Open Access Article

Ann. Acad. Med. Siles. (online) 2025; 79: 193–200
eISSN 1734-025X
DOI: 10.18794/aams/202384
www.annales.sum.edu.pl

PRACA POGLĄDOWA
REVIEW

The role of virtual reality-based relaxation therapy in the treatment of mental disorders – a narrative review

Rola terapii relaksacyjnej z wykorzystaniem wirtualnej rzeczywistości w terapii zaburzeń psychicznych – przegląd narracyjny

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ABSTRACT

In recent years, there has been rapid development in technologies utilizing virtual reality (VR), leading to their increasingly frequent application in medicine, including psychiatry. Relaxation therapy using VR techniques may offer an innovative solution to support the treatment of mental disorders. This narrative review discusses the potential applications of VR in relaxation therapy, focusing on its effectiveness in treating depression, anxiety disorders, schizophrenia, and bipolar disorder. VR technology has been shown to offer significant advantages over traditional relaxation methods. Numerous studies confirm its effectiveness in reducing psychiatric symptoms, while also highlighting the need to consider potential side effects, such as nausea or "cybersickness". VR therapy combines the benefits of technology and psychotherapy, making it a promising method for supporting the treatment of mental disorders.

KEYWORDS

depression, anxiety disorders, virtual reality

Received: 05.12.2024 **Revised:** 25.01.2025 **Accepted:** 26.02.2025 **Published online:** 10.07.2025

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Publisher: Medical University of Silesia, Katowice, Poland

STRESZCZENIE

W ostatnich latach nastąpił gwałtowny rozwój technologii wykorzystujących wirtualną rzeczywistość (*virtual reality* – VR), co doprowadziło do coraz częstszego stosowania ich w medycynie, w tym w psychiatrii. Terapia relaksacyjna z wykorzystaniem technik VR może stanowić innowacyjne rozwiązanie wspomagające leczenie zaburzeń psychicznych. W niniejszym przeglądzie narracyjnym omówiono możliwości zastosowania VR w terapii relaksacyjnej, skupiając się na jej skuteczności w leczeniu depresji, zaburzeń lękowych, schizofrenii oraz choroby afektywnej dwubiegunowej. Wykazano, że technologia VR oferuje istotne korzyści w porównaniu z tradycyjnymi metodami relaksacyjnymi. Liczne badania potwierdzają jej skuteczność w łagodzeniu objawów psychicznych, jednocześnie wskazując na konieczność uwzględnienia potencjalnych skutków ubocznych, takich jak nudności czy tzw. cyberchoroba. Terapia VR łączy zalety technologii i psychoterapii, co czyni ją obiecującą metodą wspomagającą leczenie zaburzeń psychicznych.

SŁOWA KLUCZOWE

depresja, zaburzenia lękowe, wirtualna rzeczywistość

Introduction

Mental disorders are becoming increasingly prevalent, both globally and in Poland. According to the 2011 EZOP I study, 3% of the Polish population suffered from depression, while various forms of anxiety disorders affected 1.1% of individuals [1]. Moreover, the EZOP II study, which was conducted seven years later, revealed that 3.85% of people struggled with depressive disorders and 7% with anxiety disorders. These results indicate a significant increase compared to the earlier study [2]. Another study, more localized, investigated the prevalence of depression and anxiety in the Żywiec district in 2022 [3]. The findings showed that anxiety disorders affected 11.2% of the population, while depression affected 14.4% of the study population, which counted 1659 people. This study also identified factors associated with increased and decreased risk of developing depressive and anxiety disorders. Factors that increase the risk of depression include: female gender, age over 60, unemployment, low education level, mental work, lack of physical activity, intensive sports practice, smoking, the presence of chronic somatic diseases, and the use of over-the-counter sleeping and sedative medications. On the other hand, factors reducing the risk include: male gender, age between 40 and 59, higher education level, stable employment, and physical work [4]. Risk factors for anxiety disorders included: unemployment, self-employment or retirement, lack of physical activity, daily alcohol consumption, complete alcohol abstinence, smoking, use of psychostimulants, the presence of somatic diseases, and use of sedatives and sleeping pills, both over-the-counter and prescribed. Protective factors included stable employment and occasional alcohol consumption [4]. A systematic review investigating factors contributing to the development of depression in individuals aged 65 and older, based on articles from 2000–2020, found that the presence of chronic diseases and sleep difficulties correlate with an increased risk of depression [5].

Given the growing number of cases of these disorders, scientists are exploring new treatment methods. So far, one of the most popular and effective treatments is pharmacotherapy. Analyzing existing research, it is important to note that first-line antidepressant therapy leads to symptomatic remission in 25–35% of patients. In the STAR-D project, only one-third of patients achieved a therapeutic response after the first antidepressant. Even after a year of treatment with four different antidepressants, each used for 12 weeks, remission was achieved in only two-thirds of patients [6]. In the treatment of generalized anxiety disorder, psychiatrists most often use escitalopram, sertraline, pregabalin, and paroxetine [7]. For depression, drugs from two main groups are primarily used: selective serotonin reuptake inhibitors (SSRIs), which include fluoxetine, fluvoxamine, citalopram, escitalopram, sertraline, and paroxetine, as well as serotonin and norepinephrine reuptake inhibitors (SNRIs) such as venlafaxine and duloxetine [8]. Among the known non--pharmacological treatments for anxiety-depressive disorders are various psychotherapeutic approaches, biological interventions such as transcranial direct current stimulation (tDCS), transcranial magnetic stimulation (TMS), electroconvulsive therapy (ECT), transcutaneous vagus nerve stimulation (taVNS), deep brain stimulation (DBS), and naturopathic interventions including herbal medicine, dietary supplements, acupuncture, and light therapy [9,10]. Meta-analyses show that remission rates for anxiety disorders treated with cognitive-behavioral therapy range from 13% to 53% [11]. Studies on tDCS indicate moderate effectiveness in treating acute depressive disorders, though data on treatment-resistant depression are limited. tDCS is considered a safe therapeutic method with minor side effects such as itching, tingling, and burning sensations [12]. TMS has been most extensively studied in patients with depressive disorders, and its effectiveness in treating other mental disorders is also being researched. The best results are observed after 26–28 sessions, while a lack of efficacy is noted with unsatisfactory therapeutic effects after 20 sessions [13]. The effectiveness of ECT in treating depression is estimated to be between 80% and 90%. According to the STAR-D study, ECT's effectiveness in treatment--resistant depression is around 50%, still higher than that of the previously mentioned pharmacological therapies [14]. The possibility of using transcutaneous vagus nerve stimulation (taVNS) in treatment-resistant depression has also been explored, in a pilot study, with promising results. In a group of five individuals with severe depression, two patients showed improvement, while failure in the other three was due to difficulties with operating the device [15]. While DBS is a proven method for treating bipolar disorder, its effectiveness in treating depression, despite many reports of positive effects on mood, the ability to experience pleasure, and anxiety reduction, raises ethical concerns about obtaining consent for such an invasive method and the potential loss of opportunity for patients to benefit from other treatments [16,17]. The positive impact of naturopathic therapies was examined in a comprehensive systematic review of the literature from 1996–2016 on the use of single-component herbal preparations in cancer patients, aimed at reducing drug burden and improving mental health. Among the 38 plants analyzed, those that showed potential in alleviating anxiety and depression included cohosh, chamomile, chaste tree, lavender, passionflower, and saffron [18]. A study on the effectiveness of acupuncture demonstrated that this method significantly alleviates accompanying symptoms of depression and anxiety in patients with tension headaches [19]. The effectiveness of light therapy has been confirmed by numerous clinical studies. Based on these studies, it was established that exposure to light with an intensity of 10,000 lux for 30 minutes daily is optimal for treating seasonal depression. The response to light therapy usually appears within 2–4 days, and the effects may last for varying periods, typically for several weeks after treatment, which lasts about 14 days [20].

Also helpful in the treatment of mental disorders are relaxation sessions of which the most common are those proposed by Schultz and Jacobson in the 1960s [21]. The effectiveness of autogenic training, developed by Johannes Schultz in 1932, has been confirmed by numerous studies. A meta-analysis of 60 studies (including 35 randomized trials) showed improvements in the health of individuals suffering from anxiety disorders, mild to moderate depression, and functional sleep disorders [22]. Analyzing the quantitative and qualitative effects of relaxation techniques on sleep quality in patients with insomnia caused by anxiety and depressive disorders, based on the Insomnia Severity Index (ISI), revealed a statistically significant reduction in insomnia severity from moderate to mild. Patients reported subjective improvements in sleep quality, experiencing fewer disruptions in daily tasks and fewer inconveniences related to sleep disturbances. Additionally, improvements in mood, self-esteem, and self-control were observed [23]. The effectiveness of both relaxation techniques in reducing anxiety was confirmed in a meta-analysis based on studies from 1997–2007 [24]. Research on the effects of progressive muscle relaxation, developed by Jacobson, demonstrated positive outcomes in reducing anxiety and increasing happiness levels [25]. This technique also proved effective in improving sleep quality in cancer patients [26].

Over the next decade, experts predict a rise in the popularity of online therapy, psychosomatic state monitoring methods, and virtual reality (VR) technologies. Their opinions on long-term changes are divided–ranging from futuristic concepts (such as mind-reading) to a return to traditional therapeutic methods [27]. In practice, more and more centers are attempting to utilize contemporary technology in psychiatry. An example of such a device is VR glasses, which provide high-quality relaxation with simultaneous elimination of distracting and stressful influences of the environment, potentially reducing depressive symptoms, anxiety, and stress, improving quality of life, and reducing the risk of suicide [28].

The aim of this narrative review is to analyze the functioning and potential application of VR techniques in mental disorders.

Virtual reality – historical review

VR is a three-dimensional, digital world created using computer systems, display devices, and interfaces that provide the user with immersion in an interactive environment. VR engages the user's senses, particularly sight and sound, while also allowing for the creation of tactile sensations [29]. The term "virtual reality" comes from Jaron Lanier, who coined it in the 1980s, and his company, VPL, became one of the first to commercially sell VR systems [30].

The origins of VR technology date back to 1957, when filmmaker Morton Heilig proposed that audiences could be more effectively immersed in stories if all of their senses were stimulated. Three years later, he built a device that included a display, fans, scent emitters, a sound system, and a moving chair that simulated motion. This system only allowed for sensory experiences but did not enable interaction with the material being presented. The first head-mounted display (HMD), called the Headsight, was developed in 1961. This device featured a video screen and a motion-tracking system linked to a camera. It was primarily used in hazardous environments, allowing users to remotely observe real-world settings. The equipment was utilized in military training operations and by helicopter pilots [31].

The concept of VR began to evolve in the mid-1960s. At the time, Ivan Sutherland was working on interactive computer systems using displays mounted on the user's head. The researcher's idea was to create a computer that could simulate the real world, allowing the operator to interact with it [32].

In 1970, Sutherland and his team of researchers developed the first operational interactive head--mounted display system [33]. From that time, similar systems began to develop in several different directions, leading to the rapid growth of VR technology by the late 1980s [32]. However, this technology was primarily used for training military personnel, pilots, and astronauts, remaining largely inaccessible to the general public [31].

The first applications of VR in medicine occurred in the 1990s, in simulations of colonoscopy and upper gastrointestinal endoscopy [31].

In 2012, Palmer Luckey presented a prototype of the first Oculus, a VR headset intended for commercial use. In 2014, Facebook acquired Oculus, leading to a significant increase in the popularity of VR devices for home use. Since then, VR has gained widespread popularity and has become more accessible to the average consumer, with more VR headsets on the market, such as the HTC Vive, Samsung VR, Oculus and Google Cardboard [34].

Initially, VR technology was primarily developed within the gaming industry. However, it is now used in many other fields, including education, medicine, and engineering [34]. In medicine, VR has a wide range of applications, including in education, diagnostics, treatment, counselling, and rehabilitation [31].

In medical education, VR is used for learning anatomy, surgical procedures, and skills such as cardiopulmonary resuscitation. The equipment is also used to develop soft skills, such as teaching empathy and communication with patients through simulations involving virtual patients [35].

Research is underway on the use of VR technology in radiological diagnosis [36] and in the diagnosis of anxiety disorders. This technology can be helpful in assessing the severity of anxiety [37].

Research is being conducted on the use of VR technology in radiological diagnostics [36] and in the diagnosis of anxiety disorders. VR technology can assist in assessing the severity of anxiety [37]. Additionally, VR devices are used in the treatment of various conditions, particularly in cognitive-behavioral therapy for anxiety disorders. They are also used to reduce pain and anxiety experienced by patients during medical procedures [38,39,40], as well as in rehabilitation following strokes, in Parkinson's disease, chronic pain, and other neurological and orthopedic conditions. Studies have demonstrated the effectiveness of VR in improving both motor and cognitive functions [41,42,43,44].

Equipment and software

VR content can be presented in two main ways: through HMD (Head-Mounted Display) systems and CAVE (Cave Automatic Virtual Environment) systems. Some authors also identify a third method of presenting VR content via a computer monitor [45].

HMDs are created using special goggles and headphones. The goggles, which contain a display, present images for each eye, creating a stereoscopic scene. Each image is calculated and rendered separately, taking into account the proper perspective from the position of each eye relative to the mathematical description of the three-dimensional virtual scene. The HMD continuously tracks the position of the user's head, and therefore their gaze direction. When users turn or move their heads to look around, the computer updates the images, allowing them to see a surrounding three-dimensional scene that can change dynamically [46]. These systems are easily accessible, portable, and often affordable, making them commonly used in research and widely available for public use [47]. Examples of devices based on this system include the HTC Vive, Oculus, and Samsung VR.

The CAVE system, much less frequently used, involves a small, square room where images are projected onto the walls. The three-dimensional effect is achieved through the use of 3D glasses [48,49].

The main difference between the two systems is that HMD systems cause full immersion in the virtual environment, the sense of one's own body can be createdby producing a virtual body in the form of avatar. In contrast, the CAVE system allows the participant to see their own body, which leads to more natural task execution [45].

However, the CAVE system is expensive, occupies a large space, and is not mobile, making it impractical and rarely used in research, with limited potential for widespread use.

Immersion, sense of presence, and interaction

There are three key aspects of VR: immersion, sense of presence, and interaction. Immersion refers to the sensory context of the experienced reality, providing stimuli that give the impression of being in that world. It is achieved by minimizing stimuli from real life and replacing them with elements from the virtual environment. The quality of immersion largely depends on the technology: image resolution, refresh rate, and spatial sound. The more high-quality sensory stimuli the system can provide, the better it replicates reality. With maximum immersion, the human brain would not be able to distinguish between the real world and the computer-generated one [50]. Immersion is one of the features of VR, which can be described as the sensory context of reality, evoking the impression of being in it. It is achieved by eliminating real stimuli and replacing them with virtual sensations. Immersion is influenced by various factors, such as the quality of the hardware, image resolution, refresh rate and spatialization of sound [50].

The concept of presence is closely related to immersion, which is why authors often do not separate the two terms. Some researchers view immersion as an objective indicator of engagement in the virtual world, while presence is seen as a subjective experience of that environment [51]. Presence can be defined as perceiving the virtual environment as if it were real [52]. The level of immersion is indicated by how realistically people in a virtual environment respond to presented stimuli, whether physiologically, emotionally, or behaviorally [53]. Presence includes two elements: the illusion of place, which involves feeling like one is physically in the depicted environment, and the illusion of plausibility, the belief that the situation being experienced is genuine [54]. Furthermore, user engagement and the intensity of emotions evoked by virtual environment stimuli are critical to experiencing presence [50].

Another key aspect of VR is interaction, which allows for detecting the user's actions and responding to them in real-time. This enables adjustments, such as changes in the landscape or execution of user commands, based on the current situation. Interaction is closely linked to the sense of presence [50].

Research clearly indicates the connection between presence, immersion, and emotional responses of users, highlighting that the effectiveness of relaxation techniques in VR environments is inextricably tied to these concepts [51]. It is worth noting, however, that strong negative emotions are much more dependent on immersion and presence than the milder positive emotions we aim to achieve when using relaxation techniques in a virtual environment [50].

Relaxation therapy in virtual reality

The effectiveness of VR techniques in relaxation therapy has been confirmed by numerous studies [55]. For example, a study conducted by Veling et al. [56] involved 49 participants suffering from bipolar disorder, anxiety, depression, psychosis, or mixed states. Of this group, 24 individuals engaged in traditional relaxation exercises (serving as the control group), while 25 used VR headsets (forming the experimental group). In both cases, the relaxation therapy lasted for 10 days. Before and after the therapy, participants used a visual analog scale to rate their well-being, which included levels of relaxation, calmness, joy, satisfaction, overall positive feelings, confusion, anxiety, depression, irritability, and overall negative feelings. After ten days, participants reported an improvement in well-being regardless of the therapy method, but those using VR headsets experienced greater improvement, except in the area of calmness, where traditional relaxation exercises were more effective. The study also found that the most preferred VR scenario was a beach with interactive virtual exercises, a beach without such exercises, and a deep--sea setting with dolphins.

A study, similar to the one described above, was also conducted among patients suffering from depression and anxiety disorders, in which some subjects were treated with 3 sessions of relaxation therapy using VR techniques. Scenery played during the sessions included forest and marine landscapes. The control sample for this study consisted of depression patients to whom classical relaxation techniques were applied. The condition of the patients before and after the study was compared using the Montgomery-Åsberg Depression Rating Scale (MADRS) and the Patient Health Questionnaire 9-Item Version (PHQ-9), among other scales, which showed that patients using VR techniques achieved statistically significant greater benefits compared to the control group, including a reduction in the severity of depressive and anxiety symptoms [57].

Schizophrenia is another mental disorder where VR--assisted relaxation therapy has shown potential benefits, as demonstrated by a study by Freeman et al. [58]. This study included 41 participants suffering from schizophrenia or similar disorders, who underwent four 30-minute VR therapy sessions over four weeks. Their symptoms were assessed before therapy, four weeks after the start, and again 24 weeks after. Tools such as the Psychotic Symptoms Rating Scale (PSYRATS) and the Warwick-Edinburgh Mental Wellbeing Scale (WEMWBS) were used. The study observed a significant reduction in psychotic symptoms in the VR therapy group compared to the control group. The study also compared the effectiveness of VR relaxation therapy with VR cognitive therapy and found both to be equally effective, though cognitive VR therapy is not the focus of this paper.

There is also a pilot study [59] on the use of relaxation therapy with VR techniques in the treatment of schizophrenia. In this study, a group of 13 participants reported reduced anxiety levels, measured using a visual analogue scale for anxiety in schizophrenia. This assessment was made after the first and fifth VR sessions and was compared to the patients' baseline levels before the therapy.

As previously mentioned, VR-assisted relaxation therapy can also be effective in treating bipolar disorder. A study by Ilioudi et al. [60] supports this, in which 18 participants with bipolar disorder were shown desert and forest scenes in VR. They then participated in semi-structured interviews, which were analyzed using qualitative methods based on inductive theory. The results indicated that participants felt calmer after the VR sessions and reported an overall improvement in their well-being.

Safety of therapy

Studies on the safety of VR therapy are relatively consistent. Participants generally report no side effects or experience them at low intensity [56,61]. The most common side effects include nausea, headaches, dizziness, vision disturbances, and eye discomfort, such as dryness, redness, or irritation [56,62,63]. A relatively common side effect is "cybersickness", likely resulting from a mismatch between the sense of movement in the virtual environment and physical immobility in the real world [64]. This condition manifests in three symptom areas: disorientation (dizziness), nausea, and oculomotor symptoms (eye strain, difficulty focusing eyesight, blurred vision, and headaches) [50]. The frequency and severity of side effects depend on the device, the type of tasks performed (e.g. walking or driving), and individual predispositions of those using VR goggles [63].

Manufacturers of VR headsets warn of the potential for seizures during use. Another risk is the transmission of conjunctivitis between users of the same device, which can be mitigated by disinfecting VR goggles after each use. The user manuals also mention the possibility of skin irritation, redness, itching, and swelling on the face.

Contraindications and recommendations for VR headset use vary by manufacturer, and there are no standardized guidelines on this issue. Common temporary contraindications include fatigue, colds, flu, headaches, migraines, and earaches. Manufacturers also recommend medical consultation for pregnant women, the elderly, those with binocular vision disorders, epilepsy, schizophrenia, post-cataract surgery patients, individuals with pacemakers, or those with other serious health conditions.

Recommendations for safe VR use include operating the devices in a safe environment, ensuring proper positioning, making sure the headset is level and securely fastened, starting with short sessions, taking frequent breaks during longer use, especially when discomfort occurs [65,66,67].

Conclusions

Mental disorders such as depression are a growing problem in the 21st century. The scale of this issue necessitates active exploration of innovative solutions that could help reduce it. One of these solutions is relaxation therapy using VR techniques. This method uniquely combines the traditional method of psychotherapy, which has been known since the second half of the last century, and equally old (but developing intensively only in the 21st century) digital technology. This combination allows for immersion, a sense of presence, and patient interaction, which enhances the therapy's effectiveness and offers an advantage over traditional relaxation therapy.

The effectiveness of relaxation therapy using VR techniques has been proven by numerous studies. These included the use of this method in supporting the treatment of depression and anxiety, bipolar disorder, as well as schizophrenia and psychotic disorders. Researchers agree that this method is a valuable complement to other therapeutic approaches.

The application of VR in therapy requires consideration of potential side effects, such as nausea, headaches, and cybersickness. Adjusting session length and ensuring VR is used in a safe environment are recommended. Additionally, the development of standardized safety guidelines for VR use appears necessary.

Authors' contribution

Study design – M. Stencel, B. Pilarski, B. Bula
Data collection – S. Florek, M. Stencel, B. Pilarski, B. Bula
Manuscript preparation – R. Pudlo, M. Stencel, B. Pilarski
Literature research – S. Florek, M. Stencel, B. Pilarski
Final approval of the version to be published – S. Florek, R. Pudlo

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