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VIRTUAL REALITY EXPOSURE THERAPY FOR ANXIETY  
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# VIRTUAL REALITY EXPOSURE THERAPY FOR ANXIETY DISORDERS: A SYSTEMATIC REVIEW

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## ABSTRACT

**Introduction:** Anxiety disorders are among the most prevalent mental disorders and are commonly maintained by avoidance of feared situations. Exposure therapy remains one of the most effective psychological treatments, but its implementation in routine practice may be limited by logistical and practical barriers. Virtual Reality Exposure Therapy (VRET) has emerged as an immersive and controlled form of exposure-based treatment. This systematic review aimed to evaluate the current evidence on the use of VRET in anxiety disorders.

**Methods:** A systematic review was conducted following PRISMA guidelines. PubMed and EMBASE databases were searched, duplicate records were removed, and studies were screened by title and abstract. Eligible publications included systematic reviews and meta-analyses examining VRET in anxiety disorders. After the selection process, six review-level studies were included in the final analysis. The last search was conducted on 8 March 2026

**Results:** The included studies consistently showed that VRET was associated with significant reductions in anxiety symptoms. Broad meta-analyses indicated that VRET was superior to inactive control conditions and, in many cases, comparable to in vivo exposure. Reviews focused on social anxiety disorder also confirmed meaningful symptom improvement, although some inconsistency remained regarding long-term comparisons with conventional exposure-based treatment. The most recent large meta-analysis supported the effectiveness of VR-based interventions, while also highlighting substantial heterogeneity across studies.

**Conclusions:** VRET appears to be a promising and clinically relevant intervention in anxiety disorders. Further high-quality randomized controlled trials are needed to clarify long-term efficacy, disorder-specific effects, and optimal implementation.

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## KEYWORDS

Virtual Reality; Anxiety Disorders; Exposure Therapy; Psychotherapy; Social Anxiety; Phobia

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## Introduction

Anxiety disorders are among the most common groups of mental disorders and remain a major clinical and public health concern because of their high prevalence, chronicity, and negative effect on daily functioning and quality of life [1]. They are characterized by excessive fear, anxiety, and avoidance behaviors that are disproportionate to actual threat and that persist over time. Although individual disorders differ in their dominant symptoms and triggers, they share several core mechanisms, particularly heightened anticipation of danger, strong emotional and physiological reactions to feared stimuli, and repeated avoidance of situations associated with distress [2]. This pattern is clinically important because avoidance may reduce anxiety in the short term, but in the long term it maintains fear by preventing corrective learning and reinforcing maladaptive expectations [3].

Because avoidance plays such a central role in the maintenance of anxiety, exposure-based interventions have become one of the foundations of psychological treatment for anxiety disorders. Exposure therapy is based on systematic and repeated confrontation with feared objects, situations, thoughts, or bodily sensations in order to reduce pathological fear responses and increase tolerance of anxiety [4]. Its therapeutic purpose is not merely to provoke distress, but to create conditions in which feared outcomes can be re-evaluated and new, more adaptive responses can develop. In clinical practice, exposure therapy is most commonly delivered either *in vivo*, through direct confrontation with real-life stimuli, or imaginally, through guided mental evocation of feared situations [5]. Both approaches are well established, but both also present practical limitations that may reduce feasibility in routine care.

*In vivo* exposure can be difficult to organize when feared situations are hard to recreate, expensive, socially sensitive, or potentially unsafe. This may apply, for example, to public speaking, driving, crowded environments, or highly specific phobic triggers. Imaginal exposure, in turn, depends strongly on the patient's ability to vividly imagine feared scenarios and to engage with them emotionally, which may vary substantially between individuals [6]. For this reason, researchers and clinicians have increasingly explored alternative ways of delivering exposure while preserving its basic therapeutic principles. One of the most important developments in this area has been the use of virtual reality.

Virtual reality (VR) is generally defined as a computer-generated, interactive, three-dimensional environment that creates a sense of immersion and presence in a simulated situation [7]. In contrast to ordinary digital media presented on a flat screen, VR allows the user to experience a scenario in a more embodied and spatially realistic way. In mental health care, this feature is particularly relevant because it permits controlled reproduction of emotionally meaningful situations while giving the therapist substantial control over the content, intensity, and repetition of the experience [8]. Reviews of VR applications in psychiatry indicate that the technology has gradually moved from an experimental innovation toward a clinically relevant tool used in assessment, symptom elicitation, psychoeducation, and treatment [9].

Within this broader context, Virtual Reality Exposure Therapy (VRET) can be understood as the application of exposure therapy in an immersive virtual environment. Instead of relying exclusively on real-life confrontation or imagination, VRET allows patients to face feared stimuli in computer-generated scenarios that can be graded, repeated, interrupted, and modified according to therapeutic needs [10]. Importantly, the theoretical basis of treatment remains the same as in conventional exposure. The aim is still to reduce avoidance, weaken maladaptive fear structures, and promote more adaptive emotional and cognitive responses to previously feared situations [4]. What distinguishes VRET is therefore not a different psychotherapeutic model, but a different mode of delivering exposure.

The relevance of VRET to anxiety disorders is particularly strong because many anxiety symptoms are linked to identifiable situations that can be recreated in virtual form. In social anxiety disorder, fear often arises in contexts involving observation, scrutiny, embarrassment, or negative evaluation by others. Such situations may be difficult to standardize in ordinary therapy, whereas VR can simulate conversations, interviews, presentations, or audience-based scenarios in a gradual and reproducible way [11]. In specific phobias, feared triggers are often concrete and visually definable, such as heights, enclosed spaces, or other situational cues, which makes them especially suitable for virtual simulation [12]. In more specialized contexts, such as driving phobia, VR may offer an opportunity to begin exposure in a safe and therapist-controlled setting before transferring gains to real-world conditions [13].

Another important feature of VRET is the possibility of structured graded exposure. The therapist may adjust the intensity and complexity of the virtual scenario step by step, depending on the patient's level of distress, treatment goals, and progress. This is particularly relevant because exposure is generally most effective when confrontation is systematic, repeated, and appropriately paced [10]. Virtual environments may therefore enhance standardization and allow repeated therapeutic practice under conditions that are more predictable than many real-world settings. From a practical perspective, this may help overcome some of the barriers that have traditionally limited broader use of exposure-based treatment [14]. In addition, some authors

have suggested that virtual exposure may initially be more acceptable to certain patients than immediate confrontation with feared real-life situations, which may facilitate engagement in therapy [15].

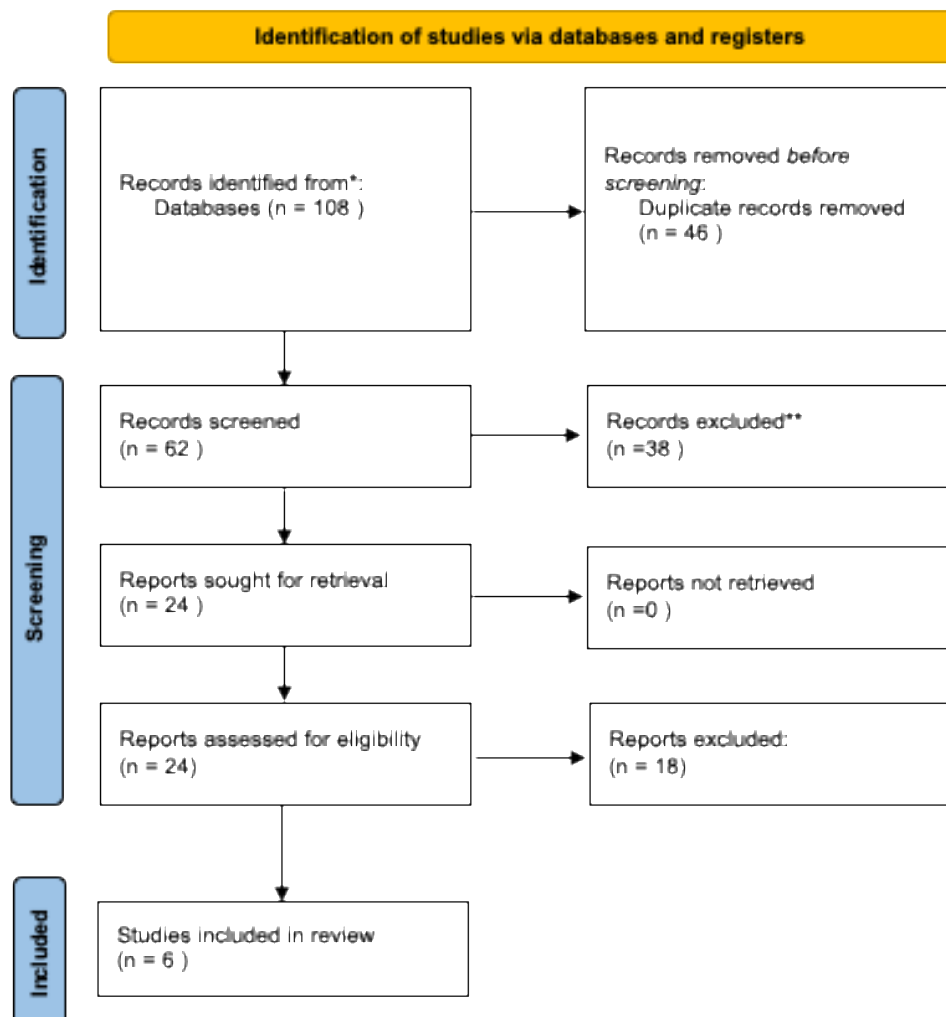
At the same time, the increasing number of publications on VRET has created a need for clearer synthesis of the available evidence. Existing review-level literature includes studies focused on social anxiety disorder, phobias, implementation issues, youth populations, and broader psychiatric applications of VR [8,11,12,14]. However, these publications do not always address the same clinical questions, and some extend beyond anxiety disorders strictly understood. As a result, the current literature may appear fragmented despite the growing interest in the field. This creates an important research problem: although VRET is increasingly discussed as a promising tool in anxiety treatment, the review-level evidence requires focused organization to clarify how this intervention is being used specifically within anxiety disorders.

The rationale for the present study is therefore based on three closely connected observations. First, anxiety disorders continue to represent a major burden for patients and health care systems. Second, exposure therapy remains one of the core evidence-based interventions for these conditions. Third, VR offers a potentially useful way of delivering exposure in a controlled, immersive, and adaptable form. Taken together, these factors make VRET a clinically and scientifically relevant topic. Therefore, the aim of this study is to examine the current evidence on the application of Virtual Reality Exposure Therapy in anxiety disorders, with particular emphasis on findings derived from systematic reviews and meta-analyses.

### Materials and Methods

This systematic review was conducted in accordance with the PRISMA 2020 guidelines. A systematic search of PubMed/Medline and Embase was performed to identify systematic reviews and meta-analyses on virtual reality exposure therapy for anxiety disorders. The search strategy combined the terms “virtual reality exposure therapy”, “VRET”, “virtual reality”, “exposure therapy”, “anxiety disorders”, “anxiety”, and “phobia”, together with terms related to systematic reviews and meta-analyses.

PRISMA 2020 flow diagram for updated systematic reviews which included searches of databases.



After removing duplicates and screening records by title, abstract, and full text, six eligible systematic reviews and meta-analyses were included in the final analysis. The objective of this review was to synthesize the available higher-level evidence on the effectiveness, clinical applications, and limitations of virtual reality exposure therapy in anxiety disorders. The last search was conducted on 8 March 2026

## Results

The following articles were included in the analysis:

1. Powers MB, Emmelkamp PM. *Virtual reality exposure therapy for anxiety disorders: A meta-analysis*(16).
2. Opiş D, Pinte S, García-Palacios A, Botella C, Szamosközi Ş, David D. *Virtual reality exposure therapy in anxiety disorders: a quantitative meta-analysis*(17).
3. Carl E, Stein AT, Levihn-Coon A, Pogue JR, Rothbaum B, Emmelkamp P, Asmundson GJG, Carlbring P, Powers MB. *Virtual reality exposure therapy for anxiety and related disorders: A meta-analysis of randomized controlled trials*(18).
4. Horigome T, Kurokawa S, Sawada K, Kudo S, Shiga K, Mimura M, Kishimoto T. *Virtual reality exposure therapy for social anxiety disorder: a systematic review and meta-analysis*(19).
5. Morina N, Kampmann I, Emmelkamp P, Barbui C, Hoppen TH. *Meta-analysis of virtual reality exposure therapy for social anxiety disorder*(20).
6. Zeng W, Xu J, Yu J, Chu X. *Effectiveness of virtual reality therapy in the treatment of anxiety disorders in adolescents and adults: a systematic review and meta-analysis of randomized controlled trials*(21).

The six review-level publications selected for the final analysis were published between 2008 and 2025 and collectively reflect the evolution of research on virtual reality exposure therapy from early, relatively small meta-analyses toward larger and more methodologically advanced evidence syntheses. Three of the included studies addressed anxiety disorders more broadly, with different proportions of specific phobias, social anxiety disorder, panic disorder, and related conditions, whereas two focused specifically on social anxiety disorder and one assessed VR-based interventions for anxiety in a wider sense across adolescents and adults. Despite differences in scope, the general direction of findings across the six publications was consistent: virtual reality-based interventions, and particularly virtual reality exposure therapy, were associated with clinically meaningful reductions in anxiety symptoms, performed better than inactive control conditions, and in several analyses produced effects comparable to more traditional exposure-based approaches. At the same time, the studies differed in diagnostic breadth, control conditions, follow-up duration, and methodological rigor, which is important when interpreting both the size and generalizability of the observed effects.

The earliest included meta-analysis, conducted by Powers and Emmelkamp(16), represents one of the first quantitative attempts to synthesize the clinical efficacy of VRET in anxiety disorders. This study identified 13 studies with a total of 397 participants and compared virtual reality exposure therapy both with in vivo exposure and with control conditions such as waitlist or attention control. The meta-analysis demonstrated a large pooled effect size for VRET in comparison with control conditions, with Cohen's  $d = 1.11$  (95% CI 0.82–1.39), indicating that VRET was substantially more effective than no active exposure-based intervention. Importantly, when VRET was compared directly with in vivo exposure, the pooled estimate slightly favored virtual reality, with  $d = 0.35$  (95% CI 0.05–0.65), suggesting that VRET was at least comparable and possibly somewhat superior in the studies available at that time. The authors also reported a trend indicating that larger numbers of treatment sessions were associated with stronger effects, which supported the hypothesis of a dose-response relationship. Thus, this early meta-analysis laid the foundation for later research by showing that VRET was not only technically feasible but also therapeutically meaningful in anxiety treatment(16).

The meta-analysis by Opiş et al.(17) expanded this evidence base and provided a broader and more structured evaluation of VRET in anxiety disorders. A total of 23 studies involving 608 participants were included in the final analysis. The authors compared VRET delivered within a behavioral or cognitive-behavioral framework with classical evidence-based interventions without virtual reality. Their results indicated that VRET performed significantly better than waitlist controls and showed post-treatment efficacy similar to that of established evidence-based treatments. In addition, the meta-analysis suggested that VRET had a substantial real-life impact and that the observed therapeutic effects remained stable over time to a degree comparable with traditional interventions. Another important observation was the absence of any significant difference in dropout rates between virtual reality exposure and in vivo exposure, which suggests that the use of VR did not reduce treatment acceptability. Opiş et al. also identified evidence consistent with a dose-response relationship, further supporting the clinical plausibility of this treatment model. Compared with the



earlier analysis by Powers and Emmelkamp(16), this study shifted the emphasis from the mere demonstration of efficacy toward a broader assessment of equivalence, durability, and practical treatment outcomes(17).

A further important development in the literature is represented by the meta-analysis of randomized controlled trials conducted by Carl et al.(18). This publication included 30 studies with a total sample of 1,057 participants, making it substantially larger than the previous broad meta-analyses. The diagnostic composition of the included studies reflected the expanding scope of VRET research: 14 studies addressed specific phobias, 8 focused on social anxiety disorder or performance anxiety, 5 on post-traumatic stress disorder, and 3 on panic disorder. The pooled analysis showed that VRET was significantly superior to inactive control conditions. Specifically, the effect size was large relative to waitlist controls ( $g = 0.90$ ) and medium-to-large relative to psychological placebo conditions ( $g = 0.78$ ). At the same time, the pooled comparison between VRET and in vivo exposure was not statistically significant ( $g = -0.07$ ), supporting the interpretation that VRET and traditional exposure were broadly comparable in short-term clinical outcome. Carl et al. also reported that larger sample sizes were associated with smaller effect sizes in VRET-versus-control comparisons, suggesting that earlier literature may have slightly overestimated treatment magnitude. Nevertheless, the overall pattern remained clearly favorable to virtual reality-based treatment. This study therefore strengthened the evidence base by showing that positive VRET findings persisted even when the analysis was restricted to randomized controlled trials and applied to a larger and diagnostically broader sample(18).

Taken together, the first three meta-analyses(16–18) demonstrate a highly consistent pattern across more than a decade of review-level literature. First, all three studies confirmed that VRET was substantially more effective than inactive or minimal-intervention control conditions. Second, all three suggested that VRET was broadly comparable to in vivo exposure at post-treatment. Third, later analyses progressively incorporated more studies and more heterogeneous anxiety-related diagnoses, but without changing the overall direction of effect. This consistency is clinically important because it indicates that support for VRET was not limited to one early cluster of small phobia studies, but remained visible even as the field expanded methodologically and diagnostically. At the same time, these broad analyses also revealed the start of a recurring issue in the literature, namely increasing heterogeneity. As virtual reality interventions were applied across more settings, disorders, and study designs, pooled positive findings remained robust, but interpretation of the exact magnitude of benefit became more complex(16–18).

Two of the six final studies were devoted specifically to social anxiety disorder, which made it possible to assess whether the more general conclusions regarding anxiety disorders also applied to this particularly relevant clinical subgroup. Horigome et al.(19) conducted a systematic review and meta-analysis registered in PROSPERO and included 22 studies with 703 participants. Their primary outcome was change in social anxiety evaluation scores, and their results supported a significant therapeutic effect of VRET. The reported Hedges'  $g$  values indicated improvement not only immediately after treatment but also across follow-up periods:  $g = -0.86$  post-intervention,  $g = -1.03$  at 3 months,  $g = -1.14$  at 6 months, and  $g = -0.74$  at 12 months. These data suggested that VRET in social anxiety disorder was associated with substantial symptom reduction and that treatment effects were not purely short-lived. However, an important nuance emerged when VRET was compared directly with standard treatment for social anxiety involving in vivo or imaginal exposure. Horigome et al. found that while VRET and standard exposure were similar at post-treatment, VRET appeared inferior at follow-up time points. They also found no significant difference in dropout rates, indicating that acceptability remained comparable. Therefore, this meta-analysis supported the efficacy of VRET in social anxiety disorder, but introduced some uncertainty concerning its long-term equivalence to conventional exposure-based treatment(19).

The later publication by Morina et al.(20) also focused on social anxiety disorder, but functioned partly as a reanalysis and critical response to previous conclusions in the field. This meta-analysis found a strong treatment efficacy of VRET from pre-treatment to post-treatment and from pre-treatment to follow-up. The authors reported that their within-group findings were largely in line with those of Horigome et al.(19), but their between-group comparisons differed somewhat more. In particular, they noted that the effect of VRET compared with waitlist was smaller than that reported by Horigome et al., although it remained within the large-effect range. More importantly, Morina et al. did not find significant differences between VRET and in vivo exposure either at post-treatment or at follow-up. This directly challenged the interpretation that VRET might be inferior to standard exposure in the longer term. Their analysis therefore maintained the view that VRET was an effective treatment for social anxiety disorder and suggested that the differences from traditional exposure might be smaller than previously proposed. However, the authors also emphasized that conclusions

about direct comparison were based on a relatively limited number of randomized studies, meaning that the available evidence still required cautious interpretation(20).

When the two social-anxiety-focused analyses(19,20) are considered together, several conclusions can be drawn. Both studies clearly support the efficacy of VRET in reducing social anxiety symptoms. Both also indicate that VRET is associated with sustained improvement over time and does not appear to have worse acceptability than standard exposure-based interventions. The primary point of difference concerns comparative long-term efficacy versus in vivo or imaginal exposure. Horigome et al.(19) suggested a possible inferiority of VRET at follow-up, whereas Morina et al.(20) did not confirm such a difference. This discrepancy does not undermine the broader conclusion that VRET is therapeutically useful in social anxiety disorder. Rather, it indicates that the exact relative position of VRET versus standard exposure remains unsettled, especially when long-term outcome is considered. From a clinical perspective, the safest interpretation is that VRET provides meaningful symptom reduction in social anxiety disorder and is broadly comparable to standard exposure in the short term, but that the durability of this equivalence still requires further confirmation(19,20).

The most recent and quantitatively broadest study included in the final analysis was the systematic review and meta-analysis by Zeng et al.(21). This publication included 33 studies and 3,182 participants from 18 countries, thereby far exceeding the sample sizes of the earlier broad meta-analyses. The pooled analysis demonstrated that VR therapy significantly improved anxiety symptoms compared with conventional interventions, with a standardized mean difference of -0.95 (95% CI -1.22 to -0.69;  $p < 0.00001$ ). However, one of the most important findings of this study was the very high level of heterogeneity, with  $I^2 = 91\%$ . Sensitivity analysis indicated that several studies exerted substantial influence on the pooled estimate; after exclusion of two influential studies, the effect remained statistically significant and the heterogeneity dropped to  $I^2 = 44\%$ , with an adjusted SMD of -0.76 (95% CI -0.86 to -0.67). Thus, the positive direction of effect was robust, but the magnitude of the pooled result was sensitive to study composition and variation across the literature(21).

An important interpretive issue in relation to Zeng et al.(21) is that this review used a broader concept of anxiety-related intervention than the earlier VRET-specific meta-analyses. In addition to virtual reality exposure therapy, the review also included other VR-based therapeutic approaches and a wider range of anxiety contexts across adolescents and adults. As a result, the study strongly supports the general usefulness of VR-based treatment for anxiety symptom reduction, but its findings are not fully identical in meaning to those of the earlier exposure-focused reviews. Nevertheless, this broadening of scope is informative in itself. It suggests that the therapeutic value of VR is not confined exclusively to classical phobia-style exposure paradigms, but may extend to other anxiety-related settings. At the same time, because the review incorporated different intervention types and a broad clinical spectrum, it also illustrates why later meta-analytic evidence in this field has become increasingly heterogeneous. For the purposes of the present analysis, Zeng et al.(21) may therefore be interpreted as a study that confirms the overall promise of VR-based interventions in anxiety while also underscoring the need to distinguish between strictly exposure-based VRET and broader VR therapies(21).

Across all six final studies(16–21), a number of common patterns emerge. The first and most consistent is superiority over inactive control conditions. This was shown in Powers and Emmelkamp(16), Opreș et al.(17), Carl et al.(18), the social anxiety analyses by Horigome et al.(19) and Morina et al.(20), and the large broad synthesis by Zeng et al.(21). The second recurring pattern is approximate equivalence between VRET and conventional exposure-based treatment at post-intervention. This was reported in broad form by Opreș et al.(17) and Carl et al.(18), and also appeared in the social anxiety literature, although not without some disagreement about follow-up findings(19,20). The third major pattern is durability of effect. Several studies reported that symptom improvement persisted over follow-up periods, which suggests that VRET does not merely produce immediate novelty-related responses, but may contribute to sustained therapeutic change. Finally, the six analyses collectively show that the field is moving from proof-of-concept toward more refined questions concerning moderators, treatment format, follow-up durability, and the relative role of VRET among other forms of exposure-based care(16–21).

Another important aspect of the six-study synthesis concerns methodological quality and interpretive caution. The early meta-analyses provided strong support for efficacy, but were based on smaller numbers of trials and participants. Later studies included larger samples and more advanced analyses, but they also made the heterogeneity of the field more visible. Carl et al.(18) demonstrated that larger sample sizes were associated with smaller effect sizes, suggesting the possibility of small-study effects in the earlier literature. Zeng et al.(21)

identified substantial heterogeneity and also noted limitations in study quality. In VR intervention trials, blinding is often difficult or impossible, and this can influence measurement and implementation bias. In addition, studies differ in headset type, degree of immersion, therapist involvement, treatment duration, diagnostic criteria, and comparator interventions. These factors do not invalidate the positive therapeutic findings, but they do caution against interpreting pooled effect sizes as precise and universally transferable estimates. Instead, the literature appears to support a robust beneficial effect of VRET and related VR interventions, while also indicating that the exact magnitude of this effect varies according to population, diagnosis, intervention structure, and trial design(18,21).

The analysis of the final six articles also suggests that the strongest and most consistent evidence exists for anxiety conditions in which feared situations can be realistically and repeatedly simulated. This is particularly evident in specific phobias and social anxiety disorder. In these conditions, the logic of VRET closely mirrors the psychopathology of the disorder: feared scenarios are situational, identifiable, and suitable for graded confrontation. The broad anxiety meta-analyses(16–18) included substantial numbers of phobia and social-anxiety studies, while the disorder-specific analyses(19,20) confirmed that social anxiety disorder is one of the most developed areas of VRET research. The more recent broad review by Zeng et al.(21) supports VR-based treatment beyond narrowly defined classical phobia paradigms, but the evidence appears most cohesive where exposure mechanisms are central and where the virtual environment can closely approximate feared real-world situations. This observation is important because it suggests that the therapeutic usefulness of VRET may not be uniform across all anxiety-related conditions, but may be strongest where situational fear and avoidance are most directly targeted by immersive simulation(16–21).

In summary, the six review-level studies included in the final analysis support the conclusion that virtual reality exposure therapy is a clinically meaningful intervention in anxiety disorders. The earliest meta-analyses(16,17) established that VRET produced large effects relative to control conditions and was broadly comparable to in vivo exposure. The later randomized-trial meta-analysis by Carl et al.(18) reinforced these findings in a larger and more methodologically rigorous dataset. The social-anxiety-focused analyses(19,20) confirmed substantial efficacy in this important clinical subgroup, although some uncertainty remained regarding long-term comparisons with standard exposure. Finally, the most recent broad meta-analysis(21) showed that VR-based interventions continue to demonstrate significant anxiety-reducing effects even in a much larger and more heterogeneous evidence base. Overall, the final six articles indicate that VRET has moved beyond the stage of technological novelty and should be regarded as a valid exposure-based therapeutic approach whose strongest support concerns symptom reduction, short-term comparability with conventional exposure, and growing applicability across anxiety-related clinical settings.

## **Discussion**

The findings of this systematic review suggest that Virtual Reality Exposure Therapy is a promising and clinically relevant intervention in anxiety disorders. Across the six review-level studies included in the final analysis, the overall direction of evidence was favorable for VRET. The broad meta-analyses indicated that virtual reality-based exposure was consistently superior to inactive control conditions and, in many cases, comparable to traditional exposure-based interventions delivered in vivo(16-18). The studies focused specifically on social anxiety disorder also supported significant symptom reduction, although some inconsistency remained regarding long-term comparisons between VRET and standard exposure therapy(19,20). The most recent large meta-analysis further confirmed that VR-based interventions were associated with meaningful improvement in anxiety symptoms, while also highlighting substantial heterogeneity across the literature(21). Taken together, these findings indicate that VRET should not be understood merely as an innovative technological addition, but rather as a therapeutically meaningful way of delivering exposure-based treatment.

One of the most important observations emerging from the present review is that the usefulness of VRET appears to be strongest in anxiety conditions where fear is linked to identifiable, situational, and reproducible triggers. This is especially evident in social anxiety disorder and phobic disorders. In such conditions, feared situations can often be recreated in a virtual environment in a way that is sufficiently realistic to provoke clinically relevant anxiety while still remaining under therapeutic control. Reviews of the implementation of VR in anxiety-related disorders emphasize that this controllability is one of the main advantages of the method(22). In practice, this means that the therapist may determine not only the type of feared stimulus presented, but also its intensity, duration, and progression across sessions. Such control is difficult to achieve in routine real-world exposure, where many relevant situations are unpredictable, difficult to repeat, or



logistically complex. This helps explain why VRET has attracted sustained interest particularly in public speaking anxiety, social situations, heights, driving, and other clearly situational fears.

The present findings also suggest that the clinical significance of VRET lies not only in efficacy itself, but in the way it may bridge the gap between the theoretical foundations of exposure therapy and its practical implementation. Traditional exposure remains one of the most effective interventions for anxiety disorders, but it is also a method that may be difficult to deliver in a consistent way. Real-life exposure often requires time, specific settings, therapist involvement outside the consulting room, or confrontation with stimuli that are hard to organize repeatedly. From this perspective, VRET offers an important practical advantage: it allows feared scenarios to be recreated in a structured, repeatable, and graded form while preserving the central mechanism of therapeutic exposure. Comparative evidence in phobic disorders suggests that virtual exposure may in some settings achieve results similar to gold-standard in vivo exposure(23). This does not mean that VRET should be treated as a replacement for standard exposure in all cases, but it does support the view that it may function as a realistic alternative or adjunct where real-life exposure is difficult to organize or poorly accepted.

A particularly important area highlighted by this review is social anxiety disorder. Two of the six included studies focused specifically on this diagnosis, and both supported the efficacy of VRET in reducing symptom severity(19,20). This is clinically meaningful because social anxiety disorder is one of the conditions in which exposure is central to treatment, but also one of the conditions in which real-life exposure can be especially difficult to standardize. Social situations differ widely in intensity, interpersonal demands, and emotional salience, and this can complicate routine exposure planning. Virtual reality offers a way to simulate audiences, conversations, interviews, or public speaking situations in a more predictable and repeatable format. Additional meta-analytic evidence outside the final six studies also supports the value of VRET in social anxiety disorder, including more recent analyses using meta-regression approaches(24) and earlier meta-analyses focused specifically on social anxiety symptoms(25). This broader context strengthens the interpretation that social anxiety disorder is one of the most clinically relevant targets for virtual exposure-based treatment.

At the same time, the present review suggests that the relative position of VRET compared with standard exposure remains more certain in the short term than in the long term. The broad meta-analyses generally supported the conclusion that VRET and in vivo exposure achieve similar post-treatment effects(16-18). However, some uncertainty emerged in the social anxiety-focused literature, where one meta-analysis suggested possible inferiority of VRET at follow-up, whereas another did not confirm this difference(19,20). This should not be interpreted as evidence against VRET, but rather as a sign that direct long-term comparisons remain limited by the size and composition of the evidence base. It is possible that some treatment effects depend on diagnosis, intervention intensity, therapist guidance, or the degree to which therapeutic gains are transferred into everyday life. Therefore, the current literature supports the general effectiveness of VRET more strongly than it supports any strong claim of long-term superiority over conventional exposure.

Another relevant implication of the present findings concerns treatment acceptability and patient engagement. Although exposure therapy is well established, it is often perceived by patients as demanding, distressing, or difficult to initiate. In this context, one of the proposed advantages of VRET is that it may offer a more acceptable or manageable starting point for some individuals, particularly when direct confrontation with real-life feared situations is overwhelming at the beginning of treatment. Reviews focused on stand-alone VRET and on user experience in social anxiety disorder suggest that virtual exposure may indeed be perceived as engaging and acceptable in ways that support treatment participation(26,27). This may be particularly relevant in patients who are reluctant to start classical in vivo exposure or who have limited access to suitably structured therapeutic settings. However, this potential advantage should be interpreted with caution. A meta-analytic examination of attrition in VRET for anxiety disorders showed that dropout remains an important issue and that virtual reality does not eliminate the practical and motivational challenges common to psychotherapy more broadly(28). Therefore, the literature supports the view that VRET may improve engagement in some contexts, but it should not be idealized as automatically solving adherence-related problems.

An additional issue of major importance is the generalization of treatment gains beyond the virtual setting. One of the most frequent conceptual concerns related to VRET is whether patients improve only in the simulated environment or whether the benefits extend into real-life functioning. This question is especially important in anxiety disorders, because the ultimate aim of treatment is not merely reduced distress during sessions, but improved everyday behavior and reduced avoidance outside therapy. Earlier meta-analytic evidence suggests that gains achieved through virtual reality exposure can indeed generalize to real-life

outcomes(29). This is an important observation because it supports the ecological validity of VRET and suggests that virtual environments may be capable of eliciting meaningful therapeutic learning rather than simply producing temporary effects limited to the digital context. Although additional long-term studies would strengthen this conclusion, the currently available evidence does not support the concern that VRET works only “inside the headset.”

The present review also highlights a broader conceptual issue in the literature, namely the increasing heterogeneity of what is described as “VR therapy.” Earlier studies and reviews tended to focus more specifically on VRET as an exposure-based intervention, whereas later literature sometimes uses broader categories such as VR-based intervention or VR therapy. This distinction is not only semantic. VRET refers specifically to the use of immersive virtual environments to conduct exposure therapy, whereas broader VR interventions may also include distraction-based techniques, supportive cognitive-behavioral components, psychoeducation, relaxation, or mixed intervention formats. This issue became particularly visible in the most recent and broadest review included in the final analysis(21). Broader reviews of VR in psychiatric disorders also show that virtual reality is increasingly being applied in a wide range of mental health contexts, often with different therapeutic aims and mechanisms(30). For the field to progress methodologically, future research should distinguish more clearly between exposure-based VR treatment and broader VR-assisted psychological interventions. Such differentiation would improve the interpretability of future reviews and make it easier to identify which mechanisms are truly responsible for clinical benefit.

Another important point concerns methodological interpretation in line with PRISMA-oriented thinking. Review-level evidence should be interpreted not only in terms of pooled direction of effect, but also with attention to heterogeneity, overlap of primary studies, and variability in methodological quality. Several of the included meta-analyses likely drew on overlapping pools of primary trials, which means that the six included reviews should not be treated as six entirely independent bodies of evidence. In addition, the analyzed reviews differed in diagnostic scope, comparator type, intervention design, session number, outcome measures, and duration of follow-up. This makes precise quantitative comparison difficult and limits the possibility of making overly definitive statements about one single “true” effect size of VRET. Nonetheless, the repeated positive direction across different reviews remains important. Even when the evidence base expanded and became more heterogeneous, the general therapeutic signal remained favorable. This consistency is one of the strongest arguments for the clinical relevance of VRET.

The significance of these findings for the field is considerable. First, they support the view that immersive digital technologies can be integrated into evidence-based psychotherapeutic models without abandoning established treatment principles. Second, they suggest that VRET may contribute to the modernization of anxiety treatment not by replacing psychotherapy, but by improving the practical delivery of one of its most central techniques. Third, they indicate that the field has moved beyond proof-of-concept and now requires more refined clinical questions. These questions include which anxiety disorders benefit most, which patients are best suited to VRET, how much therapist involvement is optimal, and how technical factors such as immersion level or software realism affect outcomes. The current evidence is already sufficient to justify serious clinical and scientific interest, but not yet sufficient to resolve all implementation and comparative questions.

From the perspective of future research, several directions appear particularly important. More randomized controlled trials with larger sample sizes and longer follow-up periods are needed. Greater methodological consistency would also be valuable, especially with regard to diagnostic criteria, outcome measures, intervention descriptions, and comparator conditions. It would also be useful for future studies to report more clearly on factors such as treatment dose, headset type, immersion level, therapist guidance, and adverse effects or tolerability. Such details would improve the interpretability of both primary trials and future meta-analyses. In addition, more data are needed in younger populations. Recent review-level evidence suggests increasing interest in immersive VR treatment in children and adolescents with social anxiety and related disorders, but this remains a less developed area than adult anxiety treatment(31). Thus, although the field is clearly progressing, important gaps remain.

The present review also has practical implications. For clinicians, the available evidence suggests that VRET may be considered a meaningful option in settings where exposure therapy is indicated but difficult to implement conventionally. This may apply particularly to social anxiety disorder, specific phobias, and other conditions in which feared situations are situational and reproducible. For researchers, the present findings reinforce the need to move beyond the simple question of whether VR works, toward more clinically informative questions about for whom, under what conditions, and with which specific therapeutic protocol it

works best. For the broader field of digital mental health, these findings offer an example of an area in which technological innovation is well aligned with an established psychotherapeutic mechanism, which may partly explain why VRET has shown more durable clinical promise than some less theoretically grounded digital interventions.

Overall, the available evidence suggests that Virtual Reality Exposure Therapy is a promising and clinically relevant intervention in anxiety disorders, particularly as a controlled and adaptable form of exposure-based treatment. Its greatest value appears to lie in the ability to recreate anxiety-provoking situations in a structured, repeatable, and therapeutically manageable way, while preserving the core principles of exposure therapy. At the same time, the current literature remains methodologically heterogeneous, which means that the exact magnitude and long-term consistency of treatment effects should be interpreted with caution. These considerations highlight both the current clinical relevance of VRET and the need for further high-quality research.

### Conclusions

Virtual Reality Exposure Therapy appears to be an effective and clinically meaningful intervention in anxiety disorders. The findings of this review indicate that VRET is associated with significant reductions in anxiety symptoms and, in many cases, achieves outcomes comparable to conventional exposure-based treatment.

The available evidence suggests that VRET may be particularly useful in disorders in which feared situations can be realistically simulated, especially social anxiety disorder and phobic disorders. Its main advantage lies in combining the therapeutic principles of exposure therapy with the practical benefits of immersive digital technology, including greater control, reproducibility, and flexibility of treatment scenarios.

At the same time, the literature remains heterogeneous with regard to study design, diagnostic scope, intervention format, and outcome assessment. Therefore, although current findings support the clinical promise of VRET, further well-designed randomized controlled trials and more methodologically consistent review studies are needed to clarify its long-term efficacy, optimal implementation, and comparative value across specific anxiety disorders.

Taken together, VRET should be regarded as a valuable component of contemporary anxiety treatment research and as a promising direction for the further development of exposure-based interventions.

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