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THE USE OF DIGITAL INTERVENTIONS BASED ON ARTIFICIAL INTELLIGENCE IN THE PSYCHOTHERAPY OF ADOLESCENT ANXIETY DISORDERS: A PRELIMINARY REVIEW OF POTENTIAL USABILITY, EFFICACY AND SAFETY

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Artificial intelligence (AI)-assisted digital mental health interventions are being increasingly discussed as a potential strategy for improving access to psychological support among adolescents with anxiety symptoms and anxiety disorders. Their possible advantages include flexible availability, reduced barriers to help-seeking, psychoeducation, symptom monitoring, CBT-informed exercises, conversational interaction, and personalized feedback. However, their clinical role remains insufficiently defined, particularly regarding efficacy, safety, ethical governance, and the distinction between digital support and psychotherapy in the traditional clinical sense. This narrative review examines current evidence and conceptual debates regarding AI-assisted digital interventions relevant to adolescent anxiety disorders, with a focus on usability, acceptability, preliminary efficacy, safety, ethical and legal considerations, and human clinical oversight. Available literature suggests that conversational agents and CBT-informed digital tools may provide low-threshold support and may reduce the symptoms of anxiety, depression, or general emotional distress in some users. Nevertheless, existing evidence remains heterogeneous and preliminary, often relying on young adult, mixed-age, non-clinical, or transdiagnostic samples, short follow-up periods, and self-report outcomes. Direct evidence for AI-assisted interventions specifically in adolescents with formally diagnosed anxiety disorders remains limited, and findings from broader youth, young adult, mixed-age, or transdiagnostic samples should not be directly generalized to this clinical population. It should not be considered a replacement for therapist-delivered psychotherapy, clinical assessment, or specialist child and adolescent mental health care. Their most appropriate current role is as adjunctive or supportive tools within supervised, stepped-care, or blended-care models. Future research should include adolescent-specific clinical trials, anxiety-focused outcomes, longer follow-up, systematic safety reporting, and clear evaluation of human oversight models. AI-assisted digital interventions may help reduce parts of the adolescent mental health treatment gap; however, their use must remain evidence-informed, developmentally sensitive, ethically regulated, and clinically supervised.

Keywords: artificial intelligence, adolescent anxiety, digital mental health, cognitive-behavioural therapy, conversational agents

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INTRODUCTION

Anxiety disorders are among the most common mental health problems in adolescence and are often accompanied by difficulties in emotional, social, academic, and family functioning. During this developmental period, young people face increasing demands related to peer relationships, identity formation, school achievement, autonomy, and future planning. When anxiety becomes persistent and impairing, it may affect school performance, social participation, self-esteem, family relationships, and overall quality of life. It is also frequently associated with depressive symptoms, other anxiety-related conditions, and later mental health difficulties (1-4). Early recognition and timely intervention are therefore important priorities in child and adolescent mental health care.

Cognitive-behavioral therapy (CBT) is one of the best-established psychological treatments for anxiety disorders in children and adolescents. It usually includes psychoeducation, identification and modification of maladaptive thoughts, exposure-based techniques, behavioral experiments, skills training, homework tasks, and relapse prevention. Meta-analytic evidence supports its effectiveness and acceptability in young people, although outcomes may vary depending on symptom severity, comorbidity, family involvement, treatment format, and access to trained professionals (5-8). In practice, however, many adolescents still do not receive timely psychological treatment. Limited availability of specialists, waiting lists, geographical distance, financial barriers, stigma, lack of family support, and reluctance to seek face-to-face care all contribute to this treatment gap (9,10).

Digital mental health technologies have been proposed as one way to reduce some of these barriers. Mobile applications, internet-based interventions, digital CBT programs, and conversational agents can offer flexible and low-threshold forms of support. For adolescents and young adults, these formats may be particularly acceptable because digital communication is already part of everyday life and may feel less stigmatizing than traditional service pathways (11-13). Within this broader field, artificial intelligence (AI) has attracted increasing attention because it may support personalization, automated feedback, symptom monitoring, conversational interaction, and adaptive delivery of therapeutic content (14-16).

Still, AI-assisted digital interventions should not be equated with psychotherapy in the traditional clinical sense. Psychotherapy involves a trained human therapist, individualized formulation, clinical judgment, therapeutic responsibility, supervision, and the capacity to respond to complex interpersonal and clinical dynamics. Most current AI-based tools in mental health are more accurately described as digital mental health interventions, conversational agents, CBT-informed self-help tools, or adjunctive supports rather than autonomous psychotherapeutic treatments (17-19). This distinction is particularly important in adolescent psychiatry, where developmental vulnerability, family involvement, informed assent, safeguarding, crisis escalation, and clinical oversight are essential.

The available evidence on AI-assisted interventions for adolescent anxiety remains promising but preliminary. Tools such as Woebot, Wysa, and Tess have shown potential for reducing the symptoms of anxiety, depression, or general emotional distress and for increasing access to low-threshold support (20-22). However, much of the evidence comes from short-term studies, feasibility designs, mixed-age or non-clinical samples, transdiagnostic interventions, or tools designed for general emotional well-being rather than adolescent anxiety disorders specifically (11,18,13). Conclusions about efficacy, safety, and clinical implementation therefore require caution.

The use of AI-supported interventions in adolescent mental health also raises ethical, legal, and professional questions, including privacy, transparency, informed consent and adolescent assent, parental or guardian involvement, algorithmic reliability, crisis detection, commercial influence, and professional accountability (23-27). Young users may experience conversational agents as empathic or emotionally supportive, but perceived support should not be confused with authentic empathy or a human-equivalent therapeutic alliance (17,28,29).

This narrative review examines current literature and conceptual debates on AI-assisted digital mental health interventions relevant to adolescent anxiety disorders, focusing on usability, preliminary efficacy, safety, ethical and legal considerations, and human clinical oversight. By clarifying both the potential and the limitations of these tools, the review aims to support a cautious, clinically grounded, and ethically responsible approach to their future use in adolescent mental health care.

METHODS

This paper was designed as a narrative review of current evidence and conceptual discussions on artificial intelligence (AI)-assisted digital mental health interventions relevant to adolescent anxiety disorders. A narrative

approach was chosen because the literature in this field is still heterogeneous and rapidly developing, including randomized and feasibility studies, real-world evaluations, systematic and scoping reviews, ethical analyses, conceptual papers, and clinical commentaries.

The review was guided by the following broad question: what is currently known about the usability, acceptability, preliminary efficacy, safety, ethical implications, and clinical limitations of AI-assisted digital mental health interventions for adolescents with anxiety symptoms or anxiety disorders? A targeted literature search was conducted using PubMed/MEDLINE, Google Scholar, and relevant publisher databases. Search terms included combinations of "artificial intelligence," "AI," "digital mental health," "chatbot," "conversational agent," "adolescent," "youth," "anxiety," "anxiety disorders," "cognitive behavioral therapy," "CBT," "digital psychotherapy," "AI-assisted psychotherapy," "Woebot," "Wysa," "Tess," "ethics," "safety," "privacy," "therapeutic alliance," and "clinical oversight." Particular attention was given to literature on adolescent and youth mental health, CBT-informed digital tools, conversational agents, and ethical or safeguarding issues in digital psychiatry.

The search primarily focused on publications from 2010 onward, while earlier foundational studies were included when relevant to adolescent anxiety, CBT, digital mental health, or ethical considerations. Priority was given to peer-reviewed articles, systematic or scoping reviews, meta-analyses, randomized or feasibility studies, and recent conceptual papers on responsible AI integration in mental health care. Sources were considered relevant if they addressed AI-assisted or conversational digital mental health interventions, digital CBT or CBT-informed support, adolescent or youth mental health, anxiety symptoms or anxiety disorders, usability, preliminary outcomes, safety, privacy, ethical or legal issues, or human clinical supervision.

To improve transparency while preserving the narrative character of the review, the literature identification and selection process was presented as a structured narrative search rather than as a systematic review. A total of 60 potentially relevant sources were initially considered through targeted searches and reference checking. After relevance assessment, 29 sources were excluded because they were not sufficiently aligned with the aims of the review, were replaced by more recent or more relevant sources, or addressed broader digital mental health topics without sufficient relevance to AI-assisted interventions, adolescent anxiety, usability, safety, ethics, or clinical oversight. The final synthesis included 31 sources judged to be most relevant to the aims of this narrative review. No formal PRISMA-based screening protocol, systematic risk-of-bias assessment, or quantitative evidence synthesis was performed. (Figure 1).

Given the emerging and methodologically diverse nature of the field, this review did not aim to provide a formal quantitative synthesis or risk-of-bias assessment. Instead, the evidence was narratively organized around clinically relevant themes: adolescent anxiety and treatment gaps, CBT-informed digital interventions, preliminary efficacy, usability and acceptability, safety and safeguarding, ethical and legal considerations, limitations of current evidence, and future research priorities. During the synthesis, particular caution was applied in distinguishing AI-assisted digital mental health tools from psychotherapy in the traditional clinical sense, and in separating adolescent-specific evidence from studies conducted in adult, mixed-age, non-clinical, or transdiagnostic samples.

The review was informed by literature on chatbot-based and AI-supported mental health interventions, including Woebot, Wysa, and Tess, as well as recent work on responsible AI integration, personalization, therapeutic progress, ethical governance, and limitations of AI-supported psychotherapy-

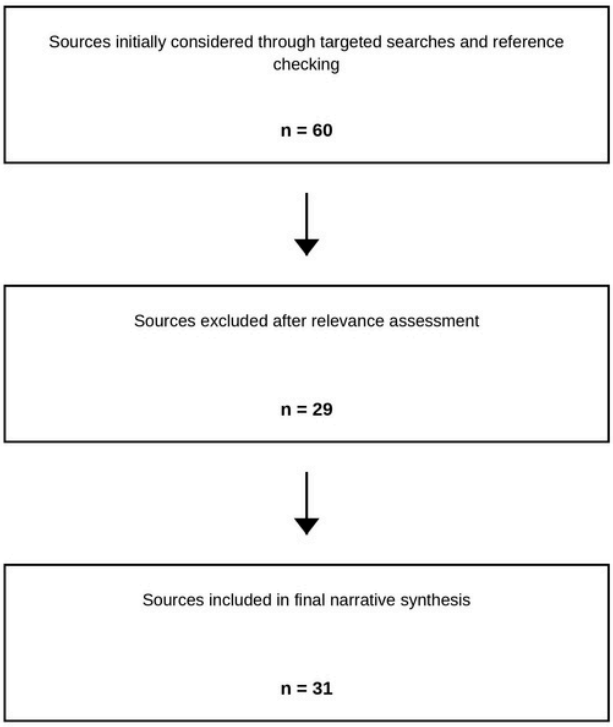


Figure 1. *Source identification and relevance-based selection*

related tools (14,30,23,20-22,18,27). Because adolescents represent a developmentally vulnerable population, special attention was given to transparency, informed consent and assent, parental or guardian involvement when appropriate, crisis escalation pathways, privacy protection, and human clinical oversight.

Adolescent anxiety disorders and the treatment gap

Adolescence is a period of rapid biological, psychological, cognitive, and social change. Young people are faced with increasingly complex peer relationships, academic expectations, identity-related questions, changing family roles, and preparation for adult life. Although fears and worries may be part of normal development, anxiety becomes clinically relevant when it is persistent, excessive, difficult to control, and associated with functional impairment.

Anxiety disorders are among the most common psychiatric disorders in children and adolescents. Epidemiological studies show that anxiety symptoms during adolescence may affect social development, academic achievement, family functioning, and overall quality of life (1-3). In many cases, anxiety does not occur in isolation, but is associated with other anxiety presentations, depressive symptoms, behavioral difficulties, substance use risk, and later mental health problems (2,4). Different forms of anxiety, including social anxiety, generalized anxiety, panic symptoms, separation anxiety, and school-related anxiety, may interfere with peer integration, autonomy, self-confidence, and academic progression.

The importance of adolescent anxiety is not limited to current distress. When untreated, anxiety disorders may become chronic or recurrent and may increase vulnerability to depression, functional impairment, and difficulties in later psychosocial adjustment (1,4). For this reason, adolescence can be seen not only as a period of vulnerability, but also as a window of opportunity. Timely intervention may reduce current impairment and potentially influence longer-term mental health trajectories.

Despite the availability of evidence-based psychological treatments, many adolescents with anxiety symptoms or anxiety disorders do not receive adequate or timely care. This treatment gap remains one of the major challenges in youth mental health. Barriers include limited availability of child and adolescent mental health professionals, waiting lists, geographical distance from specialized services, financial constraints, stigma, parental hesitation, limited information about treatment options, and adolescents' reluctance to disclose emotional difficulties in face-to-face settings (9,11,10). These barriers may be even more pronounced in underserved regions and in health systems with limited specialized resources.

Digital mental health interventions have been proposed as one way to reduce parts of this gap. Internet-based and mobile interventions may offer flexibility, easier access, and a greater sense of privacy than traditional service pathways. For some adolescents, digitally delivered support may also be more acceptable because it fits their usual ways of communication and information seeking (11,12). Still, accessibility alone is not enough. In adolescent mental health care, digital access has to be balanced with developmental sensitivity, clinical safety, family context, professional responsibility, and clear procedures for escalation when risk is identified.

AI-assisted digital tools may further expand the possibilities of digital mental health care through automated interaction, personalization, symptom monitoring, and adaptive delivery of CBT-informed strategies. However, these tools should be viewed as potential adjuncts or supportive interventions within a broader care framework, not as independent replacements for clinical assessment or therapist-delivered psychotherapy. This distinction is especially important in adolescent anxiety disorders, where treatment often requires not only symptom reduction, but also developmental support, family involvement, assessment of comorbidity, and safeguarding in situations of clinical risk.

CBT-informed digital and AI-assisted interventions

Cognitive-behavioral therapy is a structured and evidence-based approach commonly used in the treatment of anxiety disorders in children and adolescents. In therapist-delivered CBT, treatment usually includes psychoeducation, identification and modification of maladaptive thoughts, exposure-based techniques, behavioral experiments, skills training, homework tasks, relapse prevention, and, when appropriate, involvement of parents or caregivers. These elements are delivered within a therapeutic relationship that allows the therapist to individualize treatment, monitor emotional responses, adapt interventions to developmental level, and respond to comorbidity or clinical risk (5-8).

Digital CBT and CBT-informed interventions translate some of these components into online, mobile, or application-based formats. They may include psychoeducational modules, symptom monitoring, mood tracking, guided exercises, relaxation techniques, exposure planning, cognitive restructuring worksheets, behavioral activation tasks, reminders, and feedback based on user input. Some programs are self-guided, while others include therapist

guidance, coaching, parental involvement, or professional monitoring. In adolescent anxiety, such formats may be useful because they can reduce practical barriers to care and provide support in a form that many young people perceive as familiar and accessible (11,12).

Artificial intelligence may add further functions to these interventions, such as conversational interaction, personalization of content, automated feedback, adaptive intervention pathways, and monitoring of symptom changes over time. Conversational agents such as Woebot, Wysa, and Tess have been studied as examples of chatbot-based mental health support using CBT-informed or related psychological strategies. These tools may offer psychoeducation, emotional support, self-reflection prompts, mood tracking, behavioral suggestions, and structured exercises aimed at reducing anxiety, depression, or general emotional distress (20-22,18).

At the same time, CBT-informed digital support should not be confused with psychotherapy in the classical clinical sense. A chatbot or AI-based conversational tool does not independently provide comprehensive psychiatric assessment, individualized case formulation, therapeutic responsibility, or a human therapeutic alliance. Although some users may experience conversational agents as supportive, current AI systems are more accurately understood as digital mental health tools, self-help supports, or adjunctive interventions rather than replacements for therapist-delivered psychotherapy (17,19). This distinction is particularly important in adolescent psychiatry, where clinical work often includes developmental assessment, family context, school functioning, comorbidity evaluation, safeguarding, and crisis management.

Recent literature suggests that AI-supported psychotherapy-related tools may contribute to personalization, engagement, and perceived therapeutic progress, but their implementation should remain clinically cautious and ethically governed. Beg and colleagues emphasize both the potential of AI-driven psychotherapy-related systems and the challenges related to usability, personalization, therapeutic boundaries, clinical validity, and responsible integration into mental health care (14,30,15). In this sense, AI should not be framed as a simple technological replacement for psychotherapy, but as a developing set of tools whose value depends on evidence, transparency, safety procedures, and human oversight.

In adolescent anxiety disorders, AI-assisted digital interventions are best understood within stepped-care or blended-care models. In lower-risk situations, they may support psychoeducation, symptom monitoring, CBT-informed exercises, or work between clinical contacts. In more complex presentations, including comorbidity, severe impairment, family dysfunction, school refusal, trauma-related symptoms, or elevated clinical risk, they should not be used as stand-alone interventions. Their more appropriate role is as an adjunct to therapist-delivered care, with clear procedures for supervision, referral, escalation, data protection, and communication with caregivers when clinically and legally appropriate.

The central question is therefore not whether AI can replace psychotherapy, but whether carefully designed and validated AI-assisted tools can safely extend the reach of evidence-informed psychological support. Their potential lies in improving access, engagement, continuity, and personalization, while their limitations require cautious implementation, especially in vulnerable adolescent populations.

Current evidence for preliminary efficacy

The evidence base for AI-assisted digital mental health interventions in adolescent anxiety is growing but remains methodologically heterogeneous and clinically preliminary. Existing studies suggest that conversational agents and CBT-informed digital tools may reduce symptoms of anxiety, depression, or general emotional distress in some users. However, the strength and specificity of this evidence vary considerably across interventions, populations, study designs, and outcome measures.

Several frequently cited chatbot-based interventions, including Woebot, Wysa, and Tess, have shown promising short-term outcomes in reducing psychological distress. Woebot has been evaluated in young adults with symptoms of depression and anxiety, with reductions in self-reported symptoms over a brief intervention period (20). Tess has been examined as a psychological AI system for symptoms of depression and anxiety. At the same time, Wysa has been evaluated using real-world data as a conversational agent for digital mental well-being (21,22). These studies support the potential relevance of conversational tools for low-threshold emotional support and CBT-informed self-help.

However, findings from these interventions should be applied to adolescent anxiety disorders with caution. Many studies include young adults, university students, mixed-age samples, nonclinical users, or participants with subclinical symptoms rather than adolescents with formally diagnosed anxiety disorders. Several tools also target emotional distress, depression, stress, or general well-being rather

than anxiety disorders specifically. Outcomes are commonly based on self-report scales and short follow-up periods, while evidence on diagnostic recovery, long-term maintenance, relapse prevention, functional improvement, and safety in clinically complex adolescent populations remains limited (11,18,13).

Another important distinction concerns the level of human involvement. Fully automated conversational agents, self-guided digital interventions, therapist-guided programs, coaching models, and blended-care approaches are not directly comparable. In adolescent psychiatry, human oversight may strongly influence safety, engagement, adherence, risk detection, family communication, and referral when symptoms worsen. For this reason, evidence from supervised digital interventions should not be interpreted as evidence for fully autonomous AI-based care.

Evidence for digital mental health interventions in young people is broader than evidence for AI-specific interventions in adolescent anxiety. Reviews suggest that online and mobile interventions may be acceptable and may improve symptoms, particularly when they are structured, theory-based, and supported by some degree of guidance (11,12). AI-assisted tools are a newer and narrower category within this field, and their mechanisms of action, safety profile, sustained engagement, and comparative effectiveness remain insufficiently established.

Current evidence is therefore best described as promising but preliminary. AI-assisted conversational tools may have value as accessible, low-threshold, CBT-informed supports for adolescents with mild symptoms, psychoeducational needs, or barriers to traditional care. At present, however, the literature does not justify their use as stand-alone replacements for clinical assessment, therapist-delivered CBT, or specialist child and adolescent mental health care.

Overall, the quality of evidence was interpreted as preliminary and heterogeneous rather than definitive. Randomized controlled trials provide the strongest available evidence for selected conversational agents. Still, many were conducted in young adult, university, mixed-age, or non-clinical samples and used short follow-up periods and self-report outcomes. Real-world evaluations provide useful information on engagement and ecological use, but are limited by selection bias and lack of control groups. Reviews and conceptual papers are useful for mapping the field and identifying ethical or implementation issues, but they do not provide direct evidence of clinical efficacy. For this reason, the present review interprets the available evidence cautiously and avoids conclusions that would imply equivalence between AI-assisted tools and therapist-delivered psychotherapy.

Taken together, the overall certainty of evidence was judged to be low for AI-assisted interventions specifically targeting adolescents with diagnosed anxiety disorders. Evidence was considered somewhat stronger for broader digital CBT and CBT-informed interventions in youth, and for selected conversational agents in young adult or mixed-age samples, but this evidence remains indirect for the specific population and clinical focus of the present review. The main factors limiting certainty were population indirectness, intervention heterogeneity, short follow-up periods, reliance on self-report measures, limited diagnostic assessment, and insufficient safety reporting.

To clarify the heterogeneity of the available evidence, Table 1 summarizes selected AI-assisted and conversational digital mental health interventions relevant to anxiety, emotional distress, and adolescent mental health. Because the available sources include randomized controlled trials, feasibility studies, real-world evaluations, longitudinal studies, reviews, and conceptual papers, the table also distinguishes the level and interpretation of evidence for each source. As shown in Table 1, these interventions should currently be interpreted mainly as adjunctive, supervised, or low-threshold forms of digital support rather than stand-alone replacements for therapist-delivered CBT.

Usability and acceptability among adolescents

Usability and acceptability are important for AI-assisted digital mental health interventions in adolescents. Even when an intervention is clinically well designed, its value depends on whether young people are willing to use it, understand its purpose, find the interface appropriate, and can fit it into everyday routines.

Adolescents and young adults commonly use digital technologies for information, communication, validation, and peer support. This may increase the acceptability of digital mental health tools, especially when traditional pathways involve waiting lists, parental mediation, geographical barriers, or stigma (11-13). For some adolescents, a mobile or web-based tool may feel more private, less intimidating, and easier to access than an initial face-to-face meeting with a mental health professional.

Features such as immediate access, flexible timing, conversational interaction, brief exercises, reminders, personalized feedback, symptom tracking, and use outside clinical settings may improve usability. In anxiety disorders, where avoidance, fear of evaluation, shame, or difficulty initiating help-seeking may delay treatment, low-threshold digital support may help some adolescents begin with psychoeducation and basic CBT-informed strategies earlier

Table 1. *Selected AI-assisted and conversational digital mental health interventions relevant to anxiety, emotional distress, and adolescent mental health*

Intervention /tool	Modality and therapeutic orientation	Population/ age group	Clinical focus	Study design/evidence type	Main reported findings	Safety and methodological considerations	Evidence level / interpretation
Woebot	Fully automated conversational agent delivering CBT-informed self-help content	Young adults/college students	Symptoms of depression and anxiety	Randomized controlled trial	Short-term reductions in self-reported depressive symptoms and feasibility of chatbot-delivered CBT-informed support were reported; anxiety-related outcomes were also assessed	Not adolescent-specific; short intervention period; self-selected sample; symptom reduction rather than diagnostic recovery; should not be interpreted as evidence of autonomous psychotherapy for adolescent anxiety disorders (20)	Randomized controlled trial; preliminary evidence in young adults, not adolescent-specific clinical anxiety evidence.
Tess	Psychological AI / conversational agent using integrative therapeutic strategies, including CBT-informed elements	Adults / students and mixed user groups in available studies	Symptoms of depression and anxiety	Randomized controlled trial / feasibility-oriented evaluation	Reported reductions in self-identified symptoms of depression and anxiety, suggesting potential for low-threshold digital support	Limited adolescent-specific evidence; intervention should be framed as AI-assisted support rather than classical psychotherapy; longer-term efficacy, safety, and clinical supervision require further evaluation (21)	Randomized controlled trial / feasibility-oriented evidence; preliminary and limited by sample characteristics and follow-up.
Wysa	AI-enabled text-based conversational mental well-being application using supportive and CBT-informed techniques	Real-world users; primarily self-selected app users	Depression symptoms, emotional distress, general well-being; anxiety-related support may be included	Real-world data evaluation / mixed-methods study	Preliminary evidence suggested user engagement and improvement in self-reported symptoms among users with depressive symptoms	Real-world design limits causal inference; self-selection bias; not specific to adolescents or diagnosed anxiety disorders; safety and crisis escalation require explicit reporting (22)	Observational real-world evidence; useful for engagement and ecological use, but limited causal inference.
Kai.ai	Automated conversational agent delivering ACT-based self-help tools	Adolescents	Well-being and emotional support	Longitudinal study	Findings suggested potential usefulness of an AI-powered mobile tool for supporting adolescent well-being	Focus was well-being rather than diagnosed anxiety disorders; not CBT-specific; evidence is preliminary and does not establish efficacy for adolescent anxiety treatment (13)	Longitudinal youth-focused evidence; preliminary and not equivalent to disorder-specific anxiety treatment evidence.
AI-assisted online social therapy / youth mental health platforms	Digital platform with AI-supported or technology-assisted components, usually embedded in broader psychosocial support	Young people / youth mental health populations	Social functioning, emotional distress, youth mental health support	Conceptual and early implementation evidence	May support engagement, social connectedness, and access to structured online therapeutic environments	Often not fully automated and not equivalent to stand-alone chatbot intervention; requires moderation, human oversight, safeguarding, and integration into clinical care (12)	Conceptual and early implementation evidence; relevant for youth digital mental health support, but not direct efficacy evidence.

Digital CBT and internet-based interventions for youth	Online or mobile CBT-informed interventions; may be self-guided, guided, or blended	Children, adolescents, and young people	Anxiety, depression, and broader emotional symptoms	Systematic reviews and meta-analytic evidence across digital interventions	Evidence suggests that structured digital mental health interventions may be acceptable and may reduce symptoms, particularly when guided or clinically supported	This evidence is broader than AI-specific evidence; intervention heterogeneity is high; adolescent anxiety-specific AI evidence remains limited (11,6,8)	Review and conceptual evidence; useful for interpretation, personalization, and governance, but not direct clinical efficacy evidence.
Emerging AI-driven psychotherapy-related systems	AI-supported personalization, automated feedback, conversational interaction, monitoring, and therapeutic content delivery	Mostly adult, mixed-age, or conceptual literature	Various mental health conditions; anxiety and emotional distress included in broader discussions	Narrative reviews, conceptual papers, qualitative and implementation-oriented literature	Recent literature highlights potential for personalization, perceived therapeutic progress, usability, and expanded access	Evidence remains preliminary; responsible integration requires transparency, ethical governance, data protection, clinical validation, and human oversight (14,30,15,23)	Ethical and governance evidence; relevant to safety, accountability, and regulation, but not efficacy evidence.

(11,10). Digital tools may also support continuity between clinical contacts through symptom monitoring, homework reminders, and reinforcement of coping strategies.

However, acceptability should not be confused with clinical adequacy. Adolescents may initially be attracted by novelty, accessibility, or anonymity, but sustained use depends on perceived usefulness, trust, privacy, personalization, emotional relevance, and user experience. Digital interventions often face attrition and declining engagement, which is especially relevant in anxiety disorders, where avoidance may also interfere with therapeutic tasks.

The conversational format may increase engagement by creating a sense of responsiveness and emotional availability. Some users experience chatbots as supportive, non-judgmental, and easier to disclose to than human professionals (28,18). Still, simulated empathy is not equivalent to human empathy, clinical intuition, or a therapeutic alliance (17,29).

Personalization may further improve acceptability, particularly when tools adapt to user input, symptom patterns, engagement history, or preferred communication style (15). In adolescents, however, personalization must be balanced with privacy, transparency, developmental differences, family context, comorbidity, and digital literacy.

Acceptability also depends on parents, caregivers, schools, and clinicians. Adolescents may value privacy and autonomy, while adults remain responsible for safety, consent, monitoring, and escalation when risk is present. Therefore, usability should be evaluated not only through satisfaction or frequency of use, but also through developmental appropriateness, sustained engagement, clinical relevance, privacy, safety, and integration with professional care.

Safety, safeguarding, and human clinical oversight

Safety is a central requirement for the responsible use of AI-assisted digital interventions in adolescent mental health care. Adolescents are a developmentally vulnerable population, and anxiety symptoms may coexist with depression, self-harm risk, substance use, trauma-related symptoms, family conflict, school refusal, neurodevelopmental difficulties, or emerging severe mental disorders. For this reason, AI-assisted tools should not be implemented only because they are accessible, convenient, or acceptable to users. Their use requires clear safety procedures, defined limits, and human clinical oversight.

A major concern is that an AI-assisted tool may fail to recognize clinical complexity or deterioration. Anxiety in adolescents may present through avoidance, irritability, somatic complaints, sleep problems, concentration difficulties, social withdrawal, school refusal, or family conflict. Automated systems may not reliably distinguish mild anxiety from clinically significant anxiety disorders, comorbid depression, trauma-related symptoms, or situations requiring urgent clinical evaluation. AI-supported interventions should therefore include screening procedures, limits for self-guided use, and referral pathways when symptoms exceed the intended scope of the tool.

Safeguarding is particularly important when digital tools are used with minors. Responsible implementation requires

transparent procedures for parental or guardian consent, adolescent assent, confidentiality, data sharing, and crisis escalation. Adolescents should know that they are interacting with a digital tool or conversational agent rather than a human therapist, what support it can provide, its limitations, how data are stored and used, and when information may need to be shared for safety reasons (23,27).

Crisis detection and escalation remain especially sensitive. AI-assisted systems should have predefined procedures for identifying signs of acute distress or elevated clinical risk and directing users toward immediate human support. However, automated detection is not sufficient on its own. Missed risk signals, false reassurance, inappropriate generic responses, or delayed referral remain possible. AI tools should therefore not be presented as crisis services, and adolescents, families, and clinicians should be informed about emergency pathways and available professional support.

Human oversight is essential because AI systems do not possess clinical judgment, professional responsibility, or the ability to integrate developmental, family, and contextual information in the way a trained clinician can. AI-assisted tools may support monitoring, psychoeducation, or between-session practice, but they should not independently make diagnostic decisions, determine treatment suitability, or manage clinically high-risk situations (17-19).

The required level of oversight should depend on clinical risk and intervention purpose. In mild cases, AI-assisted tools may be used as low-threshold psychoeducational support. In moderate or complex presentations, they should be adjuncts to professional care. In severe or high-risk situations, they should not be used as stand-alone interventions. Overall, AI-assisted interventions appear safest within stepped-care or blended-care models, where digital tools support psychoeducation, symptom tracking, CBT-informed exercises, and continuity of care, while human professionals remain responsible for assessment, formulation, treatment planning, risk management, and safeguarding.

Ethical, legal, and data governance considerations

The use of AI-assisted digital interventions in adolescent mental health raises ethical, legal, and data governance concerns because these tools may collect highly personal psychological information, including mood states, anxiety symptoms, family and school difficulties, interpersonal problems, and risk-related content. Ethical implementation therefore requires attention to autonomy, beneficence, non-maleficence, justice, transparency, accountability, privacy, and safeguarding (23,25,27).

Autonomy is complex in adolescent care. Young people may value privacy and may disclose emotional difficulties more easily to a digital tool than to adults around them. At the same time, minors usually require some level of parental or guardian involvement, depending on age, legal context, clinical indication, and risk. AI-assisted interventions should therefore provide developmentally appropriate information about the nature and limits of the tool, data use, confidentiality, human oversight, and circumstances in which confidentiality may be limited for safety reasons. Informed consent and adolescent assent should be treated as a process of understanding, not as a formality.

Transparency is equally important. Adolescents and caregivers should know when they are interacting with an AI system rather than a human therapist. Conversational agents may use empathic language and may be experienced as supportive, but simulated empathy is not equivalent to human empathy, clinical judgment, or a therapeutic alliance (17,29). Clear communication about the non-human nature of the intervention may reduce unrealistic expectations and inappropriate reliance on automated support.

Non-maleficence requires attention to possible harms, including inaccurate responses, failure to recognize deterioration, excessive reassurance, delayed help-seeking, privacy breaches, algorithmic errors, overdependence, or use in situations for which the tool was not designed. These risks are particularly relevant in adolescents with comorbidity, severe impairment, family conflict, trauma-related symptoms, or elevated clinical risk. AI-assisted tools therefore require safety boundaries, crisis escalation procedures, mechanisms for human review, and guidance on when professional help is needed (18,19).

Beneficence and justice should also guide implementation. Digital tools may support psychoeducation, self-monitoring, skills practice, and low-threshold access, but their value should be interpreted cautiously because evidence in adolescent anxiety disorders remains preliminary (11,12). They may improve access in underserved areas or reduce stigma-related barriers, but may also reproduce inequalities if access depends on smartphones, stable internet, privacy at home, digital literacy, language, or culturally adapted content.

Data governance, accountability, and commercialization require explicit regulation. Psychological data may reveal

intimate information about emotions, relationships, family functioning, and risk, raising questions about ownership, secondary use, anonymization, withdrawal of consent, and security (24,27). If an AI-assisted tool gives inappropriate guidance, fails to detect risk, or contributes to delayed care, responsibility cannot remain unclear. Roles of developers, institutions, clinicians, schools, regulators, and commercial providers should be defined before implementation (23,26). Because many tools are commercially developed, claims about efficacy, safety, and personalization should be evidence-based, transparent, and proportionate, particularly when intended users are adolescents (31).

Overall, a clinically acceptable model should include transparent communication, meaningful consent and assent, appropriate parental or guardian involvement, privacy protection, human oversight, crisis escalation pathways, evidence-based claims, and clear accountability.

Limitations of current evidence

Although AI-assisted digital mental health interventions have attracted considerable interest, the current evidence base remains limited, especially for adolescent anxiety disorders. This is important because adolescence involves developmental vulnerability, family and school context, diagnostic complexity, and safeguarding responsibilities.

A major limitation is that much of the evidence is not specific to adolescents with diagnosed anxiety disorders. Frequently cited studies of conversational agents and AI-supported tools often include young adults, university students, mixed-age users, non-clinical samples, or participants with general psychological distress rather than adolescents who have undergone formal assessment for anxiety disorders (20-22,18). These findings therefore cannot be directly generalized to clinical adolescent populations.

Many interventions are also transdiagnostic or aimed at general emotional well-being rather than anxiety disorders specifically. Reductions in self-reported distress, depressive symptoms, stress, or general anxiety symptoms are clinically relevant, but they are not the same as evidence of effective treatment for adolescent anxiety disorders. Few studies distinguish symptom improvement from functional recovery, diagnostic remission, relapse prevention, or long-term outcome. This is important because evidence-based anxiety treatment usually requires structured assessment, formulation, exposure-based work, monitoring of avoidance, and adaptation to comorbidity and developmental context (6-8).

The available studies are often short-term and feasibility-oriented. They may show initial acceptability, symptom change, or user satisfaction, but provide less information about durability of effects, adherence, relapse prevention, adverse events, or outcomes after discontinuation (11,12). Methodological limitations are also common, including small samples, self-selected users, high attrition, limited blinding, lack of active control conditions, reliance on self-report measures, incomplete adherence data, and insufficient assessment of adverse events (11,18).

Another source of uncertainty is the level of human involvement. Fully automated conversational agents guided digital CBT programs, therapist-supported online interventions, school-based tools, and blended-care models differ substantially in intensity, safety procedures, adherence, and clinical responsibility. In adolescent anxiety, human oversight may be essential for risk management, differential diagnosis, family communication, and treatment adaptation (17,19).

Safety reporting remains insufficient. Many studies focus on usability, symptom reduction, or engagement, while less attention is given to adverse events, symptom deterioration, crisis-related responses, inappropriate recommendations, privacy concerns, or escalation procedures. Tools intended for adolescent mental health support should be evaluated not only for benefit, but also for their ability to recognize situations outside their intended scope and direct users toward human support (23,25,27).

Finally, evidence on mechanisms and implementation remains limited. It is still unclear whether improvements result mainly from CBT-informed content, self-monitoring, psychoeducation, perceived support, reminders, novelty, or the structure provided by the tool. The role of perceived empathy and alliance-like experiences is also unresolved and should not be equated with a human therapeutic alliance (17,28,29). Overall, AI-assisted digital interventions should be described as promising but preliminary, with a possible role as supportive or adjunctive tools rather than replacements for comprehensive clinical assessment or therapist-delivered evidence-based treatment.

This review also has limitations. As a narrative review, it did not use a formal systematic review protocol, PRISMA flow diagram, or standardized risk-of-bias assessment. The selection of literature was guided by relevance to the review aims, which may introduce selection bias. The heterogeneity of study designs, populations, interventions, and outcomes also limited direct comparison between sources. In addition, because AI-assisted mental health care is developing rapidly, some very recent tools or studies may not have been included. Publication bias is also possible, as

positive findings and technologically novel interventions may be more likely to be published than negative or inconclusive results.

Future research and clinical implementation priorities

Future research on AI-assisted digital interventions for adolescent anxiety disorders should move beyond feasibility, novelty, and user satisfaction toward stronger clinical evaluation. Studies need clearly defined adolescent samples, standardized diagnostic procedures, anxiety-specific outcomes, and transparent reporting of symptom severity, comorbidity, medication use, previous treatment, family involvement, and functional impairment. Without this detail, it remains difficult to determine whether observed improvements represent clinically meaningful change or only short-term reductions in general emotional distress.

Randomized controlled trials with adequate sample sizes, active comparison groups, and longer follow-up periods are needed. Future studies should compare AI-assisted tools with established digital CBT programs, therapist-guided interventions, blended-care models, and standard face-to-face CBT where appropriate. Outcomes should include not only symptom reduction, but also functional improvement, adherence, dropout, relapse prevention, safety, and user satisfaction (6-8).

Future work should also describe interventions more precisely. Fully automated conversational agents, CBT-informed self-help tools, therapist-supported digital programs, school-based interventions, and blended-care models should not be treated as equivalent. They differ in therapeutic intensity, personalization, clinical responsibility, safety procedures, and expected outcomes. Clear reporting is needed on the role of AI, the degree of human oversight, therapeutic components, intended users, and contraindications for use (18,19).

Safety and implementation should be evaluated together. Studies should report adverse events, symptom deterioration, crisis-related interactions, inappropriate responses, privacy concerns, dropout related to negative user experience, and referral or escalation outcomes. In adolescents, this also includes parental or guardian involvement, adolescent assent, safeguarding, emergency referral, and communication with clinicians or responsible adults when risk is identified (23,25,27).

Implementation research should clarify how these tools could be responsibly used in specialist services, schools, primary care, and stepped-care pathways. Clinicians should be able to evaluate whether a tool is evidence-based, safe, developmentally appropriate, and suitable for a particular adolescent, not only whether it is attractive or easy to use (23,10,12). User-centered research remains important. Adolescents, caregivers, clinicians, school psychologists, and other stakeholders should be involved in design and evaluation. Qualitative studies may clarify how young users experience trust, personalization, privacy, usefulness, and the boundaries of interaction with conversational agents (15,28).

The rapid development of generative AI and large language model-based applications represents an additional challenge for future research and regulation. These systems may allow more flexible, naturalistic, and personalized interaction than earlier rule-based or scripted chatbots, but they also introduce new risks, including inconsistent responses, hallucinated or inaccurate content, reduced transparency, over-reliance by users, and difficulties in clinical accountability. In adolescent mental health, these risks are particularly relevant because conversational fluency may increase perceived trust and emotional reliance. Therefore, future studies should evaluate generative AI and large language model-based tools separately from earlier chatbot interventions, with specific attention to safety, explainability, clinical validation, age-appropriate design, and human oversight (32). Finally, future studies should examine mechanisms of change and ethical regulation. It remains unclear whether benefits result from CBT-informed exercises, psychoeducation, self-monitoring, perceived support, personalization, novelty, or the structure of the tool. Implementation should be guided by standards for transparency, privacy protection, accountability, crisis escalation, evidence-based claims, and professional responsibility (17,24,29,26,31). The goal should not be to replace human psychotherapy, but to determine how AI-assisted tools can support evidence-based care while preserving the central role of clinicians in assessment, formulation, risk management, and treatment planning.

AI-assisted digital mental health interventions represent a promising but still preliminary approach to improving access to support for adolescents with anxiety symptoms and anxiety disorders. Their potential advantages include flexible access, reduced barriers to help-seeking, psychoeducation, symptom monitoring, CBT-informed exercises, and personalized feedback. These features may be relevant for adolescents who face barriers to traditional care or prefer more accessible digital forms of support. However, current evidence does not support the use of AI-assisted tools as replacements for therapist-delivered psychotherapy, specialist clinical assessment, or child and adolescent mental health care. Available studies are hetero-

geneous and often include mixed-age, non-clinical, or transdiagnostic samples, short follow-up periods, self-report outcomes, and limited safety reporting. Evidence specific to adolescents with diagnosed anxiety disorders remains insufficient. Therefore, the current clinical applicability of AI-assisted tools for adolescents with diagnosed anxiety disorders remains limited and should be interpreted with caution. At present, these interventions are best understood as adjunctive or supportive tools rather than autonomous psychotherapeutic treatments. In adolescent psychiatry, implementation must account for developmental vulnerability, comorbidity, family context, informed consent and adolescent assent, privacy, safeguarding, crisis escalation, and professional responsibility. Conversational agents may be perceived as supportive, but simulated empathy should not be equated with human empathy, clinical judgment, or therapeutic alliance. The most appropriate current role of AI-assisted tools appears to be within supervised, stepped-care, or blended-care models. In such frameworks, digital tools may support psychoeducation, self-monitoring, skills practice, and continuity between clinical contacts, while human professionals remain responsible for diagnosis, formulation, treatment planning, risk management, and ethical decision-making. Their future value will depend on rigorous adolescent-specific research, systematic safety reporting, ethical regulation, and responsible integration into mental health care systems.

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Not applicable.

Statement of Competing Interest

The authors declare no relevant conflicts of interest.

Statement of Data Availability

Data sharing is not applicable to this article as no new datasets were generated or analyzed during the preparation of this narrative review.

Statement of Generative AI Use

During manuscript preparation, AI-assisted tools were used for language editing, formatting support, and improvement of clarity. All AI-assisted outputs were critically reviewed, revised, and verified by the authors. The authors take full responsibility for the final content of the manuscript.

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