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Journal of Education, Health and Sport. eISSN 2391-8306.

Journal Home Page

<https://apcz.umk.pl/JEHS/index>

MULAWA, Magdalena Maria, KRYCIA, Kamila, MAZUR, Karolina, RÓŻYCKA, Karolina, PIASZCZYŃSKA, Emilia, GAŁUSZKA, Aleksandra, MATA CZ, Dominika, DRABIK, Sandra, GAŁUSZKA, Maja and ADAMCZYK, Adrianna. Virtual reality as a non-pharmacological method to support therapeutic interventions in palliative care patients. Journal of Education, Health and Sport. 2026;91:70828. eISSN 2391-8306. <https://doi.org/10.12775/JEHS.2026.91.70828>

The journal has had 40 points in Minister of Science and Higher Education of Poland parametric evaluation. Annex to the announcement of the Minister of Education and Science of 05.01.2024 No. 32318. Has a Journal's Unique Identifier: 201159. Scientific disciplines assigned: Physical culture sciences (Field of medical and health sciences); Health Sciences (Field of medical and health sciences). Punkty Ministerialne 40 punktów. Załącznik do komunikatu Ministra Nauki i Szkolnictwa Wyższego z dnia 05.01.2024 Lp. 32318. Posiada Unikatowy Identyfikator Czasopisma: 201159. Przepisane dyscypliny naukowe: Nauki o kulturze fizycznej (Dziedzina nauk medycznych i nauk o zdrowiu); Nauki o zdrowiu (Dziedzina nauk medycznych i nauk o zdrowiu). © The Authors 2026; This article is published with open access at Licensee Open Journal Systems of Nicolaus Copernicus University in Toruń, Poland
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The authors declare that there is no conflict of interests regarding the publication of this paper.
Received: 13.04.2026. Revised: 04.05.2026. Accepted: 05.05.2026. Published: 10.05.2026.

Virtual reality as a non-pharmacological method to support therapeutic interventions in palliative care patients

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Abstract

Aim: The aim of this study is to review the existing literature and research on the application of virtual reality technology in palliative care, with particular emphasis on its impact on pain intensity, psychological well-being, patients' quality of life, as well as an analysis of its feasibility and safety.

Materials and Methods: The literature was searched using the PubMed, Google Scholar, and Scopus databases (2013–2026). The following keywords were used: “virtual reality”, “palliative care”, “hospice care”, “end of life”, “pain”, “quality of life”, and “anxiety”.

Results: The available evidence suggests that virtual reality represents a viable therapeutic option, generally not associated with significant adverse effects. Studies indicate a short-term reduction in perceived pain, a potential decrease in anxiety levels, and an improvement in psychological well-being. The effectiveness of the intervention depends, among other factors, on the type of content presented, such as nature-based imagery or materials tailored to the individual needs of the patient. However, there remains a lack of studies enabling the standardisation of parameters such as session duration and frequency, while the considerable heterogeneity of applied protocols makes comparison of results challenging.

Conclusions: Virtual reality (VR) may constitute a valuable adjunct to standard palliative care in the management of symptoms and provision of psychological support, particularly as a short-term intervention in hospital and hospice settings. Further randomised clinical trials are

warranted, alongside the development of guidelines for the implementation of VR in palliative care practice.

Keywords: virtual reality, palliative care, hospice care, end of life, pain, quality of life, anxiety

Introduction

Palliative care focuses on alleviating suffering and improving the quality of life of patients with life-limiting conditions. It continues to develop in response to increasing morbidity rates, offering comprehensive support to patients in advanced stages of illness. Individuals suffering from incurable and progressive diseases often experience pain, anxiety, reduced well-being, and depression, which significantly deteriorate their quality of life [1].

Currently recommended approaches to pain management include both pharmacological interventions and non-pharmacological techniques [2].

However, there are challenges associated with these traditional strategies. Pharmacological interventions, although effective, may lead to adverse effects and dependence.

Non-pharmacological methods may, however, be inaccessible or unfeasible for some patients, due in part to physical limitations or the insufficient availability of qualified personnel. In light of these constraints, there is growing interest in exploring alternative solutions, including virtual reality technology. This technology enables immersive sensory and perceptual experiences that can effectively divert patients' attention away from perceived pain, offering an innovative approach to symptom management without the risk of adverse effects associated with pharmacological treatments or physical interventions [2].

The integration of palliative care with technologies such as virtual reality (VR) may constitute a valuable non-pharmacological tool, significantly contributing to improvements in patients' daily functioning and psychological well-being at the end of life [3, 4].

Virtual reality (VR) and augmented reality (AR) represent technologies with a broad range of applications, encompassing entertainment, education, and healthcare. VR is characterised by full perceptual immersion in a computer-generated three-dimensional environment, whereas AR enables users to remain engaged with the real-world environment while enhancing it with digital informational elements. The use of both technologies necessitates specialised VR/AR headsets [5].

Materials and Methods

This study was conducted as a narrative review incorporating elements of a systematic literature search, in accordance with established reporting guidelines for review studies. The aim was to comprehensively collate and critically evaluate the current evidence on the use of virtual reality technology in palliative care, with particular emphasis on the effects of VR on somatic symptoms, psychological well-being, quality of life, and patient experience.

Systematyczny przegląd literatury został przeprowadzony z wykorzystaniem następujących baz danych: PubMed, Scopus, Google Scholar oraz Web of Science.

The literature review included articles published between 2013 and 2026.

The search process employed a combination of keywords and their synonyms. The strategy included queries such as “virtual reality”, “palliative care”, “hospice care”, “end of life”, “pain”, “quality of life”, and “anxiety”. To enhance precision, Boolean operators (AND, OR) were applied. Additionally, a manual screening of the reference lists of selected review articles was conducted.

Publications meeting predefined inclusion criteria were considered in the analysis: articles published in English, available in full text, and appearing in peer-reviewed medical journals, as well as studies examining the use of virtual reality technology in patients receiving palliative care. Various study designs were included, such as clinical trials, pilot studies, qualitative research, systematic reviews, and meta-analyses. Additionally, studies addressing the experiences of patients, their families, and caregivers related to the use of VR in the context of palliative care were also incorporated.

The following were excluded from the analysis: articles without full-text access, publications focusing exclusively on technological aspects not related to patients, studies not addressing palliative care or advanced illness, conference reports, abstracts, and publications characterised by low methodological quality.

Results

VR in Pain Management

According to the International Association for the Study of Pain, pain is defined as an unpleasant sensory and emotional experience associated with actual or potential tissue damage, or resembling that associated with it [6]. Pain is one of the most common and burdensome symptoms, negatively affecting patients’ quality of life and psychosocial functioning. Due to its multifactorial aetiology, cancer-related pain constitutes a complex and subjective experience involving significant psychosocial components [7]. The mechanisms underlying pain,

encompassing both physical and psychological disturbances, necessitate the implementation of comprehensive therapeutic strategies aimed at pain relief, improvement of psychological functioning, psychological support, patient education, and social support [8].

Effective pain management plays a crucial role in ensuring patient comfort and preserving dignity in the final stages of life. Moreover, it constitutes a key factor in minimising unnecessary suffering for both patients and their family members [9].

Contemporary approaches to the management of patients receiving palliative care are based on a multimodal model, integrating pharmacological and non-pharmacological interventions. Opioids play a central role in pharmacotherapy for the treatment of severe pain, complemented by non-opioid medications such as nonsteroidal anti-inflammatory drugs and co-analgesics. At the same time, non-pharmacological strategies are employed, including cognitive-behavioural therapy, physiotherapy, and various supportive interventions. Such an approach enables comprehensive and individualised pain management in palliative care patients [8].

A review of the application of virtual reality (VR) as an adjunctive method for pain control in palliative care patients underscores the need for incorporating non-pharmacological approaches alongside pharmacological therapy [10].

This technology is based on the use of specialised headsets that enable full immersion in a computer-generated virtual environment. VR immersion facilitates the diversion of patients' attention away from nociceptive stimuli and redirects it towards visual and auditory experiences. This mechanism, known as attentional distraction, effectively reduces the perception of pain. The effect arises from the limited capacity of cognitive resources, directing attention to alternative stimuli diminishes the body's ability to process pain signals [10].

In recent years, numerous studies have been conducted to evaluate the effectiveness of VR in pain management among palliative care patients with advanced-stage cancer [11].

Virtual reality (VR) can be categorised into two types: immersive and non-immersive. VR experiences stimulate the brain by activating neural pathways that are difficult to engage under normal conditions. The effectiveness of VR in pain relief depends on its ability to shift brain network activity from the salience network (SN), associated with pain processing, to the default mode network (DMN), which is linked to a return to baseline states and a reduction in pain perception [11].

Immersive technologies require the use of additional equipment, such as head-mounted displays (HMDs). They enable complete immersion in a virtual environment, effectively isolating the user from real-world stimuli. This facilitates the induction of the default mode network (DMN), resulting in greater pain relief compared to non-immersive technologies. A high level of

immersion is particularly effective in alleviating short-term, intense pain, for example during medical procedures [11].

A notable limitation of this technology is simulator sickness, which manifests as dizziness, nausea, and headaches caused by a mismatch between moving visual stimuli and the lack of corresponding physical movement. To mitigate these symptoms, it is recommended to gradually increase exposure time and adjust parameters such as field of view and frame rate [11].

Non-immersive technologies refer to forms of virtual reality in which the patient is not fully isolated from the real-world environment. Their application is simpler and easier to implement, however, real-world stimuli may interfere with the creation of a fully immersive experience and limit the capacity to modulate functional brain connectivity. The degree of bodily illusion is lower in this case, resulting in a reduced analgesic effect compared to immersive technologies [11].

A randomised crossover study demonstrated that the use of VR featuring relaxing nature scenes was well tolerated by patients and, in some cases, significantly reduced perceived pain both during the session and immediately afterwards. Participants included patients from hospital-based palliative care units as well as individuals receiving home-based palliative care who had experienced cancer-related pain within the previous 24 hours and at the time of enrolment. Both 2D and 3D application technologies were utilised. Following the session, patients reported an average pain reduction of 43% with 3D VR delivered via head-mounted displays (HMDs), compared to a 34% reduction with a 2D screen-based application. T-tests confirmed a statistically significant reduction in symptoms such as drowsiness and dyspnoea. The study indicates that VR is both feasible and well accepted among palliative care patients. Both 3D and 2D modalities were positively evaluated by participants, who reported beneficial experiences both during and after the sessions [12].

In a pilot study involving adult patients with advanced colorectal cancer (stage IV), a virtual underwater environment (VR Blue) was tested during a 30-minute session. The study included 20 participants aged between 18 and 85 years who had experienced moderate pain (at least 4 points on a 0–10 scale) on most days for a minimum of three months. Participants were required to be proficient in English and to have normal or corrected vision and hearing. Individuals with psychiatric disorders, such as schizophrenia, those with recent serious health events (e.g. myocardial infarction), and those with significant cognitive, visual, or auditory impairments that could limit full participation in the VR session were excluded [13].

All patients continued their standard treatment without the need to discontinue additional pain management strategies. The entire cohort completed the VR Blue session, and data were collected from all participants both before and after the intervention. As many as 83% of participants reported high satisfaction with the therapy, and no serious adverse events were observed. Notable benefits were identified: pain decreased by 59%, tension by 74%, stress by 68%, and anxiety by 65%, while mood improved by 70%, the level of relaxation increased by 38 points. Qualitative findings further confirmed a positive attitude towards the VR Blue protocol. Exposure to this form of therapy was associated with increased tolerance to thermal pain and a reduction in symptoms such as fatigue and stress [13].

A systematic review and meta-analysis confirmed that VR not only provides a statistically significant reduction in pain intensity, but does so in a safe, scalable, and patient-centred manner, while also highlighting the limited number of studies and small sample sizes [2].

Similar conclusions were presented in a review examining the use of VR in pain management among patients with advanced cancer, which highlighted the promising potential of this technology while emphasising the need for larger and more rigorous clinical studies [14].

Pain reduction achieved through the use of VR technology is based on several mechanisms identified in the scientific literature. Primarily, immersive experiences effectively divert patients' attention away from nociceptive stimuli. Moreover, relaxation-based experiences facilitate the reduction of emotional tension and stress, while positive visual and emotional stimuli support the modulation of central mechanisms involved in pain perception [10, 11, 12, 13, 14].

VR and Anxiety, Mood, and Psychological Well-being

In addition to somatic symptoms, patients with terminal illness frequently experience significant psychological difficulties, including anxiety, low mood, feelings of helplessness, and social isolation. These challenges are associated with disease progression, chronic pain, and awareness of approaching end of life, which substantially impair quality of life and complicate symptom management. In response to these challenges, there is growing interest in non-pharmacological supportive interventions, including the use of VR [15].

In palliative care, VR is utilised to present relaxing nature scenes, virtual travel experiences to distant locations, family-related memories, and meditative environments that evoke positive emotions and reduce stress. The mechanism underlying VR is based on cognitive distraction and a sense of presence, allowing for a temporary reduction in patients' focus on illness and hospitalisation [16].

From a neurobiological perspective, emotional regulation and anxiety responses are based on complex interactions between structures of the limbic system, the prefrontal cortex, and centres responsible for stress responses. A key component in this process is the amygdala, which plays a crucial role in the processing of emotional stimuli. It is involved both in the generation of anxiety responses and in the evaluation of threat-related stimuli. Hyperactivity of the amygdala is characteristic of many disorders associated with anxiety and stress [17].

Research in the field of the neurobiology of pain and emotion indicates that cognitive processes, such as attention and executive control, can modulate the activity of limbic structures, including the amygdala, through the influence of the prefrontal cortex. In this context, immersive virtual environments have the potential to affect the activity of brain structures involved in emotional processing. This occurs through the engagement of cognitive resources and the redirection of attention away from stress-related stimuli [17].

Studies conducted in VR environments have demonstrated a reduction in the activity of brain structures associated with stress responses, alongside an increase in the activity of regions responsible for cognitive control, such as the prefrontal cortex. The prefrontal cortex plays a crucial role in emotional regulation, exhibiting the capacity to inhibit excessive activity within limbic structures [16].

Virtual reality (VR) also influences the reward system, which is responsible for the regulation of pleasure and motivation. VR experiences, particularly those of an exploratory or aesthetic nature, can stimulate this system by generating novel, positive sensory stimuli, potentially resulting in improved mood and enhanced psychological well-being [18].

Virtual reality (VR) may also influence the regulation of the stress response via the hypothalamic–pituitary–adrenal (HPA) axis. Chronic stress leads to excessive activation of this system, resulting in elevated cortisol levels and an exacerbation of both psychological and physical symptoms. Cognitive and emotional processes, such as attentional focus and stimulus interpretation, can shape the stress response. Relaxation-based experiences in VR environments promote stress reduction by activating the parasympathetic nervous system and attenuating HPA axis activity [16, 17, 18].

In a prospective study conducted on a group of seventeen participants, with a median age of 65 years (range 20–82), eight patients opted for personalised VR content, including representations of their home environment or family members. All participants evaluated the sessions positively. Compared to standard content, personalised VR demonstrated a stronger impact on well-being and emotional response. The individualisation of VR content indicates its potential to enhance the level of immersion, thereby improving the overall user experience, without a significant

negative impact on mood or emotional state. The VR intervention also contributed to an improved sense of normality in daily functioning and enhanced relationships with family members, however, patients also reported feelings of social isolation associated with awareness of physical separation from their loved ones. For some participants, these experiences contributed to increased motivation and a greater sense of hope [19].

A study conducted in a home-based palliative care setting included 14 participants (3 men and 11 women). The majority were married or in a partnership (71.4%), half were employed (50.0%), and over half had completed secondary education (57.1%). The mean Karnofsky Performance Status (KPS) score was 77.1 (± 17.3). The most common primary tumour site was the gastrointestinal tract (28.6%). Seven patients were diagnosed with localised cancer, while the remaining seven presented with metastatic disease. Five participants were not receiving any medication, one was undergoing treatment with analgesics and antidepressants, one was receiving analgesic, anxiolytic, and antidepressant therapy, and seven were treated exclusively with analgesics. A four-day cycle of VR sessions did not result in a statistically significant reduction in pain, anxiety, or depression, however, immediate symptom relief was observed following each session. The findings indicate that audiovisual VR technology may serve as an effective adjunct to standard psychological care in patients with advanced cancer, enhancing well-being through rapid alleviation of symptoms [20].

In another study, thirty patients receiving hospice and palliative care participated, including 12 women (40%) and 18 men (60%). The mean age of the participants was 74.7 years (range: 46–94 years). Each participant viewed a 15-minute video presenting calming natural scenes accompanied by ambient sounds, using virtual reality technology with a head-mounted display. Most patients completed the session, although some discontinued due to dyspnoea, fatigue, or discomfort associated with the equipment. A significant improvement was observed in the overall symptom score (30% reduction), along with beneficial changes in drowsiness, fatigue, depression, anxiety, overall well-being, and dyspnoea. However, the improvement was not sustained two days after the session [21].

Systematic reviews confirm that VR may effectively reduce anxiety and improve the quality of life of palliative care patients, although they highlight the need for studies with greater statistical power. Most available studies suggest a positive impact of VR on mood, stress reduction, and subjective well-being, however, the number of randomised trials remains limited [22].

Dignity and Patient Autonomy in Palliative Care

Contemporary palliative care is grounded in a holistic model, with particular emphasis placed on preserving patient dignity and autonomy in the final stages of life. The ability to engage in

meaningful activities - those perceived by the patient as purposeful and aligned with their personal identity- is often limited by physical impairment and disease-related symptoms. However, VR enables the overcoming of these barriers by creating immersive and personalised experiences [16, 23].

A sense of activity is crucial for maintaining meaning in life and preserving dignity in patients with terminal illness [16].

VR enables the simulation of environments that are otherwise inaccessible in reality, such as travel experiences, contact with nature, or revisiting places of autobiographical significance. The realisation of so-called “bucket-list experiences” through VR has a positive impact on emotional well-being, facilitated by the sense of presence and patient engagement [16, 21].

The personalisation of VR content is a key factor in the effectiveness of the intervention. More than half of patients experienced clinically significant improvements in both emotional and physical states following personalised VR therapy, highlighting the potential to tailor experiences to individual life histories and needs [24].

Patient dignity in palliative care is closely associated with maintaining control over one’s own experiences and identity, which are often threatened by the loss of social roles and increasing dependence on caregivers. VR may counteract these processes by restoring an active role for the patient within the therapeutic context and influencing the existential dimension of pain, thereby reinforcing dignity and autonomy [10].

The mechanisms underlying the effects of VR include:

- restoration of a sense of agency through the ability to choose experiences,
- enabling a return to meaningful roles and personal memories,
- reduction of isolation and dependence. Additionally, VR supports existential processes such as life reflection, acceptance of illness, and the integration of biographical experiences, which are essential for preserving dignity at the end of life [10, 21].

Autonomy is a fundamental principle of bioethics and clinical practice in palliative care. VR enables patients to choose the type of activity, maintain control over the course of the experience, and actively participate despite physical limitations [23, 24].

According to Self-Determination Theory, the fulfilment of the needs for autonomy, competence, and relatedness is essential for psychological well-being. Personalised VR interventions address these needs, enhancing patient engagement and satisfaction.

VR may also support relational autonomy by enabling shared experiences with loved ones, thereby strengthening social bonds and enhancing the sense of belonging [24].

Virtual reality represents a promising tool for supporting the implementation of meaningful activities in palliative care, contributing to the enhancement of patients' sense of dignity, autonomy, and meaning in life. The integration of VR into clinical practice addresses patients' psychosocial and spiritual needs, constituting an important component of comprehensive end-of-life care, although further research is required [16, 23, 24].

Conclusion:

Current evidence suggests that virtual reality represents a promising non-pharmacological approach to supporting patients receiving palliative care. Studies indicate that the use of mechanisms such as cognitive distraction, sensory immersion, and modulation of central pain processing can lead to a reduction in subjective pain perception, as well as improvements in psychological well-being and quality of life. The effectiveness of VR depends, among other factors, on the type of content presented (e.g. nature-based imagery or materials tailored to individual preferences). However, there remains a lack of research addressing the standardisation of key parameters, such as session duration and frequency, and the heterogeneity of applied protocols continues to limit the comparability of findings. Further large-scale clinical studies with greater statistical power are required to determine optimal methods for implementing VR technology and to evaluate its long-term effectiveness in palliative care populations.

Disclosure

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All authors have read and agreed with the published version of the manuscript.

Funding Statement

No funding was received for the Authors.

Institutional Review and Board Statement

Not applicable.

Informed Consent Statement

Not applicable.

Data Availability Statement

Not applicable.

Conflict of Interest Statement

Authors declare no conflicts of interest.

Declaration of the Use of Generative AI and AI-Assisted Technologies in the Writing Process:

During the preparation of this work, the author(s) used Chat GPT for the purpose of language polishing, and stylistic refinement. After using this tool, the author(s) reviewed and edited the content as needed and take(s) full responsibility for the substantive content of the publication.

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