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REVIEW

Virtual Reality in the Treatment of Anxiety-Related Disorders: A Review of the Innovations, Challenges, and Clinical Implications

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Abstract

Purpose of Review This review aims to examine the evolving literature on virtual reality (VR) technology in the treatment of anxiety-related disorders. We explore recent evidence across categories of anxiety-related disorders, focusing on the advantages and limitations of VR as a means of delivering exposure therapy. Finally, we propose recommendations for incorporating VR in current clinical practice and areas for future innovation.

Recent Findings VR-based exposure therapy (VRET) is the dominant application of VR for anxiety-related disorders. Growing evidence shows that it is a well-accepted intervention that is superior to waitlist conditions, especially for phobias, social anxiety, and post-traumatic stress disorder; however, more investigation is needed into how VRET compares to conventional treatment modalities. Recent innovations include successful self-directed VRET programs, augmenting VRET with neuromodulation, and beginning exploration of therapeutic processes in the delivery of VRET. Notable limitations include limited comparison to standard treatment and lack of standardization of VRET protocol, which limits translatability.

Summary VRET shows promise in enhancing treatment models for anxiety-related disorders, but uniformization of software and delivery protocols will be a key next step.

Keywords Virtual reality · Exposure therapy · Cognitive behavioral therapy · Anxiety-related disorders · Digital mental health

Introduction

Anxiety-related disorders are among the most common mental health conditions worldwide [1]. They are estimated to impact more than 300 million people globally and manifest as symptoms of uncontrollable worry, fear, and hyperarousal [1]. Untreated anxiety-related disorders can lead to disability and decreased quality of life by affecting work, relationships, and even physical health problems [2]. Cognitive Behavioral Therapy (CBT) is considered the first-line treatment for anxiety-related disorders across the lifespan [3]. While CBT consists of multiple components, exposure therapy in particular has gained robust empirical support as a key ingredient in anxiety treatment [3–5]. Despite its robust effect and consideration as the first-line treatment, exposure therapy remains one of the least utilized evidence-based practices [6]. Research into this dissemination gap points to challenges accessing trained providers, clinician hesitancy to provide exposure therapy, and logistical barriers to conducting in-vivo exposures, such as the availability of relevant stimuli [7]. Clinicians and researchers have long been interested in leveraging technological innovations to address these issues [8]. With recent explosive advancements in digital technology, virtual reality (VR) presents a promising opportunity to overcome some logistical barriers and transform the exposure therapy delivery model.

This review aims to examine the evolving literature on the use of VR in treating anxiety-related disorders. We explore the most recent evidence for primary categories of anxiety-related disorders (specific phobias, social anxiety disorder, post-traumatic stress disorder, obsessive-compulsive disorder, and selective mutism), with a focus on the advantages and limitations of VR as a means of delivering

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exposure therapy. Finally, we propose recommendations for incorporating VR in current clinical practice and areas for future innovation.

Traditional Treatment of Anxiety-Related Disorders

In exposure therapy, patients are systematically exposed to fear-inducing stimuli to facilitate safety learning (i.e., learning feared situations are safer and more tolerable than predicted) while reducing maladaptive forms of avoidance [3]. Stimuli in exposure therapy are typically presented through in-vivo exposure (IVE) or imaginal exposure (IE). IVE happens through direct interaction with the feared stimuli (i.e., being near or interacting with a feared item), whereas IE involves the patient generating mental images or scripts (i.e., imagining or writing about being in a feared situation) so the stimuli are experienced psychologically [3, 4].

Although both methods of exposure therapy are effective in treating anxiety, they face notable barriers to successful implementation [7]. For IVE, feared stimuli can be difficult to access (e.g., fears of specific animals or flying) or may require treatment outside the clinic setting (e.g., crowds for social anxiety), which can jeopardize confidentiality and generally make providers uneasy [9]. While IE involves fewer external variables, patients may struggle with generating vivid, intense versions of stressful stimuli, and may not be as effective as IVE for reducing avoidant behaviors by itself [5].

Evolution of Virtual Reality in Treatment

The term virtual reality was coined in the late 1980s by Jaron Lanier, and it is around this time that VR began widespread adaptation across areas of education, military, entertainment, and medicine [10]. Since the 1990s, mental health clinicians have explored using virtual reality as a tool to deliver exposure therapy - a form that became known as virtual reality exposure therapy (VRET) [11]. The fundamentals of VRET are similar to traditional exposures in that patients are systematically exposed to stimuli specific to their individual anxiety concerns. The key difference is that the stimuli are pre-programmed via software and delivered within a virtual environment to the patient using hardware such as VR headsets [10, 12]. The first study of VRET demonstrated efficacy in treating acrophobia (fear of heights) [11], which sparked research interest in the role of VR in anxiety treatment that continues to grow today. [Figure 1] illustrates the exponential growth of research interest in clinical applications of VR in anxiety-related disorders.

Notable Research To Date

Over 25 years after the first study on acrophobia, the majority of research on VR applications for anxiety remains focused on VRET [12, 13]. The initial wave of research investigated whether VRET was generally effective and acceptable [14, 15]. Several systematic reviews of VR studies for various anxiety-related disorders confirmed that VRET tends to result in significant benefits when compared to inactive controls such as waitlist or psychoeducation [12, 13]. VRET has demonstrated good acceptability, with participants having similar drop-out rates as traditional exposure therapy [13] and some participants even reporting that they would be more likely to participate in VR exposures than IVE for treatment of specific phobias [16]. Although it is worth considering whether patient preference is in part due to avoidant behaviors, which is inherent to anxiety disorders.

More recent interest has focused on how VRET for specific diagnoses compares to the current gold-standard of exposure therapy in IVE or IE format. A 2019 meta-analysis by Carl et al. examining RCTs on VRET across multiple anxiety-related conditions (specific phobias, social anxiety and performance anxiety, post-traumatic stress disorder, and panic disorder) demonstrated a significant effect size of VRET over waitlist controls and no significant difference in effect size between VRET and conventional exposure therapy [17]. A more recent 2023 meta-analysis by Schroder et al. on social anxiety disorder, specific phobias, panic disorder, and agoraphobia also showed no significant differences between VRET and conventional exposure delivery on pooled analysis of self-rated anxiety, avoidance behaviors, and drop-out rates [13]. Notably, a high level of heterogeneity of effect size was observed across the VR studies [13]. Overall, current evidence may suggest non-inferiority of VRET to conventional exposure treatment, although with notable limitations in study uniformity that will be discussed later in this review.

Given this context, we will review the updates to the literature with a focus on the most recent studies to contrast known findings and consider how this may guide our use of VR in clinical settings for each specific anxiety disorder.

Methods

For this topical review, an initial search was conducted on PubMed for articles utilizing VR technology in the treatment of anxiety-related disorders. Search terms included virtual reality, post-traumatic stress disorder, anxiety, panic, obsessive-compulsive disorder, agoraphobia, and phobia. Parameters were limited to clinical studies published within the past three years (Jan 2022 - Dec 2024). The resulting

255 articles underwent title and abstract screening by two authors, with uncertainties being resolved by a third author. Inclusion criteria were (1) the primary study population was individuals with a diagnosed anxiety disorder, (2) at least one study arm utilized virtual reality technology for treatment intervention, (3) using an immersive display system (i.e., headset) instead of a 2D display (i.e., a computer monitor). Exclusion criteria included (a) subclinical populations, (b) non-VR forms of simulation, (c) non-clinical studies such as review articles and study protocols.

A total of 16 studies met the inclusion criteria. Population, Intervention, Comparison, and Outcome (PICO) [18] data was extracted from the included studies with emphasis on the details of the VR exposure scenario and VRET delivery protocol. A narrative synthesis of our findings was completed to highlight innovations or key differences from the known literature.

Updates To Previous Findings

The findings of this review are categorized by each anxiety disorder. We first summarize relevant findings from past systematic reviews [12, 13, 31] before highlighting new trends and key considerations from studies captured in the current search.

Specific Phobias

Specific phobias (SPs) are some of the most commonly researched disorders within the realm of VR-based treatments [12]. The majority of past studies have examined multi-session treatment for fears of flying or heights, and most of those studies use a graduated set of scenarios that are increasingly more anxiety-provoking (i.e., pre-set fear hierarchies) as the patient moves through treatment [19]. CBT incorporating VRET for SPs has demonstrated acceptability and efficacy, with symptom reduction equivalent to traditional CBT and maintenance of gains at follow-up [12]. Cumulatively, there is a large amount of evidence supporting the effectiveness of VRET for SPs, especially for participants with SP presentations in which treatment may not be feasible with traditional in-vivo exposure, such as fears of flying [12, 19].

The present review identified six studies of VRET for SPs [20–25]. Specific phobia presentations included fear of heights [20–24], flying [22, 24], spiders [24, 25], dogs [24], and needles [24]. In all studies besides Hui et al. and Diemer et al., participants followed a pre-set hierarchy that increased exposure intensity as treatment progressed [21, 23]. All studies besides two [22, 24] administered VRET in-session, guided by therapists. Donker et al. utilized a virtual therapist and encouraged participants to complete treatment on their own time within the span of six weeks [22] while Lacey, Frampton and Beaglehole examined self-guided virtual reality therapy at home [24]. In these studies, a large majority of patients (70% and 86.5%) completed treatment, indicating high treatment adherence even when VRET was not guided by therapists or conducted in-session [22, 24].

All studies in which symptom reduction and acceptability were main outcomes found that VRET was acceptable [21, 22, 24] and led to significant symptom reduction compared to baseline [20, 21, 23] and to waitlist controls [22, 24]; however, it is important to note that no studies compared VRET to active exposure-based comparison groups. One interesting development was the gamification of treatment. Donker et al. included factors such as an airport scavenger hunt during treatment for fears of flying that produced high user satisfaction and effect size similar to that of IVE for SP [22]. Some studies [20, 23] also examined the combination of VRET with additional treatments such as intermittent theta burst stimulation (iTBS) or transcranial direct current stimulation (tDCS) and found that while tDCS may help accelerate treatment effect from VRET, neither tDCS nor iTBS led to larger or longer treatment benefits. Furthermore, two studies assessed whether existing models for mechanisms of action in IVE applied to VRET [21, 25]. Among initial fear activation, within-session fear reduction, and expectancy violation, only within-session fear reduction had significant correlation with outcomes [25]. Overall, recent research into VRET for SPs continues to demonstrate high efficacy and acceptability, with interesting new roads examining the combination of VRET with other treatment adjuncts.

Social Anxiety

Although there are comparatively fewer studies examining VRET for Social Anxiety Disorder (SAD) in the current review, there is robust existing data that supports VRET for SAD [12]. Previous studies commonly focused on fear of public speaking or being in feared environments by replicating auditoriums or classrooms in VR. Many VRET interventions produce outcomes equivalent to traditional CBT for SAD [12, 19].

The present review included five studies examining the use of VRET for SAD [26–30]. The majority of these studies asked their participants to give speeches to virtual audiences [26, 28, 30]. For instance, McGlade et al. asked participants to give a one-minute speech on a randomly assigned topic to virtual confederates [28]. Each participant gave seven separate speeches across seven exposure sessions, and they were told their speeches would be recorded and rated. In a different approach, Reichenberger et al. had participants practice asserting themselves on a train with other travelers and at a travel agency [29]. In these scenarios, the person whom they approached initially tried to dissuade the participant but eventually acquiesced to the participant's demands after four rejections. Rubin et al. explored whether adding attention guidance training to pre-recorded audience members with neutral, interested, or uninterested expressions would augment VRET and found that attention guidance did not yield additional gains beyond VRET alone [30].

Overall, these studies found significant symptom reduction compared to waitlist conditions [26–28, 30], but none of the included studies compared VRET to an active exposure-based treatment. Studies continue to show that VRET is well-tolerated with no significant disruption or participant drop-out due to simulator sickness [26, 27]. One study did observe that simulation sickness was significantly higher among participants with SAD compared to healthy controls but noted that it did not impact treatment outcomes or patients' ability to perform behavior tasks such as maintaining eye-contact [29].

Post Traumatic Stress Disorder

There have been several studies of VRET for PTSD with results demonstrating large effect sizes, superiority to waitlist controls, and comparability with traditional IVE delivery [12, 31]. Early studies have examined a wide range of trauma-related scenarios, including simulations of various combat-related environments. Studies have also combined VRET with other treatments such as D-cycloserine, a substance thought to assist with extinction processes and learning consolidation during exposure [12], suggesting an improvement in symptoms after combining VRET and D-cycloserine.

This review focuses on three studies [32–34] that all examined the effect of VRET on combat-related PTSD. Two studies [32, 34] compared the efficacy of PTSD treatment with exposures done via prolonged exposures (PE), which involved patients recounting their traumatic event while imagining the event in their mind, or PE combined with VR stimuli. Notable innovations in the VR software utilized in both studies incorporated multi-sensory immersion (i.e., audio, visual, haptic via vibrating panel, olfactory) and allowed the therapist to actively customize the exposure elements (i.e., sound of a helicopter, rumbling from an explosion) to match the trauma narrative. Difede et al. had a secondary goal of evaluating additional benefits of D-cycloserine, but it did not show a significant benefit [32], which is contrary to prior findings [12]. This study also did not find any significant differences between VRET and PE among all participants, but did find that VRET was more effective for patients with depressive symptoms [32]. This was not the case for nondepressed participants where PE was actually more effective, postulating that active interaction with the VR environment could be helpful in assisting individuals with both PTSD and depression symptoms to have better emotional engagement with the exposure stimuli. Similarly, Verdi et al. also explored whether more active stimuli from VRET augment treatment effects in PTSD patients with a high degree of dissociative symptoms [34], which has been found to blunt traditional treatment progress [35], but did not find additional benefits. The third study examined the effects of augmenting VRET with tDCS. The tDCS + VRET group showed accelerated psychophysiological habituation to VR scenarios between sessions and greater reduction in self-reported PTSD symptoms at 1-month post-treatment compared to the sham + VRET group [33]. Authors attributed this to a potential mechanism of tDCS assisting reconsolidation of memory and subsequent safety learning.

Overall, all three studies showed significant benefits of VRET on combat-related PTSD, which is consistent with previous findings [12, 31]. The VRET software for PTSD appears to have advanced features such as multi-sensory input and some degree of personalization, which could assist with exposure effectiveness. New studies should continue to build on these digital innovations as well as expand into other areas of trauma beyond combat trauma.

Obsessive Compulsive Disorder

Few studies to date have focused on VRET for Obsessive-Compulsive Disorder (OCD). Exploration of VRET for OCD began within the past decade with either non-clinical populations or small sample sizes (as few as 3 adults with OCD) and focused primarily on contamination-based OCD [36]. Despite the nascent state of this literature, there are initial signals in support of VRET for reducing OCD symptoms in general [37] and contamination fears in particular.

The current review identified only one new VRET study for OCD [38], where 36 patients with contamination-based OCD underwent 12-weeks of treatment via VRET or traditional CBT with 29 patients completing the full treatment. The VRET arm had patients explore a virtual house to observe and virtually manipulate various objects progressing from benign items (e.g. refrigerator, cabinet) to objects perceived to be more contaminated (e.g. trash can, rotten fruit) [38]. The virtual scenario did not allow patients to carry out their compulsions (e.g., dirt cannot be brushed off, faucets would not turn) [38]. The CBT arm underwent a similar 12-week protocol with IVE instead of VR exposures [38]. This study had a larger sample size (N=36) [38] than previous studies, and results showed that not only did VRET reduce OCD symptoms, it outperformed the CBT comparison group. In terms of acceptability, two participants in the VR arm discontinued due to side-effects potentially related to VR (nausea, headache, dizziness), but the VR arm had fewer discontinuations overall ($N=3$) than the conventional CBT group ($N=4$) [38]. Altogether, VRET shows promise as an effective form of treatment for contamination-based OCD. More research needs to be done on the other subtypes of OCD and with larger clinical samples.

Selective Mutism

Prior systematic reviews did not identify VRET studies for Selective Mutism (SM), and the only study of VRET for SM that met criteria for inclusion in this review was an initial feasibility trial [39]. In this study, children with SM ages 6–12 completed six therapist-led sessions where they interacted with simulations of people they are likely to encounter at school (e.g., teachers, students) [39]. All participants completed the same set of scenarios, with scenarios gradually increasing in difficulty over ten weeks of treatment [39]. The VRET protocol called for patients to choose how they would like to respond in each scenario and gradually worked up to requiring verbal responses [39]. To note, the study did not include an active exposure-based comparison. The VRET program was generally acceptable, with 75% of patients and 85% of caregivers endorsing high levels of likeability; however, speech frequency did not significantly improve after VRET [39]. Accordingly, 90% of patients rated the scenarios as not sufficiently challenging to elicit fear change [39]. While VRET is generally acceptable among individuals with SM, there is a need for ongoing feasibility research to identify therapeutic scenarios capable of facilitating effective exposure.

Synthesis of Findings and Clinical Implications

This review examines the most recent literature on the use of VRET to treat various anxiety-related disorders and contributes to the growing evidence supporting the use of VR as a promising method for administering exposure therapy [20, 22–24, 26–28, 30, 32, 34, 38]. SP [20–24], SAD [26–28, 30], and PTSD [32–34] remain the best studied diagnoses for VRET use, and our results are consistent with the previous findings for these conditions showing VRET's high acceptability and superiority over waitlist conditions [13, 17].

One key limitation of the VRET evidence base is the lack of studies comparing VRET to active treatment such as IVE and IE. This has been recognized as early as 2017 [12], and it appears to be an ongoing issue as only 2 of the 16 studies in our review had an active comparator group [32, 38]. However, it is noteworthy that VRET showed positive signals in both of the studies with active controls - outperforming IVE in the OCD [38] and producing greater improvement PTSD symptoms for the subset of participants with comorbid depression [32]. Now that feasibility and acceptability of VRET have been well-established, the next step in VRET research could focus on randomized clinical trials with larger samples comparing against standard of care treatment. This would provide the necessary data on strengths and limitations of VRET compared to current practices, which can guide how and when VRET is used.

In addition to continued research on the efficacy of VRET, newer lines of investigation are examining ways to further augment VRET delivery. Notable examples include incorporating gamification [22] or multi-sensory input [32, 33] to increase engagement and immersion during VRET. Some studies evaluated a delivery model where VRET was done independently at home through provided software [22, 24, 26, 27]. All studies of this model showed significant treatment gains compared to waitlist, which highlights a potential method of addressing treatment gaps from limited provider access. Another line of research is assessing benefits of combining VRET with other treatments such as neuromodulation and pharmacotherapy. Most augmentation studies in this review showed limited success, with iTBS [20], D-cycloserine [32], and attention guidance [30] showing no additional benefit than VRET alone. However, tDCS showed acceleration of treatment gains in SP [23] and PTSD [33] and improved outcomes compared to sham in PTSD [33] but not SP [23].

Advantages of VRET

As reflected in past systematic reviews [12, 13, 19] and our findings, VRET continues to be the dominant application of VR for anxiety-related disorders. This is partly due to VRET's potential to overcome common limitations to accessing and delivering conventional IVE in the office. A summary of the advantages and limitations of VRET is presented in Table 1.

Unlike IVE, VRET does not require physical access to the specific stimuli. This physical decoupling means previously inaccessible stimuli can be brought into the clinic setting or may be encountered in the privacy of the client's home via telehealth, all of which help to address issues related to confidentiality, stigma, provider access, and the feasibility of certain types of exposure (e.g., flying, driving) [8, 10, 22, 24]. Another advantage of VRET is added therapist control over aspects of some types of exposure relative to conventional exposures. For instance, therapists can control the amount of airplane turbulence for those facing fears of flying [22] or the density of traffic for those in a driving exposure [24]. In the case of social anxiety, therapists can pre-determine the size and reactions of an audience, and the types of responses virtual simulations provide when a patient engages them in conversation [29, 30]. The ability to pre-determine and individualize the exposure scenario allows therapists to facilitate targeted, productive experiences that are optimized to promote safety learning with each exposure iteration [5, 17]. Perhaps for these reasons, some studies have shown that patients may be more willing to engage in VRET than traditional exposure therapy. In a sample of 150 patients with specific phobias, the refusal rate for VRET was 3% compared to 27% for IVE [16]. This may offer an access point for treatment for a subset of patients who may otherwise struggle to engage with traditional exposure modalities.

Integration of VR and other adjunct technologies offers opportunities to enhance the exposure delivery process. For instance, tools like eye-tracking and heart rate monitoring can be integrated into VR headsets [21, 26, 29, 30]. Data from these features can offer a more objective, quantifiable measure of a patient's engagement with the stimulus and real-time markers of physiological arousal, which are associated with effective exposure delivery [21, 29, 30].

Limitations of VRET

Despite the amazing potential of VRET, it faces significant limitations in its current form. For instance, the financial and technological accessibility of VR systems is an ongoing practical barrier. One reason for the limited uptake of VRET since its inception is the initial investment of buying the headset equipment [10]. In the past few years, significant commercial efforts have been made to make VR more affordable for individual consumers, but VR still requires a considerable initial investment, especially when factoring in both hardware and software costs [40]. Another practical hurdle is the technological proficiency requirements for both the therapist and the patient. While VR technology has become more common, it remains a novel tool for the general population [41]. The patient must learn how to navigate an immersive virtual environment using both the hardware (headset, controllers, etc.) and software (controlling interactions with stimuli or avatars). The therapist must also be proficient in setting up and troubleshooting the hardware and VRET program. As seen during the recent adaptation of telehealth, the integration of new technology into clinical practice can be a challenging but feasible process, requiring supporting infrastructure that is accessed at both individual and system levels [42, 43].

Another important limitation of current VRET is the restricted ability to make real-time modifications to existing stimuli. A key part of the initial assessment for exposure therapy is developing a detailed understanding of the patient's feared stimuli, avoidant/safety behaviors, and underlying core fears [3, 5]. Based on this information, therapists craft highly personalized exposure tasks to address patients' idiosyncratic fears [5]. While VRET has the potential to create infinite customization possibilities, the process of creating a new stimulus requires significant time and resources, limiting real-life feasibility. This is reflected in our findings that only 2 of the 16 studies in the current review allowed for personalization of VRET scenarios [32, 34]. All other studies delivered the same stimuli across all participants without modification. Until a method of rapid and efficient customization is achieved, VRET may be less individualized and therefore potentially less effective than IVE, despite its remarkable potential.

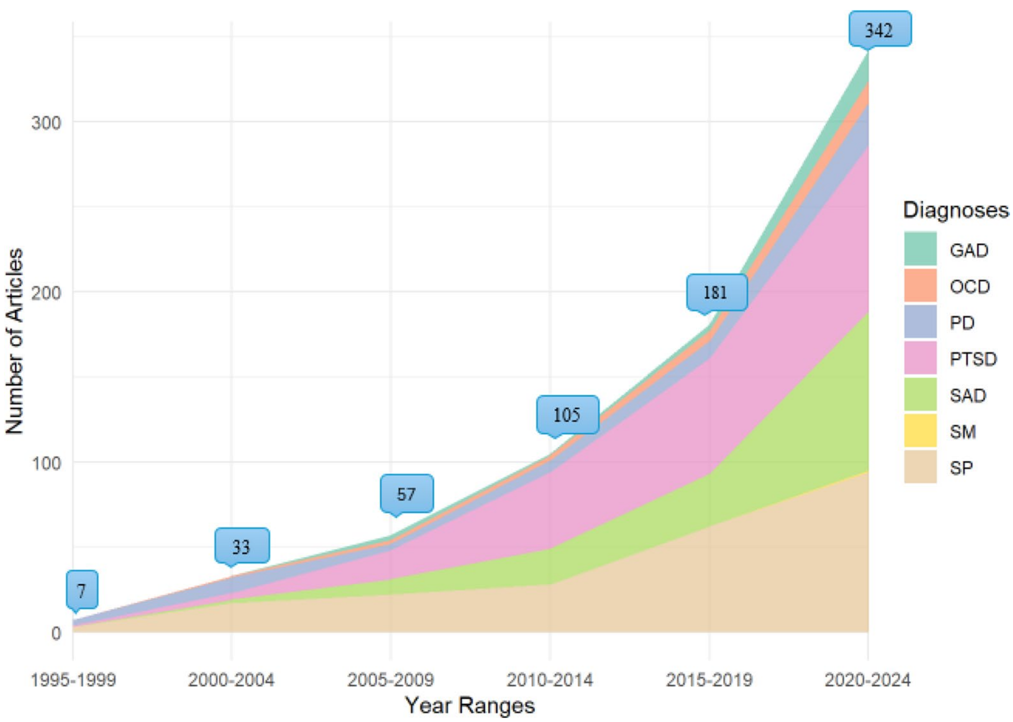
Next Steps for VR-Based Anxiety Treatment

A growing evidence base supports VRET as acceptable and tolerable among patients and clinicians [12, 16, 44], and has significant treatment benefits that in some cases match the effectiveness of active CBT comparators [17]. Given this promising data, a natural question is how to implement VRET in typical clinical workflows. Our findings show that self-directed VRET is helpful across many studies and diagnoses [22, 24, 26, 27] and that some patients may have better engagement with VRET than conventional exposures due to its immersive nature [32]. Thus, promising integrations could be to offer self-directed VRET programs for those who have limited access to in-person treatment or to leverage VRET as an engaging way of completing between-session exposures to increase total exposure treatment dose. While VRET could be considered for in-session exposure delivery, replacing IVE entirely with VRET would not be possible at this point due to the current lack of software that is comprehensive and customizable to individual patient needs.

Another crucial step towards widespread integration of VRET will involve a uniformization of VRET platforms and protocols. The initial wave of VRET research focused on feasibility and acceptability using a host of homegrown, one-off scenarios that are otherwise inaccessible for widespread clinical use [45]. This trend continues in our findings with 5 of 16 studies listing insufficient details of the hardware or software platform [21, 23, 26, 32, 33] and only 5 studies [22, 24, 27, 33, 34] utilizing either an existing software or publishing their application. This is problematic because it prevents the field from reaching a consensus on which platforms work for whom and why. The literature to date only indicates that certain unique scenarios are effective, but those programs are likely inaccessible to most clinicians. The next step should be to catalog a database of validated treatment scenarios that can be used for treatment and further research.

Table 1 Summary of Advantages and Disadvantages of VRET and Conventional Exposure Therapy (IVE and IE)

	VRET	IVE and IE
Advantages	• Does not require physical access to stimuli • Can standardize and replicate harder-to-access situations (airplane turbulence) • All exposures can be done within the clinic • Conducive to telehealth to overcome access barriers • Therapist has full control over exposure variables • May feel more approachable to patients • Easily combined with other measures (eye-tracking) and therapeutics (TMS)	• Can make spontaneous modifications to exposure during the session • Not limited by financial and technological barriers • Higher degree of patient partnership in crafting exposures • Robust data on efficacy across anxiety disorders
Disadvantages	• Financial investment • Both provider and patient need to have technological proficiency • Possibility of software/hardware malfunction • Cannot spontaneously change exposure content • Some may experience side-effects (motion sickness, headache) • Inherent sense of not being "real-life"	• Limited by proximity and access to stimuli • Some exposures are dependent on patient's imagination (IE) • Less conducive to telehealth, may be harder to access care • Inherent uncontrolled variables in the exposure



Along with validated, accessible VRET content, there is a need for standardized delivery protocols. Recent studies have begun comparisons between the efficacy of VRET and conventional treatment methods; however, it remains difficult to draw clinical conclusions about VRET due to a lack of standardization in the methodology and protocol between the studies. Delivery processes are key to optimizing the effectiveness of IVE exposure [46–48], and likely also important to the effective implementation of VRET. For instance, choices related to VRET technology (hardware, software) and procedures (therapist involvement, pre- and post-processing, session duration) may have a significant influence on treatment response. Due to the inconsistent reporting of delivery processes and a lack of standardized procedures against which future research can iterate and improve, it remains challenging to evaluate VRET effectiveness and transportability of findings from one study to another.

Table 2 Recommendations for Incorporating VRET Into Current Clinical Practice

Clinical Recommendations for Using VR-based Exposures
- Given that there is no current manual specific to VR-based exposure therapy, providers should be proficient in delivering high-quality exposure therapy as a foundation for VRET.
- Clinicians should assess whether each patient would be a good candidate for VRET considering factors such as technological literacy and ability to tolerate prolonged VR use.
- Clinicians should also determine whether benefits of VRET outweigh benefits of conventional exposures.
- VRET should only be utilized when conventional exposure (IVE, IE) would be done in a treatment course (i.e., after sufficient assessment, rapport-building, and patient education around exposures).
- Exposure stimuli or scenarios in VRET should be tailored as much as possible to each patient's specific core anxiety/fears.
- Clinicians or support staff should be proficient in operating the VR hardware and software to minimize the impact of technical difficulties on sessions, including troubleshooting glitches.
- Clinicians should assess whether the use of VRET over IVE is contributing to avoidance behaviors. Similarly, if there is limited treatment response from VRET, clinicians should consider alternative modalities of exposure or treatment.

Recommendations for Incorporating VRET into Current Clinical Practice

Finally, we offer a set of recommendations in Table 2 for providers interested in utilizing VRET in clinical practice. These recommendations are produced based upon the current body of evidence, advantages and limitations of current VR technology, and our own clinical experience using VRET as a part of anxiety treatment.

[Table 2].

Conclusions

A growing body of evidence suggests that VRET is both acceptable and effective for treatment of anxiety-related disorders. It offers access to stimuli that are difficult to represent with conventional exposure methods, and it may have the potential to be highly flexible and adaptable with advances in user-friendly development tools to customize VRET scenarios. However, further work remains in order for VRET to transition from a novel area of research to an evidence-based clinical tool. Key steps involve uniformization of VRET towards a standard protocol and more data on VRET's strengths and limitations compared to existing forms of treatment. As both VR technology and our understanding of its implementation continue to advance, VRET shows promise in helping to overcome the dissemination barriers associated with exposure therapy.

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Data Availability No datasets were generated or analysed during the current study.

Declarations

Competing Interests The authors declare no competing interests.

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