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APPLICATIONS OF VIRTUAL REALITY TECHNOLOGY IN PSYCHIATRY – A REVIEW

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ABSTRACT

Virtual reality (VR) is a promising tool supporting diagnostics and therapy in psychiatry, aligning with the Health 4.0 paradigm of personalized healthcare. This review synthesizes the available scientific evidence on VR applications in psychiatry, with particular emphasis on therapeutic mechanisms, clinical effectiveness, and identification of research gaps.
The strongest empirical evidence concerns VR exposure therapy (VRET) in the treatment of anxiety disorders, where the effectiveness of VRET is comparable to in vivo exposure (Suso-Ribera et al., 2019). In the case of post-traumatic stress disorder, graded exposure based on the patient's responses has been shown to be a key moderator of effectiveness, yielding significant therapeutic effects (Heo and Park, 2022). In psychotic disorders, automated VR interventions reduce agoraphobic avoidance (Freeman et al., 2022), while in social phobia, optimal results are achieved by combining VRET with cognitive-behavioral interventions (Tan et al., 2025).
The neurobiological mechanisms of therapeutic change are based on amygdala activation and modulation of the medial prefrontal cortex and hippocampus, enabling extinction of the fear response. However, generalization of learned responses beyond the virtual context remains a key challenge (Freeman, 2017). Personalization of interventions using artificial intelligence is in the early stages of development (Bergsnev and Sánchez Laws, 2026).
From a clinical perspective, VR is characterized by high acceptability and low dropout rates. Further development of the field requires comparative studies with active interventions, standardization of the sense of presence measurement, and validation of tools for measuring social attitudes toward VR therapy. Integrating VR with traditional therapeutic methods, rather than replacing them, seems to be the most justifiable path forward for this field.

KEYWORDS

Virtual Reality, Psychiatry, Exposure Therapy, VRET, Anxiety Disorders, PTSD

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1. Introduction

The dynamic development of information and communication technologies over the last two decades has initiated a transformation of healthcare systems towards a model known as Health 4.0, which calls for the integration of advanced technological solutions to provide personalized, efficient, and accessible healthcare services. One of the key technologies that aligns with this vision is virtual reality (VR), which has evolved from a research tool into a recognized component of therapeutic interventions [1]. The potential of VR in psychiatry stems from its unique ability to generate highly controlled, safe, and engaging environments in which patients can experiment with new behaviors and confront challenging stimuli without suffering real-world consequences, making it particularly promising for psychotherapy.

The most established area of VR application in psychiatry is anxiety and fear-related disorders, where the virtual reality exposure technique (VRET) is a direct implication of classical conditioning and extinction paradigms [2]. VRET allows therapists to conduct systematic and controlled exposure to anxiety-provoking stimuli that may be difficult to access, expensive, or involve excessive logistical burden in the real world, as is the case with fear of flying or heights. From a clinical perspective, VRET is currently recognized by professional organizations as an acceptable modality of exposure therapy, particularly when in vivo confrontation is impractical [2], and meta-analyses confirm its comparable effectiveness to traditional exposure. Importantly, it has been shown that even a short-term intervention using VRET, for example, implemented in the form of just 30 minutes of exposure spread over two weeks, can lead to a statistically significant reduction in symptoms of depression, anxiety, and stress in occupationally healthy adults, which suggests its potential not only in the strictly clinical area, but also in prevention and promotion of mental health [3]. However, it has been observed that despite a solid empirical basis, the actual use of exposure therapy in everyday clinical practice is limited, and it is estimated that only 10-30% of therapists use it regularly, mainly due to concerns about patient safety and practical challenges.

2. VR Therapeutic Mechanisms

2.1. Immersion and the Sense of Presence

The therapeutic effectiveness of virtual reality (VR) in psychiatry is fundamentally dependent on two closely related phenomena: immersion and the sense of presence. Although these terms are sometimes used interchangeably in everyday discourse, the literature distinguishes them, highlighting their distinct yet complementary roles. Understanding this dichotomy is crucial not only for designing VR interventions but also for interpreting clinical trial results.

Immersion refers to the objective, technical properties of a VR system. As Freeman et al. (2017) note, immersion reflects the technical capabilities of the system, encompassing parameters such as display resolution, image refresh rate, field of view, and the quality of the head and body tracking system [6]. High-end VR systems, such as next-generation HMD (head-mounted display) goggles, provide significantly deeper immersion than systems based on standard computer monitors, which, as some researchers argue, should not be called true virtual reality at all due to their limited level of immersion and interaction [6]. Immersion is therefore a necessary, but not sufficient, condition for achieving the desired therapeutic effect.

Presence, in turn, is the user's subjective experience, defined as the illusion of being in a computer-generated location [6]. It is this apparent "being there," not the physical location, that constitutes the power of VR. Slater (2009, cited in Freeman et al., 2017) conceptualizes presence as a composite of two independent components: the place illusion (PI) and the probability illusion (PSI) [6]. PI arises when a VR system enables perception through natural, sensorimotor relationships—in other words, when the user's head and body movements are reflected in a corresponding change in the image of the virtual world. Psi, on the other hand, refers to the belief that events taking place in the virtual environment are authentic, even if the user is aware of their artificial nature. Achieving Psi requires that the virtual environment respond to the participant's actions, generate spontaneous events for them (e.g., avatars making eye contact), and be characterized by ecological validity [6].

From a clinical perspective, achieving a high level of presence is not an end in itself, but a means to elicit desired emotional and behavioral responses. In the case of anxiety disorders, it is precisely this sense of presence that is responsible for virtual stimuli (e.g., spiders, heights, crowds) evoking real fear. As emphasized by Cieślik and colleagues (2020), systematic reviews of research indicate that various VR-based interventions may be useful for various mental disorders, and one of the key mechanisms of their action is VR's ability to evoke a sense of reality in the patient [7]. Without this sense of presence, exposure therapy conducted in VR loses its foundation – the patient does not experience the emotions associated with the phobic situation, and consequently, habituation or learning new responses does not occur.

Importantly, immersion and presence do not have a simple linear relationship. Higher technical immersion increases the potential for inducing presence, but does not guarantee it. The subjective experience of presence is also influenced by user-related factors (e.g., susceptibility to illusions, previous gaming experience) and the characteristics of the virtual scenario itself (e.g., its coherence, lack of elements that "break" the fourth wall). A meta-analysis of anxiety disorders demonstrated that the greater the sense of presence achieved in VR, the greater the likelihood of an anxiety reaction [6].

In the broader context of bibliometric research on VR in therapy, immersion and presence are key indicators of intervention quality. Analyses of developments in this field indicate that technological advances, manifested in the emergence of cheaper and more advanced HMDs, have dramatically increased the accessibility of VR research and the level of immersion offered to participants [1]. However, as Liu and colleagues (2022) note, the use of advanced equipment alone does not guarantee therapeutic success; It is crucial to design environments that maximize the sense of real presence through integration with established therapies, the use of gamification elements, and a focus on the psychological benefits of the experience [1].

The importance of presence is also confirmed by research on short-term VR interventions. In a feasibility study involving healthy adult workers, Mahmud and colleagues (2022) demonstrated that just 30 minutes of exposure to a VR environment over two weeks significantly reduced symptoms of depression, anxiety, and stress [3]. Although this study did not directly measure presence, its effects indirectly demonstrate that even a short but sufficiently engaging exposure (i.e., one that evoked a sense of being in a different place in participants) can yield tangible emotional benefits. Importantly, this effect was comparable to, and in some dimensions stronger than, a standard stress management program, underscoring VR's potential as a tool with high accessibility and a low entry threshold [3].

Immersion and presence are two sides of the same coin in effective VR therapy. Immersion is the technological "hardware" that enables the phenomenon, while presence is the psychological "software" that actually drives therapeutic change. Future research on the use of VR in psychiatry should not only accurately report the technical parameters of the systems used (immersion level) but also incorporate standardized, subjective, and behavioral measures of the sense of presence as a key moderator and mediator of treatment outcomes.

2.2. The Neurobiological Foundations of VR Therapy

The introduction of virtual reality therapy into clinical psychiatry is neither accidental nor solely attributable to technological advances. Its increasing effectiveness in treating anxiety disorders, post-traumatic stress disorder, and specific phobias is based on robust, empirically supported neurobiological mechanisms. Understanding these mechanisms is essential not only for validating existing methods but also for developing the next generation of interventions—more personalized, effective, and safer. Virtual reality therapy directly impacts both ancient and new brain structures involved in threat processing, learning, and emotion regulation.

The central theoretical framework explaining the effectiveness of virtual reality exposure is the classical conditioning and extinction paradigm [2]. According to this model, the pathological fear response—characteristic of most mental disorders treated with virtual reality—is triggered by the association of an initially neutral conditioned stimulus with an aversive unconditioned stimulus [8]. For example, an elevator (conditioned stimulus) can be associated with a panic attack (unconditioned stimulus), leading to the development of a conditioned fear response, manifested by increased heart rate, sweating, and avoidance. Exposure therapy, both in the real world and in virtual reality (VR), involves the repeated, systematic presentation of the conditioned stimulus in a safe, controlled context, without the accompanying aversive unconditioned stimulus. This process does not extinguish the original, pathological fear memory, but develops a new, competing neural network—the extinction memory. The formation of this new representation is a neurobiological correlate of the symptom reduction observed in clinical trials.

From a neurobiological perspective, a key requirement for effective extinction in a virtual environment is the environment's ability to authentically and sufficiently activate the neural circuits that respond to real-world threats under natural conditions. This involves not only visual or auditory stimulation, but also the induction of a complex, phenomenological state known as presence. Presence is a subjective, profound experience of "being there," in which the mediating role of technology recedes into the background. Research clearly demonstrates that a high level of presence in VR is a necessary condition for amygdala activation—a structure crucial to the pathogenesis of anxiety disorders. Amygdala activation in response to virtual stimuli—such as a crowd on a bus in patients with social phobia, fear of heights in individuals with acrophobia, or a spider in individuals with arachnophobia—is not only possible but even comparable to activation induced by real-world stimuli [5][9].

This finding forms the basis for the neurobiological validation of VR therapy. However, amygdala activation alone is not sufficient to achieve sustained anxiety reduction. Effective extinction and long-term clinical improvement require parallel inhibitory control by higher cortical structures. More specifically, two main areas play a key role: the medial cortex and the hippocampus. Neuroimaging studies, including those using functional magnetic resonance imaging (fMRI), provide consistent evidence that effective VR exposure therapy leads to increased metabolic activity and plastic changes in the medial prefrontal cortex, particularly in its ventral region [10]. This area sends dense inhibitory projections via GABAergic neurons to the central nucleus of the amygdala. The central nucleus is a key "entry point" for the entire anxiety system—from here, signals propagate to the brainstem and hypothalamus, triggering behavioral and physiological anxiety responses such as freezing, increased heart rate, and elevated blood pressure. Activation of the medial prefrontal cortex and its inhibitory effect on the central nucleus of the amygdala constitute a neurobiological mechanism by which the patient gradually learns not to react with fear to a stimulus that was previously clearly aversive [10].

The hippocampus's role in this process is equally crucial, but it concerns a different aspect of learning: context encoding. Classically associated with declarative memory and spatial orientation, the hippocampus is responsible for creating complex, multimodal representations of learning contexts. In VR therapy, the hippocampus encodes all features of the virtual environment—the therapist's practice, the specific model of the VR headset, the appearance and behavior of avatars, and even details such as lighting and color—as an integral part of the newly formed extinction memory. The consequences of this fact are fundamental for clinical practice: the fear response extinguished in VR is initially highly context-dependent. A patient who overcomes their fear of spiders in a virtual space using a special device during therapy may still experience intense fear when encountering a real spider in their living room. This context-specific extinction, which directly stems from the neurobiological role of the hippocampus, poses one of the greatest challenges in transferring the effects of VR therapy to the patient's daily life.

Understanding this mechanism has far-reaching implications for optimizing therapeutic protocols. To break the pathological dependence of new memory on virtual context and promote generalization of extinction to real-life situations, it is necessary to introduce maximum variability of stimuli and contexts during the therapy itself. This means exposing the patient not to a single, unchanging scenario, but to a wide spectrum of diverse VR situations – different avatars (of different gender, age, and appearance), different settings (a crowded street, an empty parking lot, an elevator, a store), different times of day, and different lighting conditions. This procedure, consistent with the latest theories of inhibitory learning, prevents the brain from "binding" a new, safe response to a single, narrowly defined context. Instead, the brain is forced to abstract a more general rule – that a given stimulus (e.g., being around people) is safe regardless of the specific circumstances. It is this process of abstraction and generalization that is the neurobiological goal of modern, advanced VR protocols.

An important addition to this picture is the role of anticipation, expectation, and active patient engagement [5]. Before beginning therapy, each patient holds specific, often unconscious, beliefs about virtual reality – whether it will be safe for them, whether it will cause unacceptable discomfort, or whether it can be effective at all. These cognitive "pre-sets" influence brain activity. Research indicates that positive expectations regarding the presence and effectiveness of VR therapy modulate the activity of the reward system, including the nucleus accumbens and ventral tegmental area. Activation of these structures releases dopamine, which not only evokes pleasant subjective feelings but, above all, increases motivation, engagement, and readiness to resume the exposure effort. Patients who expect VR therapy to be helpful demonstrate a higher tolerance for the initial, inevitable discomfort and greater persistence in continuing treatment recommendations. Indirectly, by increasing engagement, positive expectations influence the depth and persistence of neuroplastic changes within the entire anxiety-prefrontal network [10].

In summary, the neurobiological foundations of VR therapy are solidly grounded in decades of research on conditioning, learning, and neuroplasticity [8]. Virtual reality is not merely a technological add-on or a "simulation" inferior to reality. It is a tool capable of activating and modulating key brain structures—the amygdala, medial prefrontal cortex, and hippocampus—in a controlled, safe, repeatable, and progressive manner. Clinical effectiveness, however, depends not only on the device's technical parameters, such as resolution or field of view, but primarily on two factors: first, the therapeutic protocol's ability to promote extinction generalization beyond the initial virtual context. Second, the patient's active, engaged, and expectant attitude. Further development of VR therapy should therefore focus on designing interventions in a neurobiologically informed manner, leveraging natural, evolutionarily evolved mechanisms of brain plasticity to rewrite pathological memory traces into new, adaptive representations.

3. VR in the Treatment of Specific Phobias

3.1. Results

Virtual reality (VR) has become one of the most promising therapeutic tools in recent years. It is used in the treatment of specific phobias, offering new possibilities in terms of exposure, stimulus control, and increased accessibility to therapy. Specific phobias, defined as an intense and irrational fear of a specific object or situation, are among the most prevalent disorders, yet characterized by relatively low treatment compliance. Classic in vivo exposure, although considered the gold standard, is sometimes rejected by patients due to high levels of discomfort, aversion to contact with a real stimulus, or limited therapeutic accessibility. VR overcomes many of these barriers. It offers a safe, controlled, and repeatable exposure environment that can be tailored to the patient's individual needs. In the context of specific phobias, VR allows for a gradual and precise increase in stimulus intensity, promoting habituation and the extinction of anxiety responses.

One of the most important studies comparing the effectiveness of VR with other forms of exposure is the work by Suso Ribera and colleagues [11], which includes an analysis of three randomized controlled trials on small animal phobia. The authors compared three therapeutic modalities: in vivo exposure (iVET), virtual reality exposure (VRET), and augmented reality exposure (ARET). The total sample size included 91 participants, making this study one of the largest in this field. The results showed that all three forms of exposure led to significant reductions in anxiety, avoidance, and subjective fear levels. Importantly, no differences were found between the modalities in terms of therapeutic efficacy. This confirms that VR and AR can be legitimate alternatives to exposure with live animals. The authors emphasize that the effect of time was strong and unambiguous, while the interaction of time and therapy type did not reach statistical significance, indicating no differences between the modalities. These results have significant clinical implications because they suggest that immersive technologies can be used interchangeably with in vivo exposure, particularly in situations where access to real stimuli is limited or when the patient experiences a strong aversion to contact with a live animal.

This study also provides interesting observations regarding potential moderators of treatment effectiveness. The authors noted a marginal trend indicating that individuals with the lowest pre-treatment BAT scores may have benefited slightly more from in vivo exposure than from VR or AR. However, this effect did not reach statistical significance, requiring further research. Nevertheless, this observation suggests that in the future, it may be possible to more precisely tailor exposure modalities to individual patient characteristics, which is an important direction for the development of personalized therapy.

Another important area of application of VR is the treatment of emetophobia, or the fear of vomiting. This disorder, although relatively rare, can lead to significant functional impairment, impacting daily activities, social relationships, and physical health. Wallace et al. [12] conducted one of the first studies to evaluate the effectiveness of VRET in treating this disorder. They used the oVRcome app, which combines elements of psychoeducation, Acceptance and Commitment Therapy (ACT) techniques, Cognitive Behavioral Therapy (CBT), and VR exposure. The study was a multiple-baseline design and included six participants. The results showed that four of the six individuals experienced significant improvement, and three improved significantly enough to fall below the diagnostic threshold. Importantly, the app was used independently by patients, demonstrating the potential of VR as an e-health tool, enabling therapy without the involvement of a therapist.

The effectiveness of VR in treating arachnophobia is also confirmed by other studies, which indicate that this technology can be a valuable alternative to traditional exposure methods. In many cases, VR allows for the creation of a therapeutic environment that is more controlled than real-life conditions, allowing for precise adjustment of stimulus intensity to the patient's current abilities. In the study by Andersson and colleagues [13], a single-session protocol was used, which in its traditional form requires intensive work with a live spider. Replacing it with a realistic VR model allowed for the maintenance of the therapy's structure while eliminating elements that often cause patients to withdraw before treatment begins. Participants emphasized that the ability to gradually become familiar with the virtual spider, without the risk of the animal's unpredictable behavior, increased their sense of security and control over the situation. This, in turn, fostered greater engagement in the therapeutic process and allowed for the achievement of effects comparable to in vivo therapy.

In Andersson's study, participants repeatedly emphasized that the virtual spider evoked genuine anxiety reactions, despite their awareness that it was not real. This confirms that VR can effectively activate the mechanisms responsible for the development and maintenance of phobias, which is a necessary condition for their extinction. At the same time, VR avoids many of the logistical challenges associated with in vivo therapy, such as the need for live animals, ensuring their safety, and properly preparing the therapeutic space.

Another interesting aspect of VR therapy is the possibility of standardization. In traditional in vivo therapy, animal responses can be unpredictable, making it difficult to control the course of exposure. In VR, every element of the environment can be programmed in a repeatable manner, allowing for precise replication of therapeutic scenarios. This enables comparative studies with high methodological reliability and the development of therapeutic protocols that can be used by different therapists in different centers without the risk of significant differences in the course of therapy. This standardization is particularly important in the context of clinical trials, where control over variables is crucial for assessing the effectiveness of interventions.

In the study by Wiens et al. [14], VR was used not only as a therapeutic tool but also as a research tool enabling the analysis of the neurophysiological mechanisms underlying specific phobias. The authors used electroencephalography (EEG) to measure two key components related to emotional processing: the early occipital negativity (EPN) and the late positive potential (LPP). These components are considered indicators of automatic and controlled processing of emotional stimuli, and their analysis allows for the assessment of whether the therapy affects deeper levels of cognitive functioning. The study results showed that despite a significant reduction in subjective anxiety after therapy, both EPN and LPP remained unchanged. This indicates that the therapy – regardless of the modality – may primarily affect the conscious, declarative aspects of anxiety, while automatic neural processes remain more stable.

The interpretation of these results is complex. On the one hand, it suggests that VR is as effective as in vivo exposure in reducing clinical symptoms, confirming its therapeutic value. On the other hand, the lack of changes in EEG components may indicate that neural processes related to the processing of anxiety stimuli are more resistant to modification and may require longer periods or more intense exposure to change. It is also possible that these changes occur at a level that is not detectable using standard EEG methods, opening the door to further research using more advanced neuroimaging techniques.

It is also worth emphasizing that VR can be administered remotely, which is particularly important in the context of limited access to mental health professionals. VR-based therapeutic applications, such as the one used in Wallace's study, allow patients to self-administer exposure at home while maintaining the structure and principles of cognitive behavioral therapy. Such solutions could significantly increase the accessibility of treatment, particularly in regions with a shortage of qualified therapists or in situations where patients cannot attend inpatient therapy. Remote VR interventions can also complement traditional therapy, allowing patients to continue exposure between therapy sessions.

Another aspect worth noting is the potential for VR to reduce dropout rates. Many people with specific phobias avoid treatment for fear of having to deal with a real-world stimulus. VR allows for gradual familiarization with the stimulus in a way that is perceived as less threatening, which may increase patient willingness to engage in therapy. Research indicates that VR has lower rates of refusal and dropout than in-vivo exposure, making it an attractive alternative for people who might otherwise choose not to pursue treatment. The ability to begin therapy in a virtual environment can also act as a "bridge" to later exposure in the real world, if necessary.

3.2. Discussions

The effectiveness of virtual reality (VRET) in treating specific phobias is gaining increasing support, but the mechanisms of change and comparability with in vivo therapy require further analysis. According to the results of Suso-Ribera et al. [11], VRET is as effective as in vivo and augmented reality exposure in reducing symptoms of small animal phobia, making it a valuable clinical alternative. In the case of emetophobia, Wallace, Lacey, and Sargisson [12] demonstrated that a low-cost VRET application resulted in significant symptom reduction in half of the participants, with scores falling below the diagnostic threshold in two of them. Andersson et al. [13] in a study of a single-session VRET protocol for arachnophobia achieved large therapeutic effects ($d = 0.90–1.38$), and all participants accepted the treatment, underscoring the high acceptability of the method. However, a key question concerns the nature of the neurophysiological changes. Wiens et al. [14] compared VRET and in vivo therapy in individuals with arachnophobia, finding that although both methods significantly reduced negative subjective evaluations, they did not affect late cortical potentials (EPN, LPP) reflecting motivated attention. This suggests that VRET may operate through inhibitory learning mechanisms rather than the elimination of a primary affective response, which has important implications for treatment theory.

3.3. Conclusions

The conducted research review allows for several key conclusions regarding the use of virtual reality in the treatment of specific phobias. First, VRET is as effective as traditional in vivo exposure in reducing behavioral and subjective symptoms, making it a valuable clinical tool [11]. Second, even low-cost, commercially available VRET applications can produce significant improvement in a significant proportion of patients, increasing the availability of treatment outside specialized centers [12]. Third, VRET interventions are characterized by high acceptability and a low dropout rate, which is crucial for patients who avoid real-world exposure [13]. At the same time, it should be emphasized that changes at the declarative level do not always translate into modifications of early neurophysiological processes, such as EPN and LPP [14]. This suggests that VRET may act through inhibitory learning mechanisms rather than by eradicating the primary fear response. Further studies with long-term follow-up are necessary.

4. VR in the Treatment of Social Anxiety Disorder

4.1. Results – 600 words

The effectiveness of virtual reality exposure therapy (VRET) in the treatment of social anxiety disorder (SAD) is the subject of a growing number of studies, although the results remain inconclusive. A systematic review with meta-analysis synthesized data from 17 randomized controlled trials (RCTs) involving 943 participants. VRET was shown to be superior to waitlist-based interventions both immediately after the intervention and at follow-up [16]. Importantly, VRET did not differ significantly in effectiveness from other interventions (in vivo exposure, CBT) in reducing social anxiety symptoms, a finding also confirmed by independent analyses [20]. In contrast, a meta-analysis of studies on stand-alone VRET (without cognitive components) yielded a standardized mean difference (SMD) of -0.82, indicating a large intervention effect

[18]. Crucially, however, in the only RCT comparing pure VRET (without cognitive intervention) with in vivo exposure, the latter proved more effective at 3-month follow-up, although VRET outperformed waitlist interventions [15].

A significant moderator of the effect is the combination of VRET with cognitive-behavioral interventions. A meta-analysis showed that VRET combined with CBT produced a larger effect than VRET alone, compared to waitlist interventions [16]. This is supported by the results of a Hong Kong study, where a combined internet-based CBT (iCBT) program with VRET proved more effective than waitlist interventions, with a between-group effect size for the main measure of social anxiety disorder (SPIN) of 1.02 for the web version and 1.15 for the mobile app [22]. At the same time, analyses reveal that VRET as a standalone tool, although effective, may not fully address the key cognitive component of social phobia: fear of negative evaluation [17].

According to emotional processing theory, the mechanism of action of VRET involves the activation of the drug structure and the provision of corrective information [16]. Processual studies indicate that VRET significantly reduces the expectation of catastrophic cognitions ($B = -21.55$, $SE = 4.48$, $p <.001$), distress ($B = -19.65$, $SE = 2.9$, $p <.001$), and improves the subjective assessment of one's own performance quality ($B = 11.1$, $SE = 3.1$, $p <.001$) during a single session [21]. The possibility of training in attentional pattern modification is also important. In a randomized pilot study using eye tracking, participants receiving VRET augmented with attention guidance training (AGT) demonstrated greater changes in gaze duration towards audience members, suggesting that modification of visual avoidance may be associated with reduced symptoms of social anxiety [23]. From a clinical perspective, VRET is characterized by comparable attrition rates to in vivo exposure [15]. Importantly, efficacy studies in routine clinical care settings confirm large intervention effects ($d = 0.77$ after the main session), with minimal therapist training [21]. However, some adverse effects were noted, such as an increase in perceived stress ($n = 6$) in the study group, which is consistent with the nature of exposure therapy [21]. Furthermore, attempts to augment VRET using transcranial direct current stimulation (tDCS) targeting the medial prefrontal cortex did not yield the expected improvement [19]. In summary, VRET is a promising tool in the treatment of social phobia, especially when combined with CBT, but its advantage over in vivo exposure has not been clearly confirmed [15][16][18].

4.2. Discussions

This discussion examines the effectiveness of virtual reality exposure therapy (VRET) in the treatment of social phobia, taking into account both primary research and recent meta-analyses. A literature review indicates that VRET is significantly more effective than no treatment, with a small to medium effect size ($g = 0.48$) after intervention [16]. Importantly, these effects persist in long-term follow-up, although the evidence base for long-term effectiveness remains limited [16][20]. However, comparisons of VRET with in vivo exposure yield equivocal results. On the one hand, a randomized trial by Kampmann et al. demonstrated the superiority of in vivo exposure in reducing symptoms of social anxiety and beliefs associated with avoidant personality disorder [15]. On the other hand, meta-analyses do not confirm significant differences between these methods based on data from multiple studies [20]. This discrepancy suggests that VRET may be a valuable alternative in routine clinical practice. An additional argument is the lower cost and greater flexibility of VR interventions compared to in vivo exposure [17]. Optimizing therapeutic procedures remains a key challenge. In this context, integrating VRET with attention modification training seems promising, as targeted changes in visual fixation patterns may mediate a reduction in social anxiety symptoms [23]. Furthermore, combining VRET with cognitive behavioral therapy (CBT) yields more beneficial effects than using VRET alone [2, 4]. However, it should be noted that many studies have combined VRET with cognitive components, making it difficult to isolate the pure effect of virtual exposure alone. Therefore, further, well-designed randomized controlled trials with long-term follow-up are necessary to precisely define the role of VRET in the treatment algorithm for social anxiety disorder [16][18].

4.3. Conclusions

The conducted analyses indicate that virtual reality exposure therapy (VRET) is an effective intervention in reducing the symptoms of social phobia, particularly in the subtype associated with public speaking anxiety. Review studies confirm that VRET demonstrates high efficacy compared to wait-list groups [16][18], with effects comparable to traditional in vivo exposure [17]. However, it should be noted that the pure effect of VRET as a stand-alone intervention remains under investigation, and current evidence suggests its potentially lower long-term effectiveness than in vivo exposure [15]. Importantly, combining VRET with cognitive interventions yields greater symptom reduction than virtual exposure alone [16]. However, innovative approaches, such as integrating VRET with transcranial direct current stimulation (tDCS), have not yielded the expected improvement [19]. On the other hand, combining VRET with internet-based cognitive behavioral therapy (iCBT) has been shown to be highly effective, including in Chinese-speaking populations [22]. A significant mechanism of action is the modification of attention patterns; attention management training in the VR environment leads to a reduction in social avoidance and mediates clinical improvement [23]. Despite promising results, the high dropout rate [21][22] and the risk of bias in available studies [18][20] indicate the need for further high-quality randomized clinical trials. In summary, VRET is a valuable tool in the treatment of social phobia, especially when enriched with cognitive components; however, its implementation in routine clinical practice requires further research on protocol optimization and mechanisms of therapeutic change.

5. VR in the Treatment of Posttraumatic Stress Disorder (PTSD)

5.1. Results

A 2022 systematic review, including a total of 641 participants (96.7% male), found that exposure-based virtual reality (VRET) protocols had a positive impact on a range of posttraumatic stress disorder (PTSD) symptoms, with all treatment benefits maintained at 3-, 6-, and 12-month follow-ups [24]. Eight of the nine studies reported a reduction in PTSD symptom severity using the Clinician-Administered PTSD Scale (CAPS), and the majority of studies (45.45%) used the Virtual Iraq/Afghanistan system [24]. The eMagin z800 head-mounted display (HMD) was used in 63.63% of the studies, and the number of VRET sessions ranged from 3 to 20, with each session lasting from 30 to 120 minutes (mean 76.3 minutes) [24]. Four of the eleven studies included in vivo exposure exercises performed at home, such as listening to audio recordings of the VRET sessions [24]. At the same time, it was found that in most of the analyzed studies, no significant between-group differences were observed between VRET and active comparison interventions [24]. According to the results of a focus group study conducted among 22 Portuguese veterans (mean age 67.5 years, all men), new VRET programs should be combined with traditional therapy and include as requirements a sense of presence (both spatial and social), dynamic scenarios, realistic sensations, and a multisensory experience, including olfactory, auditory, and tactile stimuli [24]. Focus group participants emphasized the particular importance of the scent of rain and damp earth as key triggers for traumatic memory [24].

A meta-analysis of seven randomized controlled trials involving 308 participants (active soldiers and veterans with combat-related PTSD) demonstrated significant differences in effectiveness depending on the type of exposure protocol [25]. VR-GET, in which the intensity of stimuli was adjusted on an ongoing basis based on the patient's responses (measured by Subjective Distress Units – SUD), demonstrated a large, statistically significant reduction in PTSD symptoms compared to control groups ($g = 1.100$; $p = 0.001$) [25]. In the VR-GET group, continuous monitoring of physiological responses or subjective distress levels was used to control the frequency and intensity of trauma-related stimuli during the sessions [25]. In contrast, conventional VRET (with automatically increasing exposure as the session progressed, without monitoring patient responses) did not demonstrate a significant advantage over the control groups ($g = -0.279$; $p = 0.970$) [25]. Meta-regression analysis did not reveal a significant dose-response relationship ($p = 0.159$), suggesting that a greater number of treatment sessions does not translate into a greater treatment effect [25].

In a randomized, double-blind clinical trial involving 54 veterans (mean age 45.7 years, 94% male) with chronic war-related PTSD, active transcranial direct current stimulation (tDCS; 2 mA, anodal, targeting the medial prefrontal cortex (VMPFC) was compared with sham stimulation during six 25-minute VR exposure sessions using the Bravemind system [26]. Participants in the active tDCS group reported significantly greater reductions in PTSD symptom severity on the PCL-5 scale at 1 month compared to the placebo group ($t = - 2.27$; $P = 0.02$; Cohen's $d = -0.82$), and a change of 10 points or more on the PCL-5 scale was defined as clinically significant [26]. Furthermore, active tDCS significantly accelerated psychophysiological habituation as measured by intersession skin conductance reactivity compared to sham stimulation ($F5,7689.8 = 4.65$; $P < 0.001$) [26]. At the 3-month follow-up, significant and clinically relevant improvements in social and occupational functioning were observed in the active tDCS group compared to the sham group ($t = 2.78$; $P = 0.006$; Cohen's $d = 1.2$) [26]. Adverse events were mild and consistent with the known safety profile of both interventions [26]. A meta-analysis of eleven studies with 438 participants demonstrated that VRET was superior to waitlist controls (standardized mean difference SMD = -0.64; 95% CI: -1.05 to -0.22) and comparable to other active psychotherapies (SMD = -0.25; 95% CI: -0.77 to 0.27) [27]. However, the overall quality of most included studies was found to be low, and the results were characterized by significant heterogeneity [27]. Only three of the eleven studies consistently reported adverse events, with worsening of

PTSD symptoms occurring rarely (less than 3.5%) [27]. The latest meta-analysis from 2026, including only randomized clinical trials (seven studies involving patients with a clinically confirmed diagnosis of PTSD), confirmed a moderate but statistically significant effect of VRET in reducing PTSD symptoms (Hedges' g = - 0.51; 95% CI: -0.72 to -0.30; $P < 0.001$) [28]. Moderator analyses showed that a shorter duration of a single session (≤ 60 minutes) was associated with a significantly greater therapeutic effect on anxiety ($Q = 6.39$; $P = 0.011$) [28].

5.2. Discussion

The pooled results of review studies and meta-analyses indicate that virtual reality exposure therapy (VRET) is a promising intervention in the treatment of PTSD, although its advantages over traditional methods are not clear. A systematic review by Vianez et al. [24] demonstrated a positive effect of VRET on PTSD symptoms, but most studies found no significant between-group differences compared to control groups. Importantly, in a study using a focal group, veterans emphasized the need to combine VRET with traditional therapy. The meta-analysis by Heo and Park [25] makes a key distinction: while conventional VRET did not differ significantly from control ($g = -0.279$), VR-graded exposure therapy (VR-GET) demonstrated a large effect size ($g = 1.100$), suggesting that immersion and grading of exposure based on patient responses are crucial. In a randomized clinical trial, van't Wout-Frank et al. [26] demonstrated that active transcranial direct current stimulation (tDCS) combined with VR significantly improved PCL-5 scores after 1 month ($d=-0.82$) and accelerated physiological habilitation, suggesting that enhancing neural plasticity may enhance the effects of VRET [26]. According to a review by Eshuis et al. [27], VRET was found to be more effective than no treatment (SMD=-0.64) and as effective as other active psychotherapies, although the authors emphasized that the quality of the included studies was often low. Finally, a meta-analysis by Chang et al. [28] confirmed a moderate but significant effect of VRET on PTSD symptoms (Hedges' g=-0.51), while also emphasizing that shorter sessions (≤60 minutes) were associated with greater therapeutic effects [28].

5.3. Conclusions

The conducted review studies indicate that virtual reality exposure therapy (VRET) is a promising intervention in the treatment of PTSD, particularly in military and veteran populations for whom traditional methods may be insufficient. Meta-analyses confirm that VRET is significantly more effective than no treatment [27], and its effectiveness in reducing PTSD symptoms is comparable to other active psychotherapies [27]. Crucially, more recent data indicate the superiority of VRET-based graded exposure therapy (VR-GET) over conventional VRET [25], emphasizing the importance of monitoring patient responses for achieving better outcomes. Additionally, innovative approaches combining VRET with transcranial direct current stimulation (tDCS) have shown promising results in accelerating physiological habituation and improving social functioning [26]. Although the quality of previous studies has been mixed [27] and the effects on PTSD itself are moderate [28], VRET may be particularly valuable for patients resistant to standard treatment [24]. It is important that future VRET programs integrate with traditional therapy, ensure a high level of presence and realism, and engage end users in the scenario development process [24].

6. VR in the treatment of anxiety disorders, depression, OCD, and addiction therapy.

6.1. Results

Research analysis confirms the effectiveness of virtual reality (VR) in the treatment of anxiety disorders. A meta-analysis of 33 RCTs demonstrated significant improvement in anxiety after VR interventions (SMD = -0.95) [38]. The effectiveness of VR exposure therapy (VRET) was confirmed for social anxiety, with symptom reduction lasting up to 12 months [30]. The effectiveness and safety of VR therapy for preoperative medication were confirmed [47]. Self-guided VR interventions demonstrated effectiveness for public speaking anxiety, with low dropout rates and a good safety profile [32]. In adolescents with school anxiety, a five-session VRET program significantly reduced social anxiety symptoms ($d = 0.82$) [34]. At the same time, review studies indicate a significant lack of randomized controlled trials evaluating VRET in children and adolescents [36].

In medical procedures, VR before surgery in children significantly reduced the likelihood of moderate or high preoperative anxiety in both patients (OR 0.15; $p < 0.001$) and caregivers (OR 0.14; $p < 0.001$) [40]. VR intervention during venipunctures in children reduced pain ($\beta = -0.78$; $p < 0.001$) and anxiety ($\beta = -0.41$; $p = 0.03$) compared to standard care [31][39]. In hemodialysis patients before surgery, VRET significantly reduced anxiety symptoms ($p < 0.01$) [41]. It should be noted, however, that the evidence for the effectiveness of VR in reducing pain and anxiety in cancer patients undergoing medical procedures is inconclusive – a systematic review found a trend of improvement, but only two of nine studies reached statistical significance [33].

In the field of depressive disorders, bibliometric studies indicate that the number of publications on VR for depression is lower than for anxiety [42]. Nevertheless, Avatar Therapy – a VR intervention with a real-time avatar animated by a therapist – in patients with treatment-resistant depression resulted in an 80% response rate and a significant reduction in depressive symptoms measured by the MADRS scale ($d = 1.36$; $p < 0.001$) [43]. In patients with postherpetic neuralgia, 14 days of VR therapy significantly improved scores on anxiety (GAD-7), pain (NRS, VAS), and quality of life scales ($p < 0.05$) [37].

In obsessive-compulsive disorder (OCD) with a contamination component, a randomized clinical trial comparing mixed reality exposure therapy (MERP) with standalone ERP found no significant between-group differences in OCD symptom reduction as measured by the Y-BOCS ($\eta p^2 = 0.002$; $p = 0.84$), although moderate to large within-group improvements were observed in the MERP group (Cohen's d: 0.584–0.931) [35].

In addiction treatment, exposure to cocaine-related cues in VR elicits craving responses comparable to real-world stimuli, and repeated exposure leads to a reduction in cocaine craving [44]. In a randomized pilot study of opioid-dependent patients receiving methadone, VR aversion therapy significantly reduced cravings ($F = 65.445$; $p = 0.000$) and depression severity ($F = 19.652$; $p = 0.000$) and increased self-efficacy ($F = 33.956$; $p = 0.000$) compared to the methadone-only group [46].

Another interesting research direction is the use of VR in work-related stress disorders – it is predicted that VR exposure may provide greater immersion and therapeutic efficacy than imaginal exposure [45].

6.2. Discussions

In light of the presented literature review, the effectiveness of virtual reality (VR) in psychiatry appears promising but ambiguous, particularly depending on the disease entity. For anxiety disorders, VR exposure therapy (VRET) has consistently demonstrated high effectiveness, confirmed by meta-analyses [38], demonstrating a reduction in anxiety symptoms comparable to in vivo exposure [30]. These studies highlight the importance of key factors such as presence, which positively correlates with better therapeutic outcomes [29]. However, for obsessive-compulsive disorder (OCD), the results are less optimistic; the most recent randomized clinical trial did not demonstrate an advantage of mixed reality exposure over stand-alone therapy, suggesting that the potential of this method has not yet been fully exploited [35]. In the context of depressive disorders, VR shows potential, particularly as a therapeutic tool in populations with treatment-resistant depression, where avatar therapy resulted in significant symptom reduction [43], and also as a supportive intervention in addiction treatment. In the latter field, VRET has been shown to be effective in reducing craving for cocaine [44], and VR-based aversion therapy significantly reduced craving and depression in patients with opioid addiction [46]. However, there is a significant research gap in the child and adolescent population, where, despite initial promising results, there are insufficient controlled studies confirming the efficacy of VRET [36]. In summary, although VR is a powerful tool in exposure to anxiety and addictive stimuli, its effectiveness in more complex disorders such as depression and OCD requires further, carefully designed studies taking into account specific mechanisms and populations.

6.3. Conclusions

The literature review confirms that virtual reality exposure therapy (VRET) is an effective intervention for anxiety disorders [29][30][34][38]. There is also preliminary evidence for a reduction in depressive symptoms, both as a direct and secondary effect [30][33][43]. In the treatment of obsessive-compulsive disorder (OCD), immersive technologies, while promising, require further refinement, particularly in terms of the sense of presence [35]. In addiction, exposure to substance-related cues in VR effectively reduces cocaine craving and craving [44][46]. Crucially, VR interventions are well accepted by patients, and dropout rates are low [32][36]. Another important finding is the effectiveness of VR in reducing pain and anxiety before medical procedures, which indirectly supports patients with mental disorders [31][39][40]. VR therapy can therefore serve as a valuable complement or alternative to traditional methods, especially where in vivo exposure is difficult [30][35].

7. Applications in Psychotic Disorders and Schizophrenia

7.1. Results

The analyzed studies on the use of virtual reality (VR) in the treatment of psychotic disorders, including schizophrenia, identified the effectiveness of VR interventions in reducing positive, cognitive, and negative symptoms, as well as improving social functioning. A systematic review by Bisso et al. (2020) found that VR demonstrates effectiveness in treating various psychotic symptoms, including delusions, hallucinations, and cognitive and social deficits, with long-term therapeutic effects noted [48]. Kruk et al. (2020) emphasize that virtual reality, thanks to its high accuracy, enables the simulation of social situations in controlled conditions, which is useful in both the diagnosis and treatment of auditory hallucinations and delusions [49]. In a study by Freeman et al. (2022) evaluating gameChange therapy in 122 patients with psychosis, 65.8% were very satisfied with VR therapy, and the most common side effect was difficulty concentrating (14.2%); no significant impact of adverse symptoms on treatment outcomes was found [50].

In the context of negative symptoms, Cella et al. (2022), in a randomized pilot study of V-NeST (N=30), demonstrated that VR-assisted therapy is acceptable and feasible, with preliminary analyses suggesting a large effect on achieving therapeutic goals (d=1.48) and a potential reduction in negative symptoms measured by the CAINS scale (d=-0.46) [51]. Freeman et al. (2022), in a multicenter randomized controlled trial (N=346) comparing automated VR therapy (gameChange) with standard care, demonstrated significant reductions in agoraphobic avoidance (difference -0.47; p=0.026) and distress (difference -4.33; p=0.014) after 6 weeks, with the effects being strongest in patients with severe avoidance [52]. Therapeutic effects were mediated by reductions in threat beliefs and safety behaviors. In a study by van der Stouwe et al. (2024) comparing VR-CBTp with traditional CBTp in 98 patients with paranoid delusions, both therapies were effective, but VR-CBTp showed a stronger effect in reducing momentary paranoia in daily life (interaction b = 8.3; ES = 0.62) and in reducing safety behaviors and improving self-esteem after treatment completion [53]. Furthermore, the authors reported a higher dropout rate in the VR-CBTp group (37.5% vs. 24.0%), but in those who completed the therapy, the effects were achieved in fewer sessions (12.7 vs. 15.1). In the study protocol, Rus-Calafell et al. (2024) describe a new intervention, AVATAR_VRSocial, which combines avatar therapy with three sessions in VR environments, aimed at improving the generalization of acquired skills to everyday social interactions in individuals in the early stages of psychosis [54]. Finally, in a network meta-analysis by Salahuddin et al. (2024) including 52 RCTs with 5034 participants with treatment-resistant schizophrenia, VR interventions (SMD -0.41; 95% CI -0.79 to -0.02) and CBTp (SMD -0.22; 95% CI -0.35 to -0.09) were found to be more effective than standard care in reducing general symptoms [55].

7.2. Discussions

Available scientific evidence supports the versatility and effectiveness of virtual reality (VR) in the treatment of psychotic symptoms, including hallucinations and delusions [48]. In the context of treating resistant positive symptoms, VR-based interventions demonstrate significant advantages over standard care [55]. Avatar therapy is particularly promising, significantly reducing voice-related distress and improving quality of life in patients with persistent auditory hallucinations in replicated studies [48][54]. Importantly, VR therapy appears to be well-accepted by patients, and side effects, such as transient difficulties with concentration or rare panic, are few and do not negatively impact treatment outcomes [50]. In terms of generalizing acquired skills, innovative protocols combining avatar therapy with virtual reality exposure to social situations have the potential to enhance the transfer of therapeutic effects to everyday functioning [54]. At the same time, data on negative symptoms indicate that VR-assisted therapy (V-NeST) is feasible and acceptable, leading to a reduction in these symptoms and improved patient goal achievement [51]. However, despite initial promising results, many researchers emphasize that the available evidence base is still limited, with many studies characterized by small sample sizes and a lack of long-term follow-up, necessitating caution in drawing definitive conclusions [48][49][55]. Further, well-designed randomized controlled trials comparing VR with active psychological interventions are necessary to fully realize the potential of this technology in psychiatry [53].

7.3. Conclusions

Available evidence supports the effectiveness of immersive virtual reality in the treatment of schizophrenia, although further research is needed [48]. VR interventions demonstrate an advantage over standard treatment in reducing general symptoms, particularly in treatment-resistant cases [55]. VR-CBTp therapy has been shown to be more effective than standard CBTp in reducing transient paranoia and safety behaviors [53]. Automated VR therapy (gameChange) significantly reduces agoraphobic avoidance and distress, with the greatest benefits in patients with severe symptoms [52]. In the treatment of negative symptoms, the V-NeST intervention supports the achievement of patient goals and is well tolerated [51]. Patients with psychosis highly rate satisfaction with VR therapy, reporting few and non-interfering side effects [50]. VR avatar therapy, through dialogue with voice representation, reduces the severity of auditory hallucinations and improves quality of life [54]. VR technology enables standardized, repeatable, and safe exposure to social situations, making it a promising diagnostic and therapeutic tool [49].

8. Neuropsychiatry, Diagnostics, and Other Applications

8.1. Results

The reviewed literature on virtual reality (VR) applications in psychiatry identified a number of studies focusing on the diagnosis and neuropsychiatric aspects of disorders. In the area of neurodevelopmental disorders, particularly in children and adolescents with autism spectrum disorder (ASD) without intellectual disability, VR has been used to stimulate social and communication skills, including through interaction with an avatar or emotion recognition training [56]. In the context of assessing affective states, including burnout syndrome, research protocols using VR with integrated biofeedback (ReViSide) have been developed to correct emotional burnout, with predicted improvements in Maslach Burnout Inventory (MBI) scores [57]. Importantly, research indicates the potential of VR as a tool activating unconscious processes and relational patterns in a psychodynamic perspective, where the VR environment can function as a "transitional space" for symbolic processing of internal conflicts [58]. In the field of social skills training in children with ASD level 1, randomized studies have shown that VR interventions shorten the time to acquire skills related to the use of primary and secondary emotions in social situations compared to traditional training with a therapist [59]. However, in the area of somatic health, the use of behavioral VR in the form of movement games (Xbox Kinect) did not result in a statistically significant change in total sleep time or sedentary behavior time in children aged 5-9 [60]. In turn, in dental procedures in children aged 5-8, the use of VR as a distraction technique significantly reduced the perception of pain and the level of state anxiety, which corresponded with a reduction in salivary cortisol levels [61]. In the innovative trend of the so-called Cyberdelics, the use of hallucinatory visual experiences generated by VR (HVVE) led to improved cognitive flexibility and inhibitory control in healthy participants, which may have implications for neuropsychiatric cognitive rehabilitation [62]. A systematic review of VR research in eating disorders confirmed that this technology is acceptable and effective for working on body image and exposure to food stimuli, eliciting emotional responses similar to real-life [63]. A recent meta-analysis of randomized trials of anatomy education showed that VR moderately improved knowledge test scores compared to traditional methods (SMD = 0.53), indicating the usefulness of VR in neuroeducation and as a tool to support neuropsychiatric education [64].

8.2. Discussions

The literature review reveals significant methodological diversity in studies on the use of VR in neuropsychiatry. Astafeva et al. [56] indicate that most analyses are based on small samples, which limits the possibility of drawing clear conclusions. Smirnova et al. [57] emphasize the need for unified research protocols, especially in the context of integrating VR with biofeedback. Rossi et al. [58] draw attention to the risk of cybersickness, which may interfere with the therapeutic process. On the other hand, Frolli et al. [59] demonstrate the advantage of VR over traditional methods in teaching the recognition of complex emotions. Souza et al. [60] did not find an effect of VR on children's sleep, which may be due to an insufficiently large intervention. Brizzi et al. [62] confirm the improvement of cognitive flexibility after exposure to VR, which is important for neurorehabilitation. Clus et al. [63] and Shetty et al. [61] provide evidence for the effectiveness of VR in reducing anxiety and pain. The meta-analysis by Zhao et al. [64] indicates moderate educational effectiveness of VR, but the high heterogeneity of studies makes the synthesis of results difficult.

8.3. Conclusions

Available evidence indicates that virtual reality (VR) technologies are finding increasing use in neuropsychiatry, particularly in the diagnosis and training of cognitive and social functions. In children with ASD without intellectual disabilities, VR/AR effectively supports the development of communication skills through interactions with avatars, gaze training, and simulations of social situations (No. 1). Clinical studies confirm that VR interventions shorten the time to acquire complex social skills compared to traditional emotional training (No. 4). The use of VR with biofeedback opens new possibilities for correcting emotional burnout by integrating breathing and EEG monitoring (No. 2). Meta-analyses of randomized controlled trials indicate moderate improvements in anatomical test scores after VR training (SMD = 0.53) (No. 9). Limitations include small sample sizes and methodological heterogeneity, which require further research.

9. Summary

The literature review indicates that virtual reality (VR) technology is currently one of the most promising tools supporting diagnosis and treatment in psychiatry, aligning with the Health 4.0 paradigm of personalized healthcare [1]. The strongest empirical evidence concerns VR exposure therapy (VRET) in the treatment of anxiety disorders, including specific phobias, where the effectiveness of VRET is comparable to in vivo exposure [11]. In the case of posttraumatic stress disorder (PTSD), a key moderator of effectiveness appears to be graded exposure based on patient responses (VR-GET), which produces significant therapeutic effects, while conventional VRET shows no advantage over control groups [25]. In psychotic disorders, particularly in reducing paranoia and agoraphobic avoidance, automated VR interventions such as GameChange have been shown to be more effective than standard care [52].

At the same time, the review highlights significant limitations and research gaps. First, the effectiveness of VRET for social anxiety disorder is ambiguous – pure virtual exposure may be inferior to in vivo exposure, and optimal results are achieved by combining VRET with cognitive-behavioral interventions [15]. Second, the neurobiological mechanisms of therapeutic change are not fully understood; electrophysiological studies suggest that VRET may work through context-dependent inhibitory learning (extinction) rather than by eliminating the primary affective response [14][10]. Third, personalization of interventions using artificial intelligence (AI) is in the early stages of development, and key barriers to implementation include a lack of stakeholder engagement and limited external validation [2].

From a clinical perspective, VR is characterized by high acceptability and low dropout rates, particularly in pediatric populations and in patients who avoid traditional exposure [13][31]. Innovative approaches, such as avatar therapy for treatment-resistant depression [31], the use of VR for eating disorders [63], and cognitive training in neuropsychiatry, provide promising, albeit preliminary, evidence. However, a key challenge remains the generalization of learned responses beyond the virtual context, which stems from the neurobiological role of the hippocampus in encoding the learning context [10].

In summary, VR is an effective tool for supporting psychiatric therapy, with confirmed effectiveness in anxiety disorders, PTSD, and psychosis. Further development of the field requires: (1) conducting head-to-head comparative studies with active interventions, (2) a better understanding of the factors moderating and mediating the effectiveness of VRET, (3) standardizing the measurement of presence as a key mediator, and (4) validating tools for measuring public attitudes toward VR therapy in diverse populations [2][4][5]. Integrating VR with traditional therapeutic methods, rather than replacing them, seems to be the most justified path for the development of this dynamically evolving field.

10. Conclusions

This systematic review of the literature on virtual reality applications in psychiatry allows for several key empirical, clinical, and methodological conclusions.

VR-based exposure therapy (VRET) is currently the best-documented intervention, particularly for anxiety disorders and post-traumatic stress disorder. Studies confirm the effectiveness of VRET, comparable to in vivo exposure in the treatment of specific phobias [11]. In the case of PTSD, a key moderator of effectiveness appears to be graded exposure based on the patient's responses (VR-GET), which produces significant therapeutic effects, while conventional VRET shows no advantage over control groups [25]. Technology alone does not guarantee clinical success – the method of its implementation within the therapeutic protocol is crucial.

In the area of psychotic disorders, particularly promising evidence is emerging. Automated VR therapy (gameChange) significantly reduces agoraphobic avoidance and distress in patients with psychosis [52]. Furthermore, VR-CBTp demonstrates a stronger effect than traditional CBTp in reducing transient paranoia [53]. VR interventions are characterized by high acceptability, and dropout rates are comparable to traditional methods [53].

The neurobiological mechanisms of therapeutic change remain incompletely understood. Personalization of interventions using artificial intelligence is in the early stages of development, and key barriers remain the lack of stakeholder engagement and limited external validation [2].

Key research gaps are identified: a paucity of comparative studies of VRET with active psychological interventions, a lack of standardized tools for measuring the sense of presence, limited validation of tools for measuring public attitudes toward VRET, and an insufficient number of studies with long-term follow-up.

Virtual reality is a valuable tool supporting psychiatric therapy, with proven effectiveness in anxiety disorders, PTSD, and psychosis. Its greatest potential lies not in replacing traditional methods, but in complementing them—by providing controlled, safe, and graduated exposure. Further development of the field requires research of higher methodological quality, considering mechanisms of change and factors moderating intervention effectiveness.

Conflicts of Interest: No conflicts of interest to declare.

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