive environment in which girls could discuss their body image and eating concerns and learn strategies to enhance body image and improve eating behaviors. A discussion board acted as a permanent message board for participants that desired to communicate during the week, as well as for the group therapist to leave messages for the group.	☐ Psychoeducation ☐ Cognitive Restructuring ☐ Behavioral Activation ☐ Relaxation ☒ Psychoeducation ☒ Cognitive Restructuring ☒ Behavioral Activation ☐ Relaxation
35	My body my life [Heinicke et al., 2007]	The program consisted of a guided self-help manual supported through six internet-based group sessions (4–8 participants per group, weekly, 90 Min.) facilitated by a therapist. The program was adapted from the "Set your Body Free Program" (Gollings & Paxton, 2006). Participants were requested to read the material and complete activities corresponding to each session. The manual contained psychoeducational components and self-help intervention activities for each session and the material in each weekly section formed the basis of the group session for that week. Based on CBT-principles: it addressed body image and eating issues and experiences, examined motivations for change, examined unhealthy eating patterns, provided a rationale for normalizing eating, taught self-monitoring, explored relationships between low self-esteem, depression, interpersonal relationships and body dissatisfaction and strategies for change, explored the role of appearance-related social pressures, teasing, fat-talk, and social comparison and challenged irrational beliefs, examined negative body-talk and ways of changing negative thoughts about the body, provided body image enhancement and relapse prevention strategies Online sessions provided a supportive environment in which girls could discuss their body image and eating concerns and learn strategies to enhance body image and improve eating behaviors. A discussion board acted as a permanent message board for participants that desired to communicate during the week, as well as for the group therapist to leave messages for the group.	☒ Psychoeducation ☒ Cognitive Restructuring ☒ Behavioral Activation ☐ Relaxation

Table 6 (continued)

P#	Program [References]	Content	CBT elements
36	Nod [Bruehlmann-Senecal et al., 2020]	The app was co-developed by Grit Digital Health and Hopelab. It incorporates positive psychology, mindfulness-based self-compassion and cognitive-behavioral skill-building exercises. The app facilitated skill development via fully automated (1) social challenges, suggesting activities designed to reach out to others and taking action to build social connections, (2) reflections, brief in-app cognitive reframing exercises to help students process social experiences and reduce self-criticism, and (3) written student testimonials that encourage a growth mindset toward social connection building. Social challenge content focused on 6 core social skills and behaviors known to strengthen social connections: (1) performing acts of kindness (2) expressing gratitude (3) active listening (4) initiating social outreach/invitations (5) being receptive to others' invitations (6) engaging in appropriate self-disclosure Social challenges were designed to encourage in-person socialization within the campus. Some examples include "Get someone a snack from the dining hall" and "When you get the urge to bail on a conversation, ask a couple more questions than you normally would, and really listen to the answer". App content was written to be broadly applicable across campuses (i.e. no references were made to specific locations or events within the app). Reflections were short in-app exercises designed to scaffold cognitive restructuring of negative social experiences and savoring of positive social experiences. After completing app-based social challenges, participants were directed to use an interactive mood-rating tool to indicate how they felt about their social experience. Positive mood-ratings directed participants to exercises designed to amplify and prolong positive emotions (e.g. savoring, gratitude). Negative ratings directed participants to cognitive reframing exercises (e.g. self-compassion meditations, reappraisal). To reinforce a growth mindset toward friendship, challenges were accompanied by brief written testimonials (e.g. short recommendations of specific in-app social challenges written by students), which were selected to bolster the belief that forming satisfying social connections takes time and effort. Users were able to opt to receive intermittent push notification messages that encouraged participants to try new challenges and reflections, to set deadlines for completing challenges, and to receive reminders to come back to the app to mark challenges as completed	☐ Psychoeducation ☒ Cognitive Restructuring ☒ Behavioral Activation ☐ Relaxation

Table 6 (continued)

P#	Program [References]	Content	CBT elements
37	Rainbow SPARX [Lucassen et al., 2015a, 2015b]	Program #3 (SPARX)—adapted for sexual minority youth The main CBT skills covered in SPARX are physically represented by “the shield against depression”. The shield consists of six gems based on particular CBT content - Relax (relaxation training) - Do it (e.g. behavioral activation) - Sort it (e.g. social skills training) - Spot it (recognizing or naming cognitive distortions) - Solve it (Problem solving) - Swap it (cognitive restructuring) The shield has also a central core, which is hope. The shield against depression is used at key stages throughout the seven modules of the program to highlight the skills used, and the user collects a gem associated with the shield (which they find in the fantasy world in each module) as a reward for completing that level The modules contained certain CBT components and the physical appearance of each session reflected this as a metaphor for the concepts covered. For example, module four was the “Mountain Province” and users were required to apply problem-solving (Solve it) skills in order to climb a mountain in that particular level The difference between the original SPARX and Rainbow SPARX were mostly script-related and accounted for 5.9% of the overall programs script (e.g. mini-games, characters and weekly homework tasks remained the same). Additional changes to the appearance of SPARX were also made. In Module 1 the guide begins the level by stating that “The rainbow version of SPARX was made to help young people who feel down or depressed including guys attracted to other guys, girls attracted to other girls and young people questioning their sexuality.” A decision was made to refer to sexual attractions (and not identity labels) during this introduction for engagement reasons, because many sexual minority youth are unlikely to classify themselves as lesbian, gay or bisexual. After introductory section, the user is encouraged to customize their character and in the Rainbow Version they were not restricted by specific “girl” or “boy” choices. For instance, the customization options (Haircuts, hair colors, outfit styles) were the same for male and female avatar. In this level the guide also challenges the notion that the increased rates of depression amongst sexual minority individuals are to do with deficits associated with people who are not heterosexual, for instance by asking “Some people think that gay, lesbian, bisexual and takataapiu youth (LGBTQI+-) are more likely to get depression. Why is this?” With the correct response being (b): Because of the negativity and hassles they get from other people. Hopeful or positive (Strength-based) views about oneself as a sexual minority individual were also included, with statements such as: the other message in the game was about having hope. It’s good to repeat these simple messages: I won’t always feel this way. Things will get better. It can be hard not being straight, but I know I can handle the challenges that come my way. These statements are true and thinking them can make you feel a little better almost instantly, even if you don’t believe them at first. In Module 2 the guide character acknowledges how the actions of others can have a negative impact on sexual minority individuals. For example, the guide states, “Mostly people and beings in the ice province were nice. But in real life we can come across people who are less than likable or even outright hostile. It can be especially hard if these people hassle you about your sexuality” The guide then offers a potential “Sort it” strategy related to the bullying behaviors of others, for instance, “Wherever possible try to DO stuff with people who value you just as you are. You’ll probably enjoy yourself more as a result” During a mini-game in Module 3, the user’s avatar must unblock a series of geysers that are about to explode (e.g., heterosexism and homophobia) and the exploding geysers are used as a metaphor for negative emotions having the same potential to explode. In this same level the guide asks the user what they do when someone treats them badly, “...for example, when you get hassled for being gay, lesbian, bisexual, takataapiu or simply for being different?” with various response options. This content is then later linked to “triggers that make me feel angry or hurt”; with one trigger option stating “being told I don’t act like a girl/guy should.” The user chooses from 14 possible response strategies, for example, “Talk to someone who understands [with the number of a national free telephone counseling service for sexual minority individuals offered]” or “use slow breathing to relax” In Module 4, problems of specific relevance to sexual minority youth are used as examples for problem solving; specifically, “I don’t know if I can question my sexuality”; “I worry my friends will reject me when I tell them I’m not straight”; and “If I come out to my parents they might kick me out.” These responses were examples of problems highlighted by sexual minority youth during the development stage of the program. During Module 5 the guide encourages the user to reflect upon how homophobia might have an impact on a sexual minority individual’s thinking, for example, “Hearing negative comments like ‘that’s so gay’ for when something is lame or stupid implies that there is something wrong with being gay and if we aren’t careful we might start to believe it” In Module 6, the guide uses examples of cognitive distortions relevant to sexual minority youth, such as “Your friend walks past a group of students who are laughing. Your friend tells you, ‘I bet they were laughing at me, probably because I’m bisexual,’ and she feels really lousy. What would be your advice to her?” [Correct answer = “How do you know they were laughing at you? You’re not a mind reader”]. In this level the guide also encourages the user to “Swap it” (i.e., thought challenging) using the acronym RAPA (reality check, another view, perspective, and think action) based on the following scenario: “Someone gives you grief because you’re different. Here comes the negative thought: ‘I’m a freak and no one will ever love me’ Which of these statements is a good REALITY CHECK?” With the answers being (a) “I’m not a freak. I might be different, but wouldn’t it be boring if we were all the same?”; (b) “It’s not true some people really do care about me and love me too”; (c) “Don’t let bullies get you down, one person’s mean comments aren’t fact” [all three responses are correct answers]. In the same manner the guide asks the user to take “ANOTHER VIEW” and to put the same scenario into “PERSPECTIVE.” Finally, the guide suggests the user “thinks ACTION” in relation to the scenario, stating “...What can you do or learn from it? Don’t dwell on the negative. Think solutions, not problems. It’s more motivation. What can you do? Which of these do you think are examples of thinking ACTION?” With the correct responses being (a) “I can ask the bully what’s wrong with being different”; (c) “I can try spending more time with the people that matter”; and (d) “I now know I will eventually leave this town for somewhere better” In Module 7 the user is provided with a brief review of the content from the previous levels. The guide then gives the users the contact details of services specifically for sexual minority individuals (e.g., youth-based services for sexual minority young people) and the contact details for a national free phone service which “can suggest gay, lesbian, bisexual and takataapiu friendly counselors”	☒ Psychoeducation ☒ Cognitive Restructuring ☒ Behavioral Activation ☒ Relaxation

Table 6 (continued)

P#	Program [References]	Content	CBT elements
38	Reach out, Rise up [Anstiss & Davies, 2015]	10 week program, weekly module-based psychoeducational text packages and challenges. The text package comprised three, weekly text messages (a psychoeducational message, a weekly challenge relating to the week's psychoeducational message, and an inspirational message) that were sent to each participant for 10 weeks. Two exceptions were weeks 5 and 10 in which there were no weekly challenges. The rationale for omitting challenges from these weeks was to provide participants with opportunities to reflect on, and practice, the previous weeks' modules. In week 7, there were two aspects to the weekly challenge. The texts were scripted to be youth-friendly, and framed with participant choice and empowerment in mind, using encouraging wording (e.g., "Don't be nervous, it's all about finding ways that work 4 u", "Don't worry if u haven't done everything just keep giving things a go.") and presenting exercises in an open-ended manner (e.g., "This week's challenge is 2 try some new activities. Experiment till u find some things that make u feel good"). The same text messages were sent to each participant. Each participant commenced receiving text messages the week following their inclusion in the study, so not all participants received text package messages simultaneously. Week 1: Getting to know your moods; Challenge: Mood Journal Week 2: Self-care basics; Challenge: Breathing exercise practice Week 3: How thoughts impact and focusing on small victories; Challenge: Small victories Week 4: Balancing thoughts; Challenge: Thought record Week 5: Avoidance and suppression; Challenge: no challenge Week 6: Building resilience: living life and expression; Challenge: Trying new activities Week 7: Coping strategies: self-care and mindfulness; Challenge: Self-care, Mindfulness Week 8: Envisioning the future: goal-setting and locus of control; Challenge: Things inside and outside of your control Week 9: Envisioning the future: breaking down goals; Challenge: Goal break down Week 10: Celebration, personal strength and options for further support	☒ Psychoeducation ☒ Cognitive Restructuring ☒ Behavioral Activation ☒ Relaxation
39	Rebound [Rice, et al., 2016]	Rebound is based on the MOST model, which uses positive psychology, mindfulness and strength-based intervention uniquely integrating: (i) peer-to-peer online social networking; (ii) individually tailored interactive psychosocial interventions; and (iii) involvement of expert mental health and peer moderators The design of Rebound was informed by recommendations and previous research targeting mechanisms of change (via positive psychology strength-based interventions) for relapse prevention in young people. This includes interventions addressing residual symptoms, improved social connectedness and the enhancement of personal strengths, well-being and positive emotion rather than simply addressing young people's symptoms and deficits. 11. Modules: 1. How Rebound works: This module provides users with an overview of the key features of Rebound, including social networking, private messaging, the role of peer and expert moderators, the Talk It Out function and general privacy information 2. Find your strengths: In this module, users were introduced with the concept of personal strengths. The modules used an interactive online card-sort game where users identify their 'signature' strengths. Assessment of strengths was informed by the positive psychology framework 3. How to flourish: In this module, users were encouraged to put their identified strengths into practice. Users reflected and interacted with each other regarding their future goals, engaging with meaningful activities and overcoming barriers 4. Everybody hurts: This module provided users with psychoeducation regarding precipitant and perpetuating factors related to depression and factors that contribute to resilience and recovery 5. Small is big: This module focused on behavior change. Users were provided with a structured goal-setting framework. Users were encouraged to deconstruct seemingly insurmountable tasks into achievable elements and helped to notice and enjoy the process of behavior change 6. Can a pencil make you happy: This module introduced the construct of behavioral experiments used throughout Rebound. In this experiment, users were encouraged to interact with others (i.e. sharing positive experiences) and break their usual routine through a basic task eliciting positive effect 7. Relaxation skills: This module aimed to up-skill users in progressive muscle relaxation (PMR) techniques and relaxation breathing. Users were able to download purpose-made audio tracks teaching PMR and breathing techniques 8. Compassion for others: This module integrated self-compassion techniques for managing difficult emotions and situations. Purpose-made audio tracks are available for users to download 9. Savouring: This module drew on the positive psychology technique of savoring and provided users with a range of skills and behaviors to help them make the most of positive experiences 10. Rumination: This module assisted users in identifying helpful and unhelpful ruminative thought processes and provided examples of ways to break these cycles. The modules adopted Watkins Model of managing unconstructive repetitive thought 11. Job finding tools: This targeted module provided developmentally appropriate, practical vocational assistance on writing an effective resume and cover letter, including advice on how to address key selection criteria The Rebound program also included a group-based, structured problem-solving intervention (Talk it Out) which used an evidence-based problem-solving framework. Offered solutions and users' experiences were saved, providing a database for the participants to refer to throughout the intervention. Each proposed "Talk it Out" was moderated in a structured manualized manner through an iterative process of problem definition, brainstorming solutions, identifying pros and cons and summarizing possible choices. The peer and clinical moderator component followed the 'supportive accountability' theory-driven model of online engagement, focusing on experienced, trustworthy and accountable peer and expert moderators. The peer moderators were trained and supported young people with a recent lived experience of mental ill health. The clinical moderators were experienced youth mental health clinicians and ensured the safety of the website through daily monitoring and developed a formulation-based treatment-approach (using available information) for each allocated user.	☒ Psychoeducation ☒ Cognitive Restructuring ☒ Behavioral Activation ☒ Relaxation

Table 6 (continued)

P#	Program [References]	Content	CBT elements
40	Reframe-IT [Hetrick, et al., 2017; Robinson, et al., 2014a; Robinson, et al., 2014b; Robinson, et al., 2014c]	8 Modules (15–20 Min. each)/1 Module per week 2 Activities per week + homework Message board through which participants could communicate with the research-therapist Factsheets covering a range of related topics (managing suicidal thoughts, MP3-Relaxation files) The eight modules incorporated standard CBT approaches commonly used with young people These were: engagement and agenda setting; emotional recognition and distress tolerance; identification of negative automatic thinking; behavioural activation—help-seeking and activity scheduling (including relaxation techniques); problem solving, with a specific focus on managing suicidal ideation; detecting and challenging problematic thinking, and cognitive restructuring. Each participant had access to his/her own personalized web page accessed via secure login. The site comprised an adult ‘host’ character who delivered the therapy verbally, and a series of video diaries made by young people (actors), that told a different ‘story’ each week. There were also two activities to be completed per week that related to the issues raised in the module. The site also included a message board, a series of factsheets covering a range of related topics, downloadable MP3s and a list of local and national help lines and services that participants could access if they wished. As the weeks progressed, additional items were added to the site. (e.g. an activity diary).	☒ Psychoeducation ☒ Cognitive Restructuring ☒ Behavioural Activation ☒ Relaxation
41	RESPOND [Cook, et al., 2019]	Reducing Stress and Preventing Depression (RESPOND) English version of i-RFCBT (MindReSolve), translated and adapted from the version of Topper et al. (2017) to include case examples relevant to the target group. RFCBT differs from standard CBT by seeking to change the process of thinking rather than the content of individual thoughts 6×60 min modules, each in turn split into 3–4 sessions consisting of a single web page, with 1–2 weeks recommended per module for practice of the techniques The content includes psychoeducation, mood diaries, experiential audio exercises, pictures, and video vignettes of university students talking about their own experience of the intervention. Modules follow the same basic structure: reflection on the previous module, introduction of a new technique, experiential in-session exercises, and plans for implementation. The specific behavior-change techniques are drawn from the following groups in the Behavior Change Technique (BCT) taxonomy: 1. goals and planning (goal setting, action planning, review behavior, and behavioral contract) 2. feedback and monitoring (self-monitoring of behavior and outcomes) 3. shaping knowledge (information about antecedents) 4. natural consequences (information about social and environmental consequences and monitoring of emotional consequences) 5. associations (prompts/cues and associative learning) 6. repetition and substitution (behavioral practice/rehearsal, behavior substitution and habit formation) 7. antecedents (restructuring the physical and social environment and avoiding/reducing cues for the behavior) 8. self-belief (mental rehearsal of successful performance, focus on past success, and self-talk) The key strategies include coaching participants to spot warning signs of brooding and worry and then to make If–Then Plans in which an alternative strategy is repeatedly practiced in response to the warning signs. These strategies include being more active, slowing things down, breaking tasks down, opposite action, relaxation, concrete thinking, becoming absorbed, self-compassion and assertiveness.	☒ Psychoeducation ☐ Cognitive Restructuring ☒ Behavioural Activation ☐ Relaxation
42	Stressbusters [Smith et al., 2015] [additional information: Abeles et al., 2009]	The program is based on an effective face-to-face CBT protocol for young people with depression. Treatment components are individually delivered via computer in an age-appropriate and appealing way, through the use of secure interactive multimedia (animation and videos) 8 sessions, 45 Minutes each The session content is arranged in the following format: Introduction to the program and goal setting (Session 1) Getting activated (Session 2) Emotional recognition (Session 3) Noticing thoughts (Session 4) Thought challenging (Session 5) Problem solving (Session 6) Improving social skills (Session 7) Relapse prevention (Session 8) In each session, the user: logs on securely, reports on homework and current mood, is introduced to the topic of the session, watches a video of a depressed teenager (young actor) implementing the treatment technique, applies the technique to himself/herself through the use of interactivity, designs individualized homework based on the technique, and finally logs out. Customized handouts (e.g. mood monitoring sheets, activity diaries) and fact sheets (e.g. bullying, drug use) are printed out at the end of the session. The program has a narrator to guide the user. The eight sessions are in a linear progression, with each session building on the knowledge gained in previous sessions and on the tasks carried out at home. A session or part of a session can be repeated whenever necessary. Sessions contain flexible “add-ons” such as written fact sheets (e.g. about anxiety, bullying, depressive thinking styles), which can be printed out and taken away together with other handouts (e.g. mood diary sheets) produced by the program. The video inserts (case vignettes) are of three teenagers who feature throughout the 8 sessions. They are student actors who play the roles of depressed teenagers, specially scripted and created for the project. Stressbusters’ participants hear about their lives and watch the teenagers themselves using the program in a combination of short video sequences, talking heads and voiceovers. As the narrator talks, key words and simple illustrations appear on the screen. The teenager inputs information that is stored and used throughout the program, having the option to either drag/select text from lists or use free-text entry.	☒ Psychoeducation ☒ Cognitive Restructuring ☒ Behavioural Activation ☐ Relaxation

Table 6 (continued)

P#	Program [References]	Content	CBT elements
43	The Feeling Better program [Bradley et al., 2012]	Based on the original program: Feeling Better Program (Currie, Day, & McGrath, 2008, unpublished manuscript), 12 modules Used in the study: only 4 modules (because they are core components of CBT), i.e. Introduction, Activity and Motivation, Thoughts and Feelings, Stress and Management one module per week (= 4 weeks)	☒ Psychoeducation ☐ Cognitive Restructuring ☒ Behavioral Activation ☐ Relaxation ☐ Psychoeducation ☒ Cognitive Restructuring ☒ Behavioral Activation ☐ Relaxation
44	TOPS [Wade et al., 2012]	The TOPS intervention involved an initial home visit by the therapist and 9–13 subsequent web-based sessions. The content for each session was covered in two separate parts: 1. in the first part, the teen, primary caregiver and other participating family members completed a self-guided module that could be accessed at a password-protected website; 2. in the second part, participating family members reviewed the website content with the therapist during a synchronous videoconference Sessions 2 & 3 focused on developing a positive approach to problems and the steps of problem solving, respectively. Beginning with the third session, the therapist also aided the family in implementing the problem-solving process with a goal or problem that they had identified. The problem-solving heuristic consisted of five steps: Aim (goal identification), Brainstorm (solution generation), Choose (evaluation of the various solutions), Do It (detailed implementation plan), and Evaluate (did it work). Each portion of the sessions required 45–60 min to complete. Beyond training in social problem-solving skills, the website modules also included didactic information about the consequences of TBI and the targeted skills, video clips of teens talking about TBI and modeling the targeted skill (i.e., cognitive reframing), and interactive exercises giving the family additional practice with the concepts. Although the content was directed at the teen, all participating family members were encouraged to learn the skills and apply them in their daily lives. The TOPS website had 10 core sessions. The principles of problem-solving were addressed in the first three sessions and provided the foundation for all subsequent sessions. Sessions 4–9 covered issues that were frequent concerns following TBI including planning and organization, self-regulation, anger management, nonverbal communication and pragmatics, and social relationships. A final session addressed planning for future challenges. Six supplemental sessions addressed less common concerns such as pain management and post-high school transitions. The core session content was assigned to all families in the TOPS group, whereas the supplemental sessions were only assigned to families with concerns in those areas. At the end of the ninth session, each family member completed a brief self-assessment of their problem-solving, communication, and social skills. They also indicated their interest in receiving additional online content. Supplementary session content focused on (a) caregiver stress, taking care of yourself, marital communication; (b) working with the school; (c) planning for after high school; (d) sibling concerns; (e) pain management; and (f) talking with your adolescent.	☒ Psychoeducation ☐ Cognitive Restructuring ☐ Behavioral Activation ☐ Relaxation
45	www.loseitheblues.ie [Horgan et al., 2013]	The website provided a forum to allow participants to offer peer support to each other. It also provided information on depression and links to other supports	☒ Psychoeducation ☐ Cognitive Restructuring ☐ Behavioral Activation ☐ Relaxation

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Authors' Contributions FR conceived of the study and its design, participated in its coordination, interpretation of the data and drafted the manuscript; IP participated in the design, interpretation of the data and helped to draft and revise the manuscript; MW helped in study design and in manuscript revision; BGK participated in the design and contributed to the revision of the manuscript. All authors read and approved the final manuscript.

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Data availability All data collected for this study were obtained from published peer-review literature. Data extracted to inform this umbrella review are available on reasonable request from the corresponding author.

Declarations

Conflict of interest The authors report no conflict of interests.

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