

Virtual Reality Exposure Therapy Protocol for Post-Traumatic Stress Disorder Treatment in Military Veterans: Cross-Cultural Adaptation of Virtual Exposure Therapy in Ukraine.

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Abstract

Introduction. The integration of virtual reality technologies into PTSD treatment in Ukraine presents new opportunities for enhancing the mental health of military personnel, veterans, and individuals affected by war-related trauma. During military operations, soldiers often experience intense stress, anxiety, and intrusive memories, which can lead to PTSD. VR therapy uses fully and partially immersive technologies to create a safe virtual environment where patients can explore and process traumatic experiences under the guidance of a qualified specialist.

The use of VR technologies for PTSD treatment during the ongoing conflict in Ukraine may become a crucial tool for addressing and healing trauma in both military personnel and civilians. This method provides a structured setting that fosters emotional processing and therapeutic engagement, aiming to alleviate psychological burdens and improve mental health outcomes.

Purpose: To conduct a cross-cultural adaptation of the physiologically facilitated Virtual Reality Exposure Therapy (VRET) protocol with gradually increasing exposure, develop a Ukrainian version of the protocol tailored to the specific needs of Ukrainian PTSD patients, create VR technology and content that reflect the unique aspects of the Ukrainian war experience, and pilot test this protocol with a focus group of Ukrainian war veterans diagnosed with PTSD and carrying war-related traumatic memories.

Methodology: For the cross-cultural adaptation of the Virtual Reality Exposure Therapy (VRET) protocol, a physiologically facilitated version with gradually increasing exposure was selected. This protocol was translated by two independent translators, followed by synthesis into a single version, back-translation, analysis, and final approval by a working group. The finalized Ukrainian version was prepared for field studies with a focus group of Ukrainian war veterans ($n=50$). All veterans underwent diagnostic assessments both before and after the VRET intervention, using the following standardized scales: the Clinician-Administered PTSD Scale for DSM-5 (CAPS-5) for PTSD evaluation, the Generalized Anxiety Disorder 7-item (GAD-7) scale for anxiety disorders, the Patient Health Questionnaire-9 (PHQ-9) for depression, the Columbia-Suicide Severity Rating Scale (C-SSRS) for suicidal intentions, the Short Form Survey (SF-36) for quality of life, and the Alcohol Use Disorders Identification Test (AUDIT) for alcohol dependence.

A series of VR scenarios were developed specifically to address the needs of Ukrainian war PTSD patients, designed to trigger common PTSD responses. A unique administrative panel was also created for therapists to adjust the presence and intensity of various triggers in real time, allowing for personalized tuning of the VR experience throughout the session.

Results: Over a 6-month period, 50 Ukrainian war veterans participated in the study to assess the effectiveness of the adapted Ukrainian version of the VRET protocol for PTSD treatment. Comparison of baseline and post-intervention assessments showed significant improvements in clinical outcomes, including reductions in PTSD symptoms, anxiety, depression, and an overall improvement in quality of life.

Conclusions: The cross-cultural adaptation and testing of the Virtual Reality Exposure Therapy protocol with a focus group of Ukrainian veterans with PTSD demonstrated reductions in PTSD symptoms, anxiety, and depression, alongside improvements in quality of life. Virtual reality allowed veterans to safely re-experience traumatic events under professional supervision, with gradually increased realism, enhancing the therapy's effectiveness. This method also reduces stigma by offering a confidential setting for therapist interaction, showing substantial promise in helping veterans manage their mental health more effectively.

Keywords

virtual reality, post-traumatic stress disorder, psychological correction, exposure therapy, mental health

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Introduction

According to research results from recent decades, individuals who have been in combat zones demonstrate a high risk of developing post-traumatic stress disorder. Data indicates a widespread prevalence of PTSD among active military personnel and veterans, which may reach up to 30%. (Wells, 2023) An analysis of 5,826 veterans in 2017 from the United States revealed a 12.9% rate of PTSD, significantly higher than that found in the general population. (Smith, 2019)

In Ukraine, there is currently limited data regarding the prevalence of PTSD among active military personnel and war veterans. However, existing reports since 2015 indicate that approximately 27.7% of individuals involved in the Anti-Terrorist Operation (ATO) have been diagnosed with PTSD, representing a significant portion of the overall Ukrainian population with this diagnosis. (Pinchuk et al. 2016)

Modern systematic reviews based on meta-analyses and clinical guidelines highlight trauma-focused cognitive-behavioural therapy (TF-CBT), eye movement desensitization and reprocessing (EMDR), and exposure therapy (ET) as the most

effective psychotherapy methods for treating PTSD, including combat-related PTSD. (Friedman et al. 2018)

Exposure therapy has proven highly effective in treating PTSD. (Foa et al. 1991) This therapeutic method aims to access traumatic memory by utilizing the patient's imagination, incorporating information about the traumatic event and related emotions, thoughts, and behaviours, which aids the patient in better understanding the context of their traumatic experience and its impact on their life.

There are three general approaches to exposure therapy: 1) minimal arousal with gradual exposure, 2) flooding, and 3) arousal control during exposure based on skills. In the 1980s, Terence Keane and his colleagues found that exposure therapy was effective in treating PTSD symptoms in Vietnam War veterans. (Rothbaum et al. 1999) In the 1990s, research by Edna Foa and her colleagues demonstrated that exposure therapy was the most effective method for reducing PTSD symptoms in rape survivors, with improvements observed immediately following therapy and maintained over a three-month follow-up. (Foa et al. 1991) However, more recent studies have reported a high percentage of

dropouts from exposure therapy, with some estimates suggesting rates as high as 50%. (Wells et al. 2023) Since this type of therapy requires patients to revisit their traumatic experiences using their imagination and involves intense emotional engagement, some patients find it difficult to immerse themselves in the traumatic scene, leading to withdrawal from treatment.

Given the limitations of imaginal exposure therapy for treating combat-related PTSD, VRET, based on the principles of prolonged exposure, has emerged as a promising alternative with excellent results in this area. (Rizzo et al. 2009)

Virtual reality environments are particularly effective for treating PTSD through exposure due to the therapist's control over the presented exposure, as well as the fact that this exposure is not dependent on the individual's imaginative capacity or their ability to verbalize their experiences, including manifestations of alexithymia. (Botella et al., 2015)

Additionally, in many situations, it is impossible or impractical to return the patient to the real-life context in which the trauma occurred. Numerous studies have confirmed that virtual environments elicit emotional, physiological, and behavioural responses similar to those observed in real-life situations. Using virtual exposure therapy in patients with PTSD related to war events has allowed for gradual emotional engagement during exposure to a virtual combat environment, which significantly helps reduce avoidance symptoms and, as a result, treatment dropout, while giving the therapist complete control over the exposure—something that cannot be achieved in exposure therapy relying solely on the patient's imagination. (Wenrui, et al., 2019)

The sense of presence created by an ecologically valid, highly interactive, and multisensory virtual environment facilitates the emotional processing of memories associated with traumatic events. This approach allows for gradual and personalized exposure to the traumatic environment, tailored to the needs and resilience of each patient. Therefore, it has advantages such as increased control over stimuli, the ability to repeat exposures, and a unique opportunity to simulate environments that evoke intrusive memories in the patient.

Protocols for virtual exposure therapy vary based on the patient's initial condition, pharmacotherapy, virtual exposure exercises at home, the number of sessions, and the duration of therapy. (Wenrui, et al., 2019) After examining existing protocols for virtual exposure therapy and considering all advantages and disadvantages, we have chosen the protocol for physiologically facilitated virtual exposure therapy with graded

impact as the operational prototype for further cross-cultural adaptation.

This psychotherapeutic method is based on the physiological responses of individuals to stress, such as increased heart rate, breathing rate, sweating, and so on, and involves the systematic application of virtual reality and graded exposure to help individuals adapt to stress stimuli and manage their reactions to them. It aims to reduce PTSD symptoms through the effective use of virtual technologies and a deep understanding of the physiological and psychological aspects of the stress response. This approach reflects the integration of advanced scientific methods in psychotherapy with innovative technologies to improve treatment outcomes for patients with PTSD. (Heo & Park, 2022)

Purpose

The primary objective of this study was to develop a Ukrainian version of the VRET protocol tailored to the cultural and linguistic needs of the target group, adapting the protocol to meet the unique requirements of Ukrainian PTSD patients. The study also aimed to create VR technology and content specific to the Ukrainian war. Upon completion of the adaptation process, the protocol was pilot-tested with a focus group of Ukrainian war veterans diagnosed with PTSD and experiencing trauma-related memories linked to warfare. This study holds significant potential for enhancing therapeutic approaches to treating PTSD among veterans in the Ukrainian context.

Methodology

For translation and subsequent cross-cultural adaptation, a physiologically facilitated virtual exposure therapy protocol with graded impact was selected, as outlined in "Virtual Reality Treatment Manual" (Spira et al., 2008). Originally developed at the Medical Centre for Virtual Reality in San Diego, California, the protocol was authorized for adaptation in Ukraine by the Educational and Research Institute of Mental Health at Bogomolets National Medical University.

The translation process involved two independent translators, one informed about the study's purpose and the other uninformed. They prepared separate Ukrainian translations of the protocol, which were then synthesized into a consensus version. To verify translation accuracy, a back-translation was conducted by two native English speakers unfamiliar with the original English protocol.

Several VR scenarios were designed to address the specific needs of Ukrainian war PTSD patients by incorporating triggers commonly experienced by this population. A unique administrative panel was developed for therapists to control various triggers in real time, allowing them to adjust the VR experience throughout each session. Scenarios include:

1. **Defending a trench** in an open field while under attack by infantry and heavy machinery.
2. **Enduring bombardment** from rockets, drones, and artillery.
3. **Guarding a trench** at night with a flashlight or night-vision goggles.
4. **Riding in a personnel carrier** under attack and/or bombardment.

Therapists have full control over the intensity of bombardments, types of attacks, presence and number of combatants and machinery. Additional effects, such as corpses, smoke, wounded soldiers, blood, fire, radio chatter, and artillery strikes, can also be enabled or disabled based on each patient's specific triggers. This flexibility allows for thousands of unique scenario combinations, which the therapist can adjust to match the patient's experiences, triggers, and sensitivity level. The intensity of these effects can be gradually adjusted to suit the patient's emotional readiness.

Note: Scenarios created for PTSD patients of other conflicts (e.g., Iraq and Afghanistan) were found unsuitable for Ukrainian patients, as nearly all aspects—terrain, combat type, threats, equipment—differ from the needs in Ukraine.

During cross-cultural adaptation, a working group comprising the study coordinator, healthcare specialists, independent translators, native English speakers, and a methodologist reviewed all materials, including the original protocol, translations, synthesized version, back-translations, and written reports. This thorough analysis led to a pre-final version, which was tested by specialists. Interviews with specialists confirmed the clarity and comprehension of the Ukrainian version. Following this phase, a final Ukrainian version was approved for field research, presented below.

This adapted Ukrainian-language protocol was subsequently tested on a focus group of Ukrainian war veterans diagnosed with PTSD.

Protocol for Physiologically Facilitated Virtual Exposure Therapy with Gradual Impact

The protocol for Physiologically Assisted Virtual Exposure Therapy with Gradual Impact consisted

of ten 60-minute sessions, designed as a brief intervention, and was structured in two stages. The first stage involved preparation, including screening and informed consent. The second stage (sessions 1–10) comprised psychological interventions using VR technology to target affective factors and foster emotional skills, such as cultivating a positive outlook, nurturing positive emotions, and managing negative emotions.

The psychological interventions implemented included techniques for combating intrusive thoughts related to the traumatic event by consciously replacing, suppressing, or shifting them to the periphery of attention. Additional goals included reframing the traumatic experience, exploring alternative perspectives on reality and past events, re-evaluating traumatic memories influencing current realities, and preparing for and incorporating other evidence-based psychotherapies (TF-CBT, EMDR).

Session 1: Introduced psychoeducation about PTSD, including mechanisms of onset, symptom presentation, treatment strategies, and training in relaxation techniques (meditation).

Session 2: Engaged the patient in a controlled and minimal reactivation of traumatic memories under therapist supervision, followed by relaxation (meditation) and measurement of physiological indicators (heart rate, respiratory rate, and blood pressure) to reinforce attention-switching skills.

Sessions 3–5: Introduced VR under controlled traumatic memory activation, adding relaxation and physiological monitoring to reinforce attention-switching skills, with a gradual increase in traumatic scenario elements. Shifting focus to secondary situational aspects (e.g., weather, pre-event activities) facilitated a recontextualization of the trauma.

Sessions 6–9: Continued VR therapy with controlled memory activation, guiding patients in constructing a narrative of the traumatic experience, concluding with their return home. Relaxation and physiological monitoring continued, reinforcing adaptive focus and emotional regulation skills.

Session 10: Focused on assessing the patient's emotional state, relaxation skills acquired throughout sessions 2–9, and the development of self-stabilizing techniques for daily life, including cognitive restructuring and psychophysiological modulation.

Technical Specifications

For the protocol adaptation and study, VR technology included the Oculus Quest 2 headset with VR simulation software by “VR Mentality” LLC. The system incorporated a therapist’s interface to modify the VR environment in real time based on the patient’s traumatic memories. Virtual environments tailored to war-related experiences were developed to meet Ukrainian veterans’ needs, with elements such as specific locations and environmental details reflective of actual combat experiences.

Equipment: Oculus Quest 2, 256 GB; Unity3D-based processing; Resolution: 1832x1920; Snapdragon XR2 chip; 6 GB RAM; 3D audio. The four-dimensional interaction (visual, sensory, auditory, and kinesthetic) allowed participants to experience scenarios with carefully controlled auditory elements essential for military exposure therapy.

Participants

The focus group included 50 Ukrainian war veterans with PTSD, with the study conducted from January to July 2024.

Inclusion Criteria

1. Age 18–65 years, male or female
2. PTSD symptoms persist at least 1-month post-trauma
3. CAPS-5 criteria met: traumatic event exposure, score ≥ 2 on at least one item from criteria B and C, score ≥ 2 on at least two items from criteria D and E.

Exclusion Criteria

1. PTSD symptoms less than 1-month post-trauma
2. CAPS-5 criteria unmet (e.g., no traumatic event exposure or low scores on criteria B, C, D, and E)
3. Comorbid organic pathology, substance abuse, negative experience or reaction to VR technology, pregnancy, or significant cognitive impairments affecting instruction comprehension
4. Pronounced adverse physiological reactions to VR that remain unmanageable
5. Elevated suicide risk or severe cognitive impairment
6. Psychotic symptoms within PTSD structure (e.g., Complex PTSD) or high risk of retraumatization without a developed “psychotherapeutic roadmap”

Evaluation Approach

Demographic data, including age and gender, were collected at the beginning of the

study. A summary of this data is provided below: (see Table 1).

Table 1. Demographic data

Demography	N(%) Mean (SD)
Age	44,68 (5,20)
Gender	11 (22%) women, 39 (78%) men

All focus group participants completed the following assessments at baseline and post-intervention:

1. **Clinician-Administered PTSD Scale (CAPS-5):** This structured diagnostic interview assesses PTSD severity based on DSM-5 criteria, evaluating core symptoms, functional impairment, and symptom severity changes. Scores range from 0 to 80, with higher scores indicating greater PTSD severity.
2. **Generalized Anxiety Disorder Questionnaire (GAD-7):** A self-report tool that measures generalized anxiety disorder symptoms over two weeks. The 7-item scale ranges from 0 to 21, with higher scores indicating more severe anxiety symptoms.
3. **Patient Health Questionnaire (PHQ-9):** This 9-item self-report questionnaire evaluates depression severity, with total scores ranging from 0 to 27. Higher scores correspond to more severe depressive symptoms.
4. **Columbia-Suicide Severity Rating Scale (C-SSRS):** Assesses suicidal ideation and behavior. Scores ≥3 indicate serious suicide risk, and scores of 5 or any suicidal actions necessitate urgent intervention.
5. **Short Form Health Survey (SF-36):** Assesses quality of life across eight domains (e.g., physical functioning, mental health, social functioning). Higher scores suggest better quality of life.
6. **Alcohol Use Disorders Identification Test (AUDIT):** Measures alcohol consumption and related issues, with total scores from 0 to 40. Higher scores suggest a greater risk of alcohol-related disorders.

Statistical Analysis

Data underwent checks for missing values and normality using the Kolmogorov-Smirnov and Shapiro-Wilk tests. Descriptive statistics (mean, standard deviation, and standard error) were calculated for baseline and post-intervention scores, and paired t-tests were used to assess changes in each category. All data were organized in Microsoft Excel 2019 and analysed with SPSS version 23 (IBM, USA).

Results

Results Before Intervention

Table 2 provides a summary of the CAPS-5 scale results for the sample before the intervention. The severity of PTSD symptoms across the total

sample ranged from 40 to 60 points, with a baseline mean score of 55.01 (SD: 9.06). This indicates a high level of PTSD symptom severity in participants before the start of the virtual reality exposure therapy (VRET) protocol.

Table 2. CAPS-5 results before the intervention (n=50)

Criterion	M	SD	Q1-Q3
Criterion B	15.23	2.61	12.62-17.84
Criterion C	6.18	0.93	5.25-7.11
Criterion D	18.97	4.5	14.47- 23.47
Criterion E	14.63	3.03	11.6 -17.66

Before the intervention, participants reported a variety of traumatic experiences and PTSD-related symptoms:

Nature of Threat:

- 30% of participants experienced events that posed a direct threat to their own life.
- 40% reported experiencing threats directed toward others.
- 30% encountered threats to both themselves and others.

All participants experienced symptoms lasting over a month post-trauma, which significantly impacted their daily functioning in social, occupational, or other areas.

Symptom Severity Breakdown:

- **Intrusion Symptoms:** Moderate severity (M = 15.23)
- **Avoidance Symptoms:** Mild severity (M = 6.16)
- **Negative Thoughts/Emotions:** Severe (M = 18.97)
- **Hyper-Reactivity/Arousal Symptoms:** Moderate severity (M = 14.63)

Table 3 provides a summary of baseline assessments for anxiety (GAD-7), depression (PHQ-9), suicidal intentions (C-SSRS), quality of life (SF-36), and alcohol dependence (AUDIT).

Table 3. Indicators of anxiety, depression, suicidal intentions, quality of life, and the presence of alcohol dependence in the sample participants (n=50)

Scale	M	SD	Q1-Q3
GAD-7	16.56	2.75	13.81-19.31
PHQ-9	15.59	6.17	9.42-21.76
C-SSRS	0.6	0.29	0.31- 0.89
SF 36	17.25	31.82	14.57 - 49.07
AUDIT	12.5	1.7	10.8-14.2

The baseline assessment revealed the following average levels across mental health and quality of life measures, highlighting the psychological burden faced by participants prior to the intervention:

- **Anxiety (GAD-7):** The average score (M = 16.56) indicated anxiety levels above minimal or mild, suggesting moderate to severe anxiety concerns among participants.

- **Depression (PHQ-9):** With an average score of 15.59, participants exhibited clinically significant depressive symptoms.
- **Suicidal Intentions (C-SSRS):** The average risk of suicide was relatively low (M = 0.6), though any level of risk is notable in clinical assessments.
- **Quality of Life (SF-36):** The average quality of life score was reduced (M = 17.25), reflecting the substantial impact of PTSD symptoms on participants' well-being.
- **Alcohol Dependence (AUDIT):** The average score (M = 12.5) suggested low levels of alcohol dependence among participants.

These baseline scores underscore the psychological challenges faced by participants, affirming the need for interventions like VRET to address moderate to severe anxiety, depression, and diminished quality of life due to PTSD.

Post-Intervention Results

After the completion of the VRET intervention, all participants were reassessed to evaluate changes in PTSD symptoms. Table 4 shows the summary results of the CAPS-5 scale after intervention.

Table 4. CAPS-5 results after intervention (n=50)

Criterion	M	SD	Q1-Q3
Criterion B	12.13	2.1	10.69 - 13.57
Criterion C	2.18	0.21	1.86 - 2.49
Criterion D	8.92	2.5	5.22 -12.72
Criterion E	7.63	1.03	6.08-9.175

The results demonstrated a low level of intrusion symptoms (M=10.13), a low level of avoidance symptoms (M=2.18), a low threshold for negative thoughts and emotions (M=8.92), and a low threshold for hyper-reactivity/arousal symptoms (M=7.63).

Table 5 shows the summary confidence scores for the four CAPS-5 criteria. We measured confidence scores at baseline and used a paired t-test to compare confidence scores after the interventions.

Table 5 presents the summary confidence scores for the four main CAPS-5 criteria before and after the VRET intervention. These confidence scores reflect the participants' subjective self-reports on their levels of PTSD symptom severity in relation to the four primary symptom clusters: intrusion, avoidance, negative thoughts/emotions, and hyper-reactivity/arousal.

Confidence Scores and Statistical Analysis:

- **Intrusion Symptoms:** At baseline, the average confidence score for intrusion symptoms was significantly high, with a mean score of 15.23. After the VRET intervention, the confidence score dropped to 10.13, indicating a marked

reduction in the perceived severity of intrusive symptoms.

- **Avoidance Symptoms:** The baseline confidence score for avoidance symptoms was 6.16, indicating moderate levels of avoidance behavior. Post-intervention, the average score decreased to 2.18, indicating that participants felt a lower level of avoidance following the therapy.
- **Negative Thoughts and Emotions:** At baseline, the confidence score for negative thoughts and emotions was at 18.97. After the intervention, this score dropped to 8.92, reflecting a substantial decrease in the severity of negative emotional and cognitive reactions to the trauma.
- **Hyper-reactivity/Arousal Symptoms:** The baseline confidence score for hyper-reactivity/arousal symptoms was 14.63. Post-intervention, the confidence score decreased to 7.63, indicating that the therapy had a substantial impact on reducing hyper-reactivity and arousal symptoms.

Table 5. Confidence comparing baseline to post-intervention according to CAPS-5

Criterion		M	SD	d	t	p
Criterion B	Baseline	15.23	2.61	4.54	9.25	<0.001
	Post-intervention	10.13	2.1			
Criterion C	Baseline	6.18	0.93	9.53	41.95	<0.001
	Post-intervention	2.18	0.21			
Criterion D	Baseline	18.97	4.5	2.76	19.51	<0.001
	Post-intervention	8.92	2.5			
Criterion E	Baseline	14.63	3.03	3.10	21.85	<0.001
	Post-intervention	7.63	1.03			

The results showed a significant improvement in confidence for all CAPS-5 criteria ($p < 0.001$).

SSRS), quality of life (SF-36), and alcohol dependence (AUDIT) after intervention.

Table 6 summarizes the results of anxiety (GAD-7), depression (PHQ-9), suicidal intentions (C-

Table 6. Indicators of anxiety, depression, suicidal intentions, quality of life, and the presence of alcohol dependence among the participants in the sample after intervention (n=50)

Scale	M	SD	Q1-Q3
GAD-7	8.5	1.5	2.75-4.25
PHQ-9	8.5	0.86	7.75-9.25
SF 36	50.5	5.48	46.81-54.19

These post-intervention results demonstrated statistically significant reduction in anxiety levels ($M=8.5$) and depressive symptoms ($M=8.5$), as well as an enhancement in quality of life ($M=50.5$) among in this focus group.

Table 7 presents summary reliability estimates for the GAD-7, PHQ-9, SF-36. We measured the confidence scores at baseline and used a paired t-test to compare to the post-intervention confidence scores.

Table 7. Confidence comparing baseline to post-intervention according to GAD-7, PHQ-9, SF-36

Scale		M	SD	d	t	p
GAD-7	Baseline	16.56	2.75			<0.001
	Post-intervention	8.5	1.5	3.64	25.76	
PHQ-9	Baseline	15.59	6.17	1.61	11.38	<0.001
	Post-intervention	8.5	0.86			
SF 36	Baseline	17.25	31.82	1.46	10.29	<0.001
	Post-intervention	50.5	5.48			

The findings showed a significant improvement in confidence for GAD-7, PHQ-9, SF-36 scales ($p < 0.001$)

These findings indicate that the implementation of a treatment program following the protocol for physiologically facilitated virtual exposure therapy with gradual exposure led to a statistically significant reduction in anxiety levels ($M = 3.5$) and depressive symptoms ($M = 8.5$), as well as an enhancement in quality of life ($M = 50.5$) among the focus group of veterans studied.

These findings highlight the effectiveness of Physiologically Facilitated Virtual Exposure Therapy (VRET) with gradual exposure in treating PTSD in war veterans. The statistically significant reductions in anxiety levels ($M = 3.5$) and depressive symptoms ($M = 8.5$), coupled with an improvement in quality of life ($M = 50.5$), suggest that this therapeutic protocol can lead to meaningful psychological and emotional benefits for veterans suffering from trauma-related disorders.

These additional findings are particularly noteworthy, as they underscore the safety and tolerability of the Virtual Reality Exposure Therapy (VRET) protocol used in this study. The absence of motion sickness, dizziness, or any other form of distress related to the VR format suggests that the Oculus Quest 2 headset and the virtual environments used in this protocol were well-suited to the participants and their needs.

Furthermore, the fact that suicidal intentions and alcohol dependence did not increase among participants after the intervention is a crucial point. It demonstrates that the therapy was not only therapeutically beneficial but also safe, with no evidence of exacerbating risk factors like self-harm or substance use, which can sometimes be a concern with certain trauma-focused treatments.

Discussion

Virtual reality (VR) has emerged as a transformative tool in psychotherapy, offering a unique way for patients to confront and process traumatic experiences in a controlled and supportive environment. One of the most promising techniques utilizing VR is Virtual Reality Exposure Therapy (VRET), which allows patients to re-experience stressful or anxiety-inducing situations in a safe, immersive setting. This technique is particularly beneficial for individuals suffering from Post-Traumatic Stress Disorder (PTSD), where traditional therapeutic methods may fall

short in addressing the intensity of trauma-related symptoms. (Smith, 2019)

A critical element of VRET is the gradual immersion of patients into a virtual environment. This immersion is key to enhancing the sense of presence, a phenomenon that occurs when individuals feel truly "inside" the virtual world. Through sensory realism, including visual, auditory, and sometimes tactile stimuli—patients are able to relive traumatic events in a controlled manner. (Wenrui, et al., 2019) However, the immersion is not just about replicating the real world. It is about constructing a narrative environment that captures the emotional and psychological aspects of trauma, making the experience emotionally engaging for the patient. (Friedman & Friedrich 2018).

Studies have shown that a hyper-realistic environment is not always necessary for VRET to be effective. Instead, the primary therapeutic elements are the visual and auditory cues that trigger traumatic memories. (Trappey, 2022). The efficacy of these stimuli depends not only on their realism but also on their psychophysiological anchoring—the degree to which the stimuli activate the patient's memory and emotional response to the original traumatic experience. This allows patients to engage in emotionally charged scenarios while under the supervision of a trained therapist, facilitating a gradual processing of trauma. (Rizzo et al., 2009) A major benefit of VRET is its ability to teach patients how to manage their emotional and physical responses to trauma-related stimuli. This therapeutic exposure helps reduce the intensity of the trauma reactions, promoting long-term emotional regulation. Rather than offering temporary relief, VRET equips patients with coping skills that extend beyond the therapy session, supporting lasting recovery and a higher quality of life.

Another significant advantage of VR technologies is their capacity to tailor treatment experience to each patient's specific needs. Through the customization of scenarios, therapists can create virtual environments that align with the particular nature of the patient's trauma, ensuring that the therapy remains relevant and personalized. (Heo & Park, 2022). This approach enhances the overall effectiveness of treatment, as patients are more likely to engage with scenarios that resonate deeply with their experiences. Moreover, the individualized nature of VRET fosters a patient-centered approach that

builds trust and facilitates active participation in the therapeutic process.

VRET also helps to overcome significant stigma barriers. Many individuals, especially veterans, may feel hesitant to seek help for mental health issues due to fear of judgment or the stigma associated with PTSD and other psychological disorders. (Smith, 2019) By providing therapy in a comfortable, confidential virtual space, VRET creates an environment where patients feel more empowered to open up and engage with the treatment process. This reduction in stigma can increase patient adherence to therapy and improve overall outcomes. (Yuen, et al., 2015)

Conclusions

The study described in this article provides compelling evidence for the effectiveness of the cross-cultural adaptation of a VRET protocol for veterans suffering from PTSD. The primary objectives of the study—reducing PTSD symptoms, anxiety, and depression, while improving quality of life—were successfully achieved.

At the beginning of the study, participants displayed moderate-to-severe PTSD symptoms, moderate anxiety and depression, as well as a low risk of suicide and impaired quality of life. However, after receiving the adapted VRET interventions, participants showed significant improvements in all areas: PTSD symptoms were reduced, anxiety and depression levels decreased, and quality of life was substantially enhanced.

These results underscore the promise of virtual reality exposure therapy in treating PTSD, especially for individuals with traumatic experiences in military or conflict zones. The gradual exposure to virtual environments that mirror real-life traumatic situations is essential for the therapeutic success of VRET. By carefully controlling the exposure intensity, therapists can help patients safely confront their traumas without becoming overwhelmed, thus enabling gradual emotional processing.

In addition to the direct therapeutic benefits, the study highlights several key advantages of VRET. Most notably, it reduces stigmatization, offering patients an opportunity to engage in therapy from a confidential, safe space. Furthermore, VRET's individualized nature allows for customization, ensuring that therapy is tailored to meet the unique needs of each patient. These factors contribute to a more effective and patient-centered treatment process, ultimately leading to improved engagement and outcomes.

The findings suggest that virtual reality is a promising tool for addressing PTSD, enabling veterans to safely re-experience traumatic memories in a controlled, supportive environment.

Beyond treating PTSD, VRET also teaches patients important coping strategies to handle future stressors, helping them rebuild their lives and improve their psychological well-being.

In conclusion, VRET represents a significant advancement in trauma therapy, offering innovative and individualized care for veterans and others affected by PTSD. Its application promises to be a valuable tool in the treatment of trauma, providing lasting healing and empowerment for those who have faced the harshest of experiences. Future research and development will continue to refine these approaches, potentially expanding the use of VRET for broader applications across different patient populations.

Conflict of interest

The authors declare no conflict of interest.

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