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*Review Article*

# Digital Mental Health Interventions for Depression and Anxiety in Youth: A Scoping Review of Effectiveness, Engagement, and Implementation

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## ABSTRACT

Depression and anxiety are among the most prevalent mental health conditions affecting children, adolescents, and young people, contributing substantially to the global burden of disease. Despite the availability of effective treatments, access to care remains limited due to structural, economic, and stigma-related barriers, particularly in low-resource settings. Digital mental health interventions have emerged as a scalable and accessible approach to addressing these gaps. This scoping review aimed to map the extent, range, and characteristics of existing evidence on digital interventions targeting depression and anxiety in individuals aged approximately 10–24 years, with a focus on effectiveness, engagement, and implementation. A systematic search of PubMed, Dimensions, and CINAHL was conducted, and primary studies of any design published in English were included. Data were extracted and synthesized using descriptive and thematic approaches. A total of 42 studies were included, covering diverse modalities such as internet-based cognitive behavioral therapy, mobile applications, chatbots, and tele-mental health platforms. Digital interventions were associated with reductions in depressive and anxiety symptoms, particularly in the short term. However, between-group effects were often modest when compared with active controls. Engagement emerged as a key determinant of effectiveness, with higher adherence linked to better outcomes. While feasibility and acceptability were generally high, challenges related to sustained engagement and long-term effectiveness were common. Digital interventions show promise as adjuncts to conventional care but require further optimization and evaluation in real-world settings.

**Keywords:** Digital Mental Health; Depression; Anxiety; Youth; Digital Interventions; Engagement; Scoping Review

## Introduction

Depression and anxiety are among the most prevalent mental health conditions affecting children, adolescents, and young people globally, contributing substantially to the overall burden of disease in this population. Early onset of these disorders is associated with a range of adverse outcomes, including impaired social and academic functioning, increased risk of recurrence, and heightened vulnerability to long-term mental health difficulties [1]. Despite the availability of evidence-based psychological treatments, a significant proportion of young people do not receive adequate care. Barriers such as stigma, limited service availability, high costs, and shortages of trained mental health professionals, particularly in low- and middle-income settings, continue to constrain access to timely and appropriate interventions [2].

In response to these challenges, digital mental health interventions have emerged as a promising and scalable approach to expanding access to care. These interventions encompass a wide range of modalities, including web-based cognitive behavioral therapy (CBT) programs, mobile health (mHealth) applications, tele-mental health services, chatbots, serious games, and text messaging–based interventions. Digital platforms offer several advantages that are particularly relevant for youth populations, including accessibility, flexibility, anonymity, and the potential for large-scale dissemination. Given that young people are among the most active users of digital technologies, such interventions are often considered well aligned with their help-seeking behaviors and communication preferences [3,4].

However, the growing enthusiasm surrounding digital mental health has often been accompanied by an implicit assumption of uniform effectiveness. Emerging evidence suggests a more complex reality. Digital interventions vary substantially in their design, level of human support, theoretical orientation, and implementation context, leading to considerable heterogeneity in outcomes [5]. Increasingly, digital mental health is being conceptualized not merely as the digitization of existing therapies, but as a new model of care delivery situated within broader stepped-care and hybrid systems. Within this framework, factors such as user engagement, personalization, and integration with existing services are understood to be central to intervention effectiveness, rather than peripheral considerations[ 6].

A rapidly expanding body of research has examined the use of digital interventions for the prevention and treatment of depression and anxiety in youth. Nevertheless, the evidence base remains highly heterogeneous, spanning diverse study designs, populations, intervention modalities, and outcome measures. Some interventions are fully self-guided, whereas others incorporate varying degrees of therapist or peer support. Similarly, some studies focus on prevention in general populations, while others target clinical or high-risk groups. Engagement and adherence have emerged as critical challenges, yet are inconsistently measured and reported across studies. This heterogeneity complicates efforts to synthesize findings and identify clear patterns of effectiveness [7].

Given the breadth and diversity of this field, a comprehensive mapping of the existing literature is required to better understand the range, characteristics, and focus of digital mental health interventions for youth. A scoping review is particularly well-suited to this objective, as it enables the systematic identification and characterization of evidence across a wide range of study designs and intervention types, without restricting inclusion to specific methodologies or outcomes.

Therefore, this scoping review aims to map the extent, range, and nature of the available evidence on digital mental health interventions targeting depression and anxiety in youth. Specifically, this review seeks to identify the types of digital interventions that have been developed and evaluated, the populations they target, the outcomes assessed, and key gaps in the literature to inform future research, policy, and practice. This review addresses the following research question: What is the extent, nature, and characteristics of digital mental health interventions for depression and anxiety in youth, and what gaps exist in the current evidence base?

## Methods

### Study Design

This scoping review was conducted following established methodological frameworks and reported in accordance with the PRISMA extension for scoping reviews (PRISMA-ScR). The review process included identifying the research question, searching for relevant studies, study selection, data charting, and synthesis of findings.

### Eligibility Criteria

Eligibility criteria were defined using the Population–Concept–Context (PCC) framework. The population included children, adolescents, and young people aged approximately 10–24 years. The concept

focused on digital mental health interventions (e.g., web-based programs, mobile applications, chatbots, internet-based cognitive behavioral therapy, and tele-mental health services). The context included studies addressing depression and/or anxiety in any setting.

Primary research studies of any design were included, while reviews, editorials, commentaries, and conference abstracts were excluded. Only English-language studies were considered. A small number of contextual studies were retained where they contributed to understanding engagement, mechanisms, or implementation, but were not used as primary evidence of effectiveness.

**Information Sources and Search Strategy**

A comprehensive search was conducted across PubMed, Dimensions, and CINAHL. The final search was completed on 15 January 2026. The search strategy combined controlled vocabulary (e.g., MeSH terms) and free-text keywords related to youth, depression, anxiety, and digital mental health interventions.

An example of the PubMed search strategy is provided below:

("Adolescent"[MeSH] OR "Child"[MeSH] OR adolescent[Title/Abstract] OR youth[Title/Abstract] OR "young people"[Title/Abstract] OR "young adult"[Title/Abstract])

AND

("Depression"[MeSH] OR "Anxiety"[MeSH] OR depression[Title/Abstract] OR "depressive symptoms"[Title/Abstract] OR anxiety[Title/Abstract])

AND

("Digital Health"[MeSH] OR "Telemedicine"[MeSH] OR "Mental Health Services"[MeSH] OR "digital mental health"[Title/Abstract] OR "e-mental health"[Title/Abstract] OR mHealth[Title/Abstract] OR "mobile application"[Title/Abstract] OR "internet-based intervention"[Title/Abstract] OR "online therapy"[Title/Abstract] OR CBT[Title/Abstract] OR chatbot[Title/Abstract])

Equivalent search strategies were adapted for Dimensions and CINAHL. Reference lists of included studies were also screened to identify additional relevant articles.

**Study Selection**

All records were exported into reference management software, and duplicates were removed. Title and abstract screening were conducted independently by two reviewers. Full-text assessment was subsequently performed by members of the research team. Discrepancies were resolved through discussion and consensus, and where necessary, a third reviewer was consulted. Reasons for exclusion at the full-text stage were documented.

**Data Charting Process**

A standardized data extraction form was developed and piloted. Extracted data included study characteristics, population, intervention type, outcomes, and key findings. The process was iterative and refined during the review.

**Data Analysis and Synthesis**

Data were synthesized using descriptive numerical summaries and thematic analysis to identify patterns related to effectiveness, engagement, feasibility, and implementation.

**Quality Appraisal**

Formal quality appraisal was not conducted, consistent with scoping review methodology. However, this should be considered when interpreting findings, as included studies varied in methodological rigor.

## Results

While the majority of included studies directly evaluated digital mental health interventions in youth populations, a small number of studies were retained to provide contextual or supporting insights (e.g., mechanisms of action, engagement patterns, or broader digital mental health frameworks). These studies were not used as primary evidence of effectiveness but contributed to the overall conceptual mapping of the field.

**Study Selection**

A total of 2,680 records were identified through database searching, including 2,156 records from PubMed, 224 from Dimensions, and 300 from CINAHL. Following the removal of duplicates and the application of database-specific filters, a reduced number of records were retained for screening. Titles and abstracts were then screened against the predefined eligibility criteria to identify potentially relevant studies.

Subsequently, full-text articles of all eligible or unclear studies were assessed for inclusion. Studies that did not meet the inclusion criteria, such as those not focusing on digital interventions, not targeting depression or anxiety, or not involving youth populations, were excluded at this stage.

A total of 42 studies met the inclusion criteria and were included in the final synthesis. The study selection process is illustrated in Figure 1.

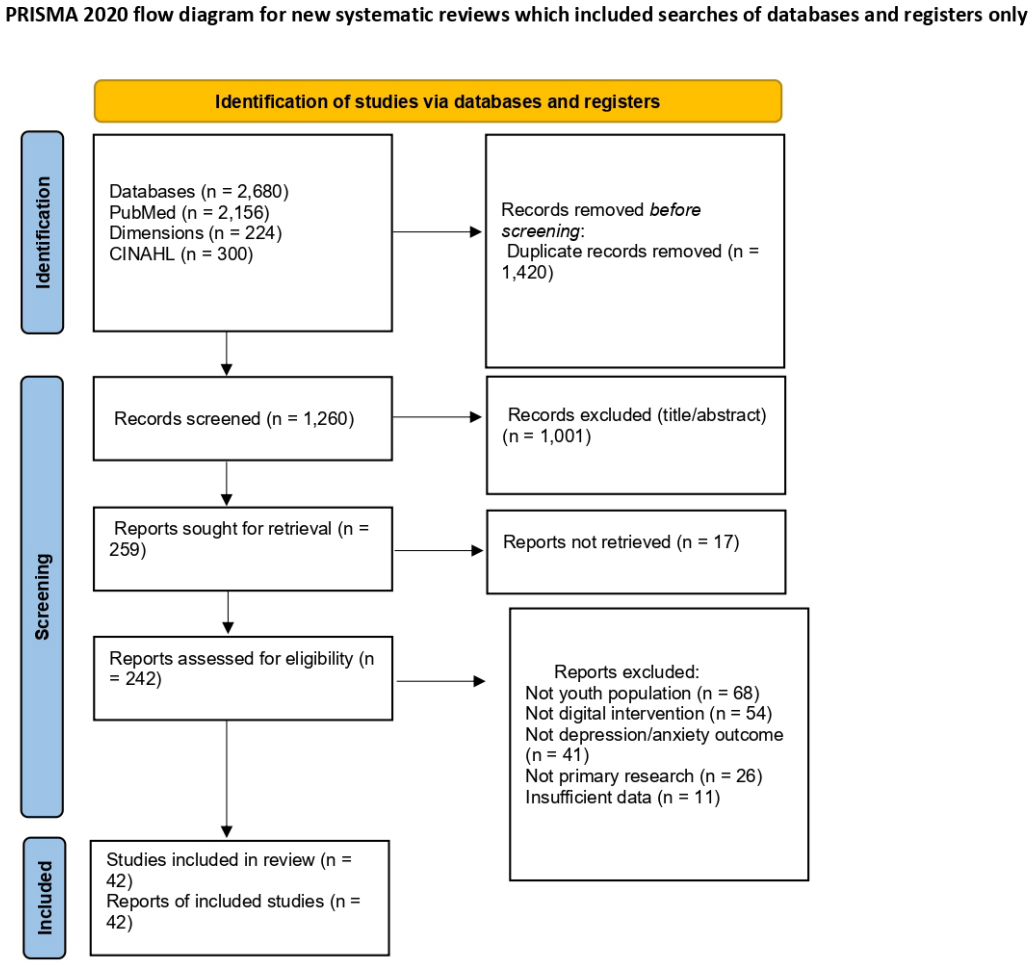


**Figure 1. PRISMA flow diagram**

### Study Characteristics

The characteristics of the included studies are summarized in Table 1. The 42 studies represented a diverse body of evidence, comprising randomized controlled trials, pilot and feasibility studies, observational designs, and study protocols. The majority of studies focused on adolescents and young adults, typically aged between 12 and 25 years, and primarily targeted depression and/or anxiety symptoms.

Intervention modalities were heterogeneous, with mobile applications and internet-based cognitive behavioral therapy being the most frequently used approaches. Other modalities included chatbot-delivered interventions, gamified platforms, and multicomponent digital systems integrating therapeutic content with social or professional support.

Overall, the distribution of study designs, populations, and intervention types reflects both the methodological development of the field and the increasing diversification of digital mental health approaches.

**Table 1. Characteristics of Included Studies**

| Study | Design | Population | Digital Modality | Sample | Key Findings |
|---|---|---|---|---|---|
| Asselbergs et al., 2016 [8] | Exploratory pilot study | Dutch students | Mobile phone–based EMA | n = 33 | Passive smartphone sensing was feasible, but predictive accuracy was limited. |
| Bell et al., 2023 [9] | Pilot RCT | Youth with depression and anxiety | Personalized smartphone intervention | n = 55 | Demonstrated feasibility, acceptability, and reductions in depression and anxiety symptoms. |

| Study | Design | Population | Digital Modality | Sample | Key Findings |
|---|---|---|---|---|---|
| Carey et al., 2016 [10] | Pilot study | Non-clinical adults | Smartphone app (MindSurf) | n = 23 | Supported usability and acceptability of a wellbeing-focused app. |
| Casella et al., 2022 [11] | Study protocol | Youth with anxiety/depression | Internet-delivered CBT + videos | Planned n = 280 | Protocol evaluating a brief online CBT intervention developed during COVID-19. |
| Creswell et al., 2024 [12] | Pragmatic non-inferiority RCT | Children with anxiety | Digitally augmented CBT with therapist support | n = 444 | Demonstrated non-inferiority to treatment as usual with potential efficiency benefits. |
| Deady et al., 2016 [14] | RCT | Young adults with depression | Web-based self-help | n = 104 | Reported short-term improvements in depressive symptoms and alcohol outcomes. |
| Senyard et al., 2025 [16] | Secondary analysis | Adolescents with anxiety | Internet-based CBT | n = 2,850 | Early engagement predicted later adherence and outcomes. |
| Fujita et al., 2025 [17] | RCT termination report | Youth awaiting care | Mobile AI chatbot | Not reported | Identified implementation challenges in chatbot deployment. |
| Geirhos et al., 2022 [18] | Pilot RCT | Youth with chronic illness + depression/anxiety | Guided internet/mobile CBT | n = 30 | Demonstrated feasibility and preliminary clinical benefit. |
| Rosso et al., 2016 [19] | RCT | Adults with depression | Internet-based CBT | n = 77 | Showed greater symptom reduction compared with control. |
| Schleider et al., 2021 [20] | RCT | Adolescents with depressive symptoms | Online single-session intervention | n = 2,452 | Demonstrated improvements in hopelessness and internalizing symptoms. |
| Pachankis et al., 2023 [22] | RCT | LGBTQ youth | Guided internet CBT | n = 120 | Showed feasibility and modest effects, stronger in stigmatizing environments. |
| Karkosz et al., 2023 [23] | Open-label RCT | Subclinical young adults | Therapy chatbot | n = 81 | Both groups improved; chatbot did not outperform control. |
| Kenter et al., 2016 [25] | RCT | Adults with depression | Guided web-based self-help | n = 269 | Symptom reductions observed, but limited added benefit over control. |
| King et al., 2015 [26] | Pilot RCT | College students at suicide risk | Online screening/intervention | n = 52 | Demonstrated feasibility of web-based screening and intervention. |
| Kulikov et al., 2023 [28] | Feasibility RCT | Adolescents with depression | CBT-based mobile app | n = 60 | Showed usability, engagement, and symptom reduction. |
| Lawrence-Sidebottom et al., 2024 [29] | Observational study | Children and adolescents | Digital collaborative care | n = 2,161 | Demonstrated symptom improvement in routine care settings. |
| Li et al., 2024 [30] | Hybrid RCT | University students | WHO digital intervention | n = 371 | Demonstrated short-term reductions in depression and anxiety. |
| Litvin et al., 2023 [31] | Large-scale RCT | University students | Gamified mental health app | n = 1,165 | Improved resilience and reduced depression/anxiety with strong engagement. |
| Lunkenheimer et al., 2020 [32] | Study protocol | Youth with chronic conditions | Guided digital CBT | Planned n = 212 | Protocol assessing effectiveness and cost-effectiveness. |
| Gleason et al., 2024 [33] | RCT | Adolescents in treatment | Relational agent intervention | n = 141 | Non-inferior to telehealth CBT for depressive symptoms. |
| Maulik et al., 2016 [34] | Development study | Rural communities (India) | Mobile decision support system | Not reported | Demonstrated feasibility in low-resource settings. |
| Nicol et al., 2022 [36] | Pilot RCT | Adolescents in primary care | Chatbot CBT app | n = 18 | Demonstrated feasibility and preliminary symptom improvement. |

| Study | Design | Population | Digital Modality | Sample | Key Findings |
|---|---|---|---|---|---|
| Peake et al., 2024 [38] | RCT | Adolescents with depression | Mobile digital therapeutic | n = 160 | Reported clinically meaningful improvements, modest between-group effects. |
| Pots et al., 2016 [39] | RCT (mediation analysis) | Adults with depression | Web-based ACT | n = 236 | Identified psychological flexibility as a mediator of improvement. |
| Rickhi et al., 2015 [40] | Pilot RCT | Youth with depression | e-mental health intervention | n = 62 | Reported reductions in depression severity. |
| Ritvo et al., 2021 [41] | RCT | Youth with depression | Online mindfulness-based CBT | n = 45 | Demonstrated improvements in depressive symptoms. |
| Cross et al., 2025 [43] | Observational study | Youth using MOST platform | Multicomponent digital system | Not reported | Higher engagement predicted greater improvement. |
| Rice et al., 2018 [44] | Pilot study | Youth in remission | Moderated online therapy | n = 42 | High engagement and relapse-prevention potential. |
| Szigethy et al., 2023 [46] | Study protocol | Adolescents with depression | Coach-supported digital CBT | Planned n = 750 | Protocol emphasizing integration into routine care. |
| Espinosa et al., 2024 [47] | RCT | Adolescents with anxiety/depression | Internet-based transdiagnostic program | n = 58 | Demonstrated reductions in anxiety and depression symptoms. |
| Wang et al., 2016 [48] | Survey study | Adults at risk of depression | e-mental health preferences | n = 841 | Identified design preferences and barriers to uptake. |
| Werner-Seidler et al., 2020 [49] | Study protocol | School adolescents | Smartphone CBT prevention apps | Planned n = 10,000 | Large-scale prevention study design. |

**Efficacy of Digital Interventions**

Across randomized controlled trials (RCTs), digital mental health interventions were consistently associated with reductions in depressive and anxiety symptoms, representing the strongest level of evidence within the included studies. Several well-powered trials, including large-scale and pragmatic RCTs, demonstrated statistically significant within-group improvements and, in some cases, clinically meaningful outcomes such as remission and functional gains [30,31,47].

However, between-group differences were frequently modest or nonsignificant when digital interventions were compared with active control conditions. Multiple trials reported improvements in both intervention and comparator groups, suggesting the influence of nonspecific therapeutic factors such as psychoeducation, self-monitoring, or expectancy effects [23,25]. Similarly, trials of app-based digital therapeutics reported clinically meaningful symptom reductions without consistently demonstrating strong statistical superiority over control conditions [38].

Evidence from pilot and feasibility studies further supports the potential effectiveness of digital interventions, although these studies were generally underpowered and primarily designed to assess feasibility, usability, and acceptability rather than definitive efficacy. Observational and uncontrolled studies consistently reported symptom improvement over time, but these findings should be interpreted cautiously due to the absence of control groups and increased susceptibility to bias.

Contextual and individual factors appeared to moderate intervention effectiveness. For example, stronger effects were observed among individuals exposed to higher levels of stigma or environmental stress [22]. In addition, temporal analyses indicated that treatment gains were often strongest immediately post-intervention, with diminished effects observed at follow-up, suggesting challenges in sustaining long-term benefits [30].

Overall, the evidence indicates that digital mental health interventions can produce meaningful short-term improvements in depression and anxiety symptoms among young people. The strongest support is derived from structured interventions, particularly internet-based cognitive behavioral therapy evaluated in randomized trials, while evidence for newer modalities such as chatbots and fully automated applications remains limited and requires further rigorous evaluation.

**Engagement and Adherence**

Engagement emerged as a central determinant of intervention effectiveness across the included studies. Adherence to digital interventions varied substantially, with many participants completing only a portion of available modules or disengaging over time [22]. Importantly, higher levels of engagement were consistently associated with improved clinical outcomes.

Quantitative analyses demonstrated that increased interaction with intervention content, including completion of therapeutic activities and frequency of platform use, predicted reductions in depressive and anxiety symptoms [28,43]. These findings suggest that engagement functions not merely as a descriptive usage metric but as a key mechanism through which digital interventions exert their effects.

Interventions incorporating features such as gamification, personalization, and social or human support demonstrated comparatively higher levels of engagement and retention. For example, gamified applications achieved significantly higher adherence rates while simultaneously improving psychological outcomes [31]. Similarly, moderated online social therapy platforms facilitated sustained user interaction and high acceptability among young people [44].

Despite these advances, engagement remains a persistent challenge. Many studies reported declining user participation over time, highlighting difficulties in sustaining motivation and continued use. Variability in how engagement was defined and measured across studies further limits comparability and underscores the need for standardized engagement metrics in future research.

Overall, the evidence indicates that engagement is a critical mechanism of action and a necessary precondition for effectiveness in digital mental health interventions.

**Feasibility, Acceptability, and User Experience**

Digital mental health interventions were generally perceived as feasible and acceptable across diverse populations and settings. Participants consistently reported benefits related to accessibility, flexibility, and anonymity, which are particularly relevant for youth populations and may help reduce barriers associated with stigma and traditional service access [24].

However, several studies identified ongoing challenges related to sustained use and user experience. Common issues included declining motivation over time, limited personalization, and reduced perceived relevance of intervention content. While the absence of human interaction was often viewed as advantageous for accessibility, it was also perceived by some users as limiting therapeutic depth and support.

At a broader level, barriers to uptake included concerns related to privacy, stigma, usability, and competing demands on users' time [48]. These findings highlight that while digital interventions can improve access to care, they also introduce new design and engagement-related challenges that must be addressed.

Evidence for feasibility and acceptability was consistent across study designs, although much of this evidence was derived from pilot and early-phase studies. As such, further research in larger, real-world implementation settings is needed to confirm these findings and assess scalability.

**Moderators and Mechanisms of Effect**

The effectiveness of digital interventions was not uniform across individuals or contexts. Several studies identified moderators of treatment response, including baseline symptom severity, environmental factors, and engagement levels [39,43].

Mechanistic analyses highlighted the role of psychological processes such as mindfulness, behavioral activation, and psychological flexibility in mediating treatment effects [39]. These findings support the theoretical integrity of translating established therapeutic mechanisms into digital formats.

Emerging research employing advanced analytical techniques further emphasizes the heterogeneity of treatment response, suggesting that digital interventions may benefit from personalization and adaptive delivery models [43].

To further synthesize findings across studies, a thematic analysis was conducted, and key themes are summarized in Table 2."

**Table 2. Thematic Synthesis of Findings Across Included Studies**

| Theme | Key Findings | Interpretation | Representative Studies |
|---|---|---|---|
| **Effectiveness of Interventions** | Digital interventions were associated with reductions in depression and anxiety symptoms across most studies, particularly in the short term. However, between-group effects were often modest when compared with active controls. | Digital interventions demonstrate efficacy, but their incremental benefit over existing or low-intensity interventions may be limited. | [25,30,31,38,47] |
| **Engagement and Adherence** | Engagement levels varied widely, with many participants not completing full interventions. Higher engagement was consistently associated with better outcomes. Gamified and socially | Engagement is a central mechanism of action and a prerequisite for effectiveness rather than a secondary outcome. | [22,28,31,43,44] |

| Theme | Key Findings | Interpretation | Representative Studies |
|---|---|---|---|
| | integrated interventions showed improved adherence. | | |
| **Feasibility and Acceptability** | Most interventions were rated as acceptable and feasible, particularly due to accessibility, flexibility, and anonymity. | Digital platforms align well with youth preferences and reduce traditional access barriers. | [9,24,29,36]. |
| **Barriers to Use and Implementation** | Common barriers included declining motivation, lack of personalization, limited human interaction, privacy concerns, and usability challenges. | While digital tools improve access, they introduce new engagement and design-related challenges. | [17,23,48] |
| **Moderators of Effectiveness** | Intervention effectiveness varied based on baseline severity, context (e.g., stigma), and user engagement. | Digital interventions are not uniformly effective; outcomes are context-dependent. | [22,39,43] |
| **Mechanisms of Change** | Psychological processes such as behavioral activation, mindfulness, and psychological flexibility mediated outcomes. | Digital interventions successfully translate core therapeutic mechanisms, particularly from CBT and ACT frameworks. | [39,41,47]. |
| **Sustainability of Effects** | Effects were strongest post-intervention, with reduced impact at follow-up in many studies. | Sustaining long-term benefits remains a major limitation of digital-only interventions. | [30,38] |
| **Implementation and Scalability** | Large-scale and protocol studies highlighted the potential for population-level delivery, particularly in schools and primary care settings. | Digital interventions are highly scalable but require integration into existing systems for maximum impact. | [46,49]. |
| **Gaps in the Literature** | Limited long-term data, inconsistent reporting of engagement, underrepresentation of low-income settings, and lack of personalization. | Future research should focus on sustainability, personalization, and real-world implementation. | Across multiple studies |

**Synthesis**

Taken together, the studies summarized in Table 1 demonstrate that digital mental health interventions are capable of producing meaningful reductions in depression and anxiety symptoms, particularly in the short term. However, their effectiveness is contingent upon user engagement, contextual factors, and intervention design. While scalable and accessible, these interventions are not uniformly superior to traditional or low-intensity comparators and require further refinement to enhance long-term effectiveness and personalization.

## Discussion

The present review synthesizes a rapidly expanding body of evidence on digital mental health interventions targeting depression and anxiety among young people. While the findings confirm that digital interventions are capable of producing meaningful improvements in mental health outcomes, they also reveal a more complex and nuanced reality than is often portrayed. Rather than representing a uniformly transformative solution, digital interventions appear to function as conditionally effective tools, whose impact is contingent upon engagement, contextual factors, and alignment between intervention design and user needs.

A central contribution of this review lies in reframing the field away from the question of whether digital interventions "work," toward a more critical examination of when, for whom, and under what conditions they are effective. Across studies, reductions in depressive and anxiety symptoms were consistently observed, yet between-group differences were frequently modest, particularly when compared against active control conditions. This pattern suggests that a substantial portion of observed improvements may be attributable to nonspecific therapeutic processes, such as increased self-monitoring, psychoeducation, or expectancy effects, rather than to the unique mechanisms of digital intervention delivery. Such findings challenge overly optimistic narratives surrounding digital mental health and underscore the importance of rigorous comparator selection in future trials [50].

At the same time, the evidence indicates that digital interventions can achieve clinically meaningful outcomes, including remission and functional improvement, even when statistical superiority is limited. This apparent discrepancy highlights a broader methodological tension within the field: traditional

statistical comparisons may not fully capture the real-world value of scalable, low-intensity interventions, particularly in contexts where access to care is constrained. From a public health perspective, even modest effects when delivered at scale may translate into substantial population-level benefit [51,52].

Perhaps the most consistent and theoretically significant finding across the literature is the central role of engagement as a mechanism of action. Engagement is not merely a mediator of effectiveness but appears to function as a necessary precondition for therapeutic benefit. Interventions characterized by higher levels of user interaction, whether through gamification, personalization, or integration of social and human support, consistently demonstrated stronger outcomes[ 53]. Conversely, low adherence undermined effectiveness across modalities, regardless of theoretical robustness. These findings suggest that digital mental health should not be conceptualized solely as a matter of content delivery, but rather as a problem of behavioral design, requiring insights from fields such as human–computer interaction, behavioral economics, and persuasive technology [54]

The heterogeneity of treatment response further reinforces the need to move beyond "average effect" models. Emerging evidence indicates that digital interventions do not exert uniform effects across users; instead, outcomes vary according to baseline symptom severity, contextual factors such as stigma, and patterns of engagement. This variability points toward the necessity of precision digital mental health, in which interventions are dynamically adapted to individual profiles. The integration of machine learning and real-time data analytics offers a promising avenue for identifying these patterns and optimizing intervention delivery, although such approaches remain in their infancy[55]

From a clinical perspective, the findings support the integration of digital interventions within stepped-care and hybrid care models, rather than their deployment as stand-alone solutions. Interventions that incorporated some degree of human support, whether through therapists, coaches, or moderated peer interaction, tended to achieve superior engagement and more sustained outcomes[56]. This suggests that the most effective future models are likely to be blended systems, combining the scalability of digital platforms with the relational and adaptive capacities of human care providers.

The relevance of digital mental health interventions is particularly pronounced in low- and middle-income countries (LMICs), where structural barriers to mental health care, including shortages of trained professionals, limited service infrastructure, and high levels of stigma, are especially acute [2]. In such contexts, digital interventions offer a potentially scalable and cost-effective means of expanding access to care. However, the applicability of these interventions in LMIC settings requires careful consideration of contextual constraints.

Access to digital infrastructure remains uneven, with disparities in internet connectivity, smartphone availability, and data affordability potentially limiting reach among vulnerable populations. In addition, variations in digital literacy may affect engagement and sustained use. These structural limitations suggest that interventions designed and evaluated in high-income settings may not be directly transferable without adaptation [4].

Cultural relevance represents another critical consideration. Many digital interventions are grounded in established therapeutic models such as cognitive behavioral therapy, which may not fully align with local conceptualizations of mental health and help-seeking behaviors. As such, culturally sensitive adaptation, including language, content, and delivery format, is essential to ensure acceptability and effectiveness across diverse populations [3,4].

Furthermore, the integration of digital interventions into existing health systems is likely to be a key determinant of success in LMICs. Hybrid models that combine digital tools with community-based or primary care services may offer a more feasible and sustainable approach than fully standalone interventions [6]. Future research should prioritize implementation-focused studies in low-resource settings to evaluate real-world effectiveness, scalability, and equity of access [51].

At the level of implementation, the review highlights both the promise and the limitations of digital mental health. Digital interventions clearly address key barriers to care, including accessibility, cost, and stigma. However, they introduce new challenges related to sustained engagement, personalization, and integration within existing health systems. Importantly, several studies identified structural and perceptual barriers, including privacy concerns, usability issues, and lack of perceived relevance that may limit uptake in real-world settings[5]. Addressing these barriers will require a shift from intervention development toward implementation science and system-level integration.

The findings of this review should be interpreted in light of several limitations. First, the included studies were heterogeneous in design, population, and outcome measurement, which limits the comparability of findings and precludes quantitative synthesis. Second, a substantial proportion

of studies were pilot or feasibility trials, often underpowered to detect between-group differences. Third, follow-up periods were frequently short, limiting conclusions regarding long-term effectiveness and sustainability. Finally, the rapid evolution of digital technologies means that some interventions evaluated in earlier studies may no longer reflect current design standards or user expectations.

Despite these limitations, the present review provides a comprehensive and critical synthesis of the current evidence base and identifies several priorities for future research. There is a clear need for longer-term trials assessing the sustainability of effects, as well as studies employing active and well-matched control conditions to isolate intervention-specific mechanisms. Future work should also prioritize engagement optimization, including the systematic evaluation of design features such as gamification, personalization, and social integration. Perhaps most importantly, research must move toward adaptive and personalized intervention models, leveraging real-time data to tailor content and delivery to individual users.

A critical area requiring further development is the translation of digital interventions from controlled research settings into routine clinical practice. While many interventions demonstrate efficacy under trial conditions, real-world implementation introduces additional challenges, including integration with existing healthcare systems, clinician acceptance, regulatory considerations, and long-term maintenance. Sustainable implementation will likely depend on embedding digital tools within established care pathways, supported by appropriate training, infrastructure, and policy frameworks. Without such integration, the scalability of digital interventions may not translate into meaningful population-level impact.

In conclusion, digital mental health interventions represent a promising but not yet fully realized innovation in the treatment and prevention of depression and anxiety among young people. Their effectiveness is best understood not as a fixed property, but as an emergent outcome shaped by interaction between technology, user, and context. Advancing the field will require a shift from demonstrating efficacy to engineering engagement, personalizing care, and embedding digital interventions within broader mental health systems. Only through such an integrative approach can the full potential of digital mental health be realized.

**Strengths and Limitations**

A key strength of this review lies in the breadth and methodological diversity of the included studies, capturing the full spectrum of digital mental health research from early feasibility trials to large-scale randomized and implementation-oriented studies. This comprehensive scope allows for a more ecologically valid understanding of the field, extending beyond efficacy under controlled conditions to include issues of engagement, scalability, and real-world applicability. The inclusion of diverse intervention modalities further strengthens the analysis by enabling cross-comparison of design approaches, rather than privileging a single technological paradigm.

Importantly, this review adopts a critical rather than purely descriptive synthesis, interrogating not only whether digital interventions are effective, but also the conditions under which their effectiveness is optimized. By foregrounding engagement, heterogeneity of response, and contextual moderators, the analysis advances the field beyond aggregate effect estimates toward a more nuanced and mechanistic understanding of digital intervention impact.

Several limitations should, however, be acknowledged. First, the included studies were heterogeneous in design, intervention type, outcome measures, and follow-up duration, which constrains direct comparability and precludes formal meta-analytic aggregation. Second, a substantial proportion of studies were pilot or feasibility trials, often underpowered to detect between-group differences, thereby limiting the strength of causal inference. Third, follow-up periods were frequently short, restricting conclusions regarding the durability of treatment effects and long-term clinical benefit.

Additionally, the rapid evolution of digital technologies introduces an inherent temporal limitation. Interventions evaluated in earlier studies may no longer reflect current standards in user experience design, personalization, or integration with health systems. As such, the evidence base is partially shaped by technological obsolescence, a challenge that is unique to digital health research. Finally, while the review captures a broad range of populations, the evidence remains disproportionately concentrated in high-income settings, raising questions regarding generalizability and equity in global mental health contexts.

## Conclusion

Digital mental health interventions represent a promising and evolving approach to addressing depression and anxiety among young people, particularly in contexts where access to traditional services is limited. This review demonstrates that such interventions can produce meaningful short-term

improvements in mental health outcomes; however, their effectiveness is variable and often modest when compared with active control conditions.

The findings highlight that effectiveness is not an inherent property of digital interventions but is shaped by user engagement, intervention design, and contextual factors. Engagement, in particular, emerges as a central mechanism through which therapeutic benefits are realized. Despite their scalability and accessibility, digital interventions face ongoing challenges related to sustained use, personalization, and integration into real-world healthcare systems.

The absence of formal quality appraisal and the heterogeneity of included studies limit the strength of conclusions that can be drawn regarding effectiveness. Furthermore, the evidence base remains heavily concentrated in high-income settings, raising concerns about generalizability.

Future research should prioritize long-term effectiveness, rigorous comparative designs, and implementation-focused studies that examine how digital interventions can be successfully integrated into routine care. Advancing the field will require a shift from demonstrating efficacy to optimizing engagement, enhancing personalization, and ensuring equitable access across diverse populations.

**Synthesis**

Taken together, the findings of this review indicate that digital mental health interventions for depression and anxiety in youth are not uniformly effective, but operate through a set of interacting mechanisms shaped by user engagement, intervention design, and contextual factors.

Engagement emerges as a central pathway through which these interventions exert their effects. Higher levels of user interaction, including completion of therapeutic content and sustained platform use, are consistently associated with improved clinical outcomes. In this sense, engagement functions not merely as a usage metric but as a core mechanism linking intervention delivery to psychological change.

These mechanisms are grounded in established therapeutic processes, including behavioral activation, cognitive restructuring, mindfulness, and psychological flexibility. Digital platforms appear capable of translating these processes into scalable formats; however, their effectiveness depends on the extent to which users actively engage with and internalize these components.

At the same time, intervention outcomes are moderated by individual and contextual factors, including baseline symptom severity, environmental stressors, and sociocultural context. This variability highlights the limitations of "one-size-fits-all" approaches and underscores the need for adaptive and personalized intervention models.

Overall, digital mental health interventions should be conceptualized not as static tools, but as dynamic systems in which effectiveness emerges from the interaction between user, technology, and context. Optimizing these interactions represents a key priority for future research and implementation.

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