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REVIEW

Virtual reality and chronic low back pain

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ABSTRACT

Aim: Chronic low back pain (CLBP) is a highly prevalent and significant cause of disability which is often resistant to pharmacological management. Virtual reality (VR) is an emerging technology with the potential to influence CLBP, and has been suggested as an alternative to opioids for pain management. VR is a goalfocused, computer-simulated reality allowing modification of the user's experience of their perceived world.
Materials/Methods: A narrative review of peer-reviewed literature using a systematic search strategy, and sole reviewer for data extraction.
Conclusions: VR has demonstrated effectiveness in reducing acute, experimental and chronic pain. This review describes the theoretical basis of the therapeutic effects of VR on CLBP via three distinct mechanisms: distraction, neuromodulation and graded exposure therapy. Furthermore, clinical application will be considered, including discussion of ethical issues associated with the technology.

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KEYWORDS
Virtual reality; assistive technology; back pain; graded exposure therapy; distraction; neuromodulation

➤ IMPLICATIONS FOR REHABILITATION

- Virtual reality (VR) is suggested as an alternative for opioids in the management of acute and chronic pain.
- The therapeutic mechanisms of VR in chronic low back pain (CLBP) are equivocal but include distraction, neuromodulation of body perception and graded exposure therapy.
- VR may show greater efficacy in patients with CLBP with associated kinesiophobia.
- VR may show greater effect with increased immersion.

Introduction

Pain is an experience amalgamating physical, cognitive and emotional processes to protect from harm; often by facilitating overt behaviours [1]. Low back pain (LBP) is a highly prevalent [2] and significant cause of disability [3]. Chronic LBP (CLBP) is often resistant to pharmacological management[2]. Fear avoidance is a well-established behaviour in CLBP, where fear of pain results in activity avoidance, maladaptive learning, modified perception of pain and resultant compensatory behaviours [4]. Fear of movement due to expectation of pain (kinesiophobia) is a strong predictor of pain chronicity [5].

One emerging technology with potential to influence CLBP, unachievable by other means is virtual reality (VR) [6]. VR is a goal-focused, computer-simulated reality allowing modification of the user's experience of their perceived world [7,8]. VR exists on a continuum from non-immersive to fully immersive (Table 1). In non-immersive VR body tracking technology transfers movement to alter the perspective of the simulated avatar [9]. Immersion increases with the integration of multi-sensory (e.g., visual, auditory and tactile) experience into the simulation through equipment (e.g., a head-mounted display (HMD) or wearable haptic devices) [6,10]. This synthesis of sensations is associated with a stronger illusion of presence and realism [11]. With VR systems becoming more readily available and affordable the scope of their use to a wider population is increasingly conceivable. This article aims to describe the theoretical basis of the therapeutic effects of VR with specific focus on CLBP.

Virtual reality analgesia

"VR analgesia" is a potential alternative to opioids for pain management [12,13]. A meta-analysis has examined the effectiveness of VR in reducing acute and chronic pain [14]. Studies show population, diagnosis and dosage heterogeneity; but did provide support for short term analgesic effects for both forms of pain. VR was originally used in managing pain during dressing changes in paediatric burn patients using the "SnowWorld" game; designed around cold and ice as the antithesis to the injuries suffered by the patients [15]. The intervention facilitated a 44% reduction in pain [16]; further corroborated by a randomized controlled trial where the system showed a 23.7 point difference in pain reduction compared to passive observation control (95% confidence interval (CI): 2.4–45.0, p=.029) [17]. VR analgesia has been shown across other procedures including cancer treatment [18,19]; dental work [20]; and IV placement [6,21]; as well as across experimental modalities, such as ischaemic tourniquet [22,23] and cold pressor test [24]. VR pain reduction also corresponds with analgesic brain activity changes on functional MRI [25,26].

Despite the pathophysiological complexity in the transition from acute nociception to chronic pain [27], VR has also been shown to influence pain in chronic populations. In fibromyalgia,

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Table 1. Glossary.

	Definition	
Embodiment	The perception of the body being replaced by that of an avatar; facilitated by motion trackers to allow coordination with the simulation.	
Head mounted device (HMD)	A type of headset providing a visual display of the simulation where head movements are tracked to modify the user's perspective.	Phone-based systems where a smartphone is wrapped in a case and provides the computing power for the simulation (Google Cardboard, Samsung Gear); or more powerful devices where content is provided by an external computer. (Occulus Rift, HTV VIve).
Immersion	The perception of being physically present in a simulated reality.	Non-immersive VR systems usually use a monitor screen and motion capture technology (e.g., Microsoft Kinect and "exergame" systems). Immersive VR uses HMD and wearable devices (e.g., Valve Index, Oculus Quest).
Orientation	The tracking of head movement by a system to allows the user to modify their visual image of the simulation according to their gaze.	Immersive and non-immersive
Positioning	An advanced form of tracking where the position of the user's body is monitored allowing relocation through the simulated environment. This requires external sensors (infrared/ video capture/ inertial sensors) to facilitate body tracking.	Immersive
Presence	The phenomenon where a user's perception is unable to acknowledge the role of the VR system in creating their experience of a simulated reality.	Increasing with immersion
Wearable monitors	Devices used to monitor and quantify physical movements and physiological data, which feed information into the simulation.	Immersive

an 8-week course of a non-immersive VR exercise game had a positive effect on health-related quality of life and a 16.32% reduction in disease effect in the Fibromyalgia Impact Questionnaire ($p<.01$; MCID: 14%) [28]. Similarly, benefits have been found in complex regional pain syndrome (CRPS) [29]; chronic neck pain [30] and spinal cord injury-related neuropathic pain [9]. Underlying mechanisms proposed include cortical reorganization, mirror-neuron training, emotional regulation and distraction [31]. To describe the impact of VR on CLBP, three specific approaches will be examined: distraction, neuromodulation and graded exposure therapy (GET) [6].

Distraction

Distraction is the re-direction of an individual's attentional resources away from pain, towards other sensations (e.g., visual, auditory and tactile stimuli) [10]. Thus, reducing cognitive capacity to process pain and alleviating pain experience [32]. The Gate Control Theory of pain [33] proposed the role of attention (alongside cognition and emotion) in influencing pain interpretation. Humans have a finite attentional capacity [34]; illuminating the concept of targeting attentional resources for pain management. Distraction *via* an adapted counting Stroop task [35] reduced pain intensity and brain activity associated with pain perception; and increases in areas associated with inter-cortical modulation and pain inhibition [36]. Further studies elaborate on the correlations between brain activity, pain perception and distraction [25,37].

Viewing one's own body can reduce pain in healthy subjects [38] and it is suggested that viewing a virtual body perceived as one's own may also be analgesic [39]. Mental processes can run independently to divert finite attentional resources [40]. VR integrates multi-sensory stimulation into a "reality" where the painful body is replaced by a healthy simulacra [7]; diverting attention from pain processing [34,41]. Variability of sensory integration (visual, auditory, tactile and olfactory), allows the VR system to distract more effectively [10]. Immersion requires attention [42] and can be enhanced through hand and body tracking to foster interactivity [26]. Experimental studies on exercise-induced pain in healthy subjects showed immersion significantly reduced pain intensity and rate of perceived exertion [7]. These authors posit that enhancing presence and immersion endows greater analgesic effects. Higher cognitive load also predicts pain during cold pressor testing during immersion [43]. Disproportionate attention to CLBP has associations with pain intensity and is predictive of disability and healthcare utilization [44]. VR may allow disengagement from attention-related pain behaviours [45].

Jones et al. [46] studied a heterogeneous chronic pain population (including CLBP). Thirty participants were exposed to a 5 min partially-immersive VR experience, allowing head orientation modification without body repositioning. Interaction was controlled by clicking a button. Sixty percentage reduction in numerical pain score was seen during intervention ($p<.001$), and 33% of subjects reported a 100% reduction in pain during VR. Moderate engagement and realism scores reported.

Alemanno et al. [47] examined a 6 week/12 session neurorehabilitative VR intervention teaching subjects how to correctly execute spinal movements, based upon auditory and visual feedback. A 2.3 point reduction in pain rating score ($p<.05$); functional improvement in Roland Morris Disability Questionnaire (0.67, $p<.05$); and increases in the Beck Depression Index were seen. Published as an abstract; sparse details of intervention, methodology and outcomes are provided in the study. Subsequently, findings should be viewed with caution.

Applegate et al. [48] underwent an exploratory study examining whether time-to-task failure (TTF) during a Sørensen back extension endurance test could be influenced by VR. Back extensor muscle endurance is predictive of CLBP [49]. The author's theorized distraction could reduce kinesiophobia and influence TTF. Twenty four CLBP sufferers and a healthy control group (matched by age, sex and body mass index) were recruited. The simulation was produced using a HMD, and participants experienced an environment where they attempted to "fly" through hoops- needing to sustain extension to achieve the task. Performance was facilitated through visual and auditory feedback. Both groups underwent the classic Sørensen test [50] and the VR equivalent, with comparisons made across groups. Results of the VR group indicated that lowered kinesiophobia scores on the Tampa Scale for Kinesiophobia (TSK) correlated with a longer TFF in the VR group. Kinesiophobia was not predictive of performance in the classic test. Females showed a trend towards longer TTF in the VR group (p=.06), however, no significant difference was seen across the two groups.

Despite evidence of an analgesic distraction mechanism in acute and experimental pain, the results in CLBP patients are equivocal with sparse evidence. Undoubtedly, changes in cognitive loading are not independent, and VR analgesia is suggested to originate from modulation of a pain matrix which amalgamates attention with emotion, memory and other senses [41]. Top down modulation of pain through distraction is probably insufficient to explain all neurobiological mechanisms of VR [31], and certainly inadequate to address the complex needs of CLBP patients [8].

Neuromodulation

Somatic disperception (incongruity between bodily perception and physical state) can occur in CLBP [51]. Sufferers show inaccuracy in illustrating their back, often with parts missing from their perception [52]. Disperception facilitates encoding of a persistent bodily representation as being under threat, and development of protective behaviours in response [53]. Indicative physical findings include poor visual recognition of back movements [54], reduced proprioception [55] and impaired tactile acuity [56]. The degree of distortion is associated with pain intensity and intervention to improve quantitative measures (such as two-point discrimination) can reduce pain [57].

Alongside self-reported back disperception [58], CLBP patients commonly hold maladaptive beliefs about the fragility of their back, contributing to pain and disability [59,60]. It is likely that body perception is a multi-level nervous system disturbance combining cortical reorganization [61,62] with abnormal peripheral integration of multi-sensory information [63]. Brain-focused interventions employing bodily illusions have been suggested to improve body perception and reduce pain [1,64]. Boesch et al. [65] provide a comprehensive review of bodily illusions in chronic pain. Whilst the associated research has methodological issues, evidence for bodily illusions on corticomotoneuronal activity shows consistent effects [66]. Body Illusions such as the rubber hand illusion[67] and mirror therapy [68,69] integrate proprioceptive, visual and motor feedback to alter neural encoding of a painful limb and provide a perception of agency to convince the subject their painful limb is healthy [64,70]. Although, practical constraints limit the use of MT in CLBP patients; an illusory perception of a healthy spine may be possible with VR [64].

Virtual reality and disperception

Two principles underpin the effect of VR on body disperception: observation and embodiment. Observing a body, in part or whole, which is perceived as one's own, can have analgesic effects [39] and perception of a virtual body as one's own can create a sense of identification with the avatar [71]. Embodiment is the perceptive illusion of "owning" a surrogate body [72]. The induction of a co-located virtual arm is seen in CRPS and peripheral nerve injury (PNI) through VR [72]. The computer scientist Jaron Lanier posited the theory of homoncular flexibility – the phenomenon of controlling virtual avatars using different degrees of freedom to the physical body [73]. Lanier's experiments showed embodiment can even be applied to novel avatars, such as controlling the limbs of virtual lobster bodies [74,75]. This highlights the potential for novel virtual body modification to alter perception of a painful back.

A proof-of-concept study evaluated the impact of 12 VR sensorimotor rehabilitation sessions over 4–6 weeks, on the restoration of body image in 20 subjects with CLBP [57]. The simulation reproduced exercise performance, to correct control of trunk movements by providing visual and audio feedback. Measures of pain, function, quality of life, cognitive function and sensorimotor output were used. VR-guided training met the minimal clinically important difference (MCID, −2.4) for significant improvement in pain reduction (numerical rating scale [NRS]) ($p<.001$); and the Roland Morris Disability Questionnaire ($p<.001$; MCID, 5 points) [76]. Significant improvements were observed in The Brief Pain Inventory ($p<.001$); McGill Pain Questionnaire ($p<.001$); improvements in the "physical functioning" subscale in the SF-36 correlated with NRS ($R=-0.521$, p=.047); and McGill Pain scores ($R=-0.550$, p=.034). Unfortunately, only 13 participants reported neuropsychological data and no intention-to-treat analysis was used. In summary, this VR intervention reduced pain, as well as providing physical, functional and neuropsychological benefits; potentially indicative of corticospinal reorganization. This may demonstrate a basis of reinforcement learning, facilitated by immediate feedback in VR [77].

Illusion modification

Visual feedback can also be augmented to enhance analgesic effect [64,78,79]. Virtual bodies can be modified for clinical benefit [1]; as seen in experiments with healthy participants where heat pain threshold changes by altering limb colour [80] or transparency [81]. In CRPS and PNI, Matamala-Gomez et al. [72] found that increasing limb transparency showed greater pain reduction in CRPS patients compared to PNI; suggesting the effect of modification may vary between pathologies. It is, therefore, likely that effects will vary across the heterogenous CLBP population in response to virtual body modification.

Another proof-of-concept study examined the impact of visual illusions which altered the size and muscularity of the back in two CLBP patients who reported pain on lifting [82]. Two subjects were recruited; one of which (participant A) had distorted back perception (evidenced by high scores on the Fremantle Back Awareness Questionnaire) [83]; as well as maladaptive beliefs about their back and severe pain intensity and disability. The other (participant B) had no back perception distortion, little maladaptive beliefs and mild pain and disability. The illusions used real-time video footage of the subjects' rear; observed using a HMD. Video was modified in real time, manipulating the shape of the back ("Re-shaped"; +25% wider shoulders and −25% narrower waist) or merging with an overlay of a muscled back ("Strong"; the same dimensional changes and a muscular overlay). Subjects performed a lift, observing their backs in two control conditions (Unedited and Reshaped), and one experimental condition (Strong). They then rated their perceived fear, back strength, confidence and pain intensity; and completed a modified embodiment questionnaire [84,85]. Participant A experienced high levels of embodiment of all conditions. Participant A also reported lower pain and fear; and strength and confidence were higher in the experimental condition, compared to controls. Thus indicating that the illusion shifted the subject's perception of his body during lifting, with reduced need for protection. Participant B, however, did not report embodiment of the Strong condition (only the control conditions) and reported minimal difference in outcomes across conditions. The authors suggest participant A had a greater underlying protective response (demonstrated by higher pain severity and fear scores) and this vulnerability led to a greater affective response. This demonstrates that modifying appearance of the back can change body perception to aid performance, but that effects may be limited to those with distorted perception and protective sensitivity.

Augmentation of observed movement can alter adverse neural encoding with back pain by disconfirming expectations of pain, and allowing the experience of usually painful movement, without pain [64]. For example, amplifying perception of performed movements so individuals are rewarded with a virtual experience where motion appears larger [73]. Conversely, experiments with neck pain sufferers used VR to make movement seem less than that performed, subsequently leading to pain reduction [86,87]. The Motor Offset Visual Illusion (MoOVI) facilitates augmented perceived movement in healthy subjects [64] by creating the illusion that a small real-world movement is experienced as a larger simulated movement. The researchers hypothesized that perceived neck movement would be influenced by modified visual–kinaesthetic feedback. The illusion provided a simulation of either less or more motion than that performed by the participant. 50° of cervical spine rotation was offset between 50% (half) and 200% (double). Twenty four healthy participants were recruited, exceeding the 80% power calculation. Each participant was exposed to the illusion at four different ranges (50%, 100%, 150% and 200%), and with three virtual conditions (first-person perspective vision, vision and sound, vision and sound and observation of an avatar). The results found that perception of head movement was dependent on visual–kinaesthetic feedback (p=.001) and systematically followed the virtual gain (degree of perceived rotation change); as found in the drift of hand perception during the RHI. Furthermore, visual suggestion alone is sufficient to facilitate this illusion as the drift was not altered by addition of sound or an avatar. This highlights the heavy weighting of visual information to influence perceived motion [88]. It proposes a basis of how simulation of augmented motion can facilitate patients to experience a simulation of pain-free movement exceeding current physical limitations. Thus disconfirming expectations of pain associated with movement and altering protective body disperception.

Virtual graded exposure therapy (VR-GET)

Associations between altered neural encoding and kinesiophobia are established [89]. CLBP patients can avoid activity, attenuate pain, however, subsequently suffer compensatory changes to spinal musculature increasing risk of chronicity [90]. This leads to hypervigilance to pain; greater fear and anxiety of painful movements; and further protective behavioural adaptations to activity. Consequently, the individual is more avoidant. VR may intervene and reduce fear avoidance; breaking this cycle of deconditioning and disability [1].

Traditional approaches in managing kinesiophobia have included GET, which promotes the transition from inactivity to functional restoration [89]. GET is a cognitive-behavioural intervention to reduce fear and disability [91]. It combines quotas of individualized hierarchies of feared movements; and positive reinforcement to minimize expectations of fear [89]; encouraging participation with activity despite pain [92,93]. Activity exposure aids correction of erroneous pain expectations and demonstrates clinical effectiveness in kinesiophobic CLBP sufferers [4,94,95]. Unfortunately, long-term outcomes following GET have been disappointing, reducing its clinical utility [96]. Other issues associated with GET include low levels of adherence and high drop-out, suggesting that it is not preferred by patients [97,98]. Often generalizability from clinic to the individual's home is limited [99]. Finally, kinesiophobic patients often develop subtle protective behaviours during activities to limit exposure to feared stimuli, which worsens pain [89]. These are all issues which VR may be able to influence to optimize exposure therapy.

VR-GET and CLBP

A systematic review [8] theorized that VR interventions combining psychological and behavioural factors may benefit chronic pain. VR-GET provides graded movement exposure within simulations of real-life activities; personalized to the needs of the individual [57]. Part of the suggested benefit is through attentional distraction to divert cognitive focus on pain on to the simulation [89]. However, distraction from fearful stimuli could be considered as avoidance itself [100], and the theoretical mechanism of VR-GET is likely through modification to augment the perception of movement. The adaptive nature of VR-GET can provide exposure to progressive challenge [101], and provide real-time feedback and reward to reinforce appropriate behaviour [102]. The manner GET is implemented in VR is difficult to achieve by traditional means [103]. The reducing costs and availability of VR enhance the accessibility and transfer into any environment, which can sustain patient motivation and adherence [104,105]. Integration of the intervention in practice allows patient and clinician the ability to monitor and influence progression [8].

Non-immersive VR

The Microsoft Kinect platform is a non-immersive VR system which is used to implement GET. Kinect scans the user's motion to control the display (rather than a controller). A Kinect-based protocol (GEXP-graded exposure *in vivo*) for the treatment of pain-related fear and avoidance has been developed [100]. The benefits of this system are adaptability (allowing non-experts to alter the simulation to the patient's needs); and the portability of the platform. The system allows uninhibited user movement which is important during exposure interventions [100] and is designed to incorporate in-game rewards to enhance user engagement. Non-immersive VR sacrifices immersion for interactivity; which may lead to greater naturalistic interaction and stronger phenomenological user experiences [100]. A final advantage is automated evaluation of psychological and physical metrics. It can, for example, record psychophysiological state through factors such as cognitive workload [106], task engagement [107] or stress [108]. Alternately, it can evaluate physical performance through activity parameters (e.g., performance velocity), or by measuring motor strategy alterations indicative of avoidant behaviours.

Kinect was used to examine the impact of VR-GET on fear and catastrophizing due to CLBP [109]. Thirty individuals with high levels of pain-related fear and disability were randomly assigned to control or VR groups where they were exposed to a progressive reaching task. The VR group viewed a virtual avatar corresponding to their movements on a large HD screen. Bivariate analysis demonstrated the VR group (compared to control) showed reduced association between fear and pain intensity; and higher degrees of acceptability of GET. This may indicate that VR-GET may have greater utility in CLBP patients compared to traditional GET, through the attenuation of fear associated with exposure to back-stressing tasks. Unfortunately, as this was published only as an abstract no further detail is available.

A similar optoelectric motion-sensing system was used for a proof-of-concept, randomized controlled trial examining the feasibility of VR-GET intervention with individuals with kinesiophobic CLBP [110]. The intervention consisted of a virtual dodgeball game where motion was increased by the height the balls were launched (5–10% increasing lumbar flexion). Ninety repetitions, between 25° and 60° flexion, were performed and observed on a large screen using 3D glasses. Fifty two participants were recruited (to ensure 80% power) and randomly allocated to the intervention group (3 consecutive days of dodgeball, 15 min sessions) or control (no intervention). Whilst all participants were given a cash payment prior to and at the end of the experiment, the intervention group's performance was rewarded through the game with cash incentives. Primary outcomes were pain and harm expectancy *via* visual analogue scales. Secondary outcomes included lumbar range of motion, and self-report questionnaires (Roland Morris Disability Questionnaire, McGill Pain Questionnaire, Tampa Scale of Kinesiophobia and State-Trait Anxiety Inventory). A further questionnaire explored participant experience. The results demonstrated the system encouraged CLBP sufferers to perform significantly greater lumbar flexion through manipulation of the virtual task. This occurred without increases in pain (both groups saw significant pain reduction) despite participants using more spinal flexion during the simulation to perform tasks which could have been achieved by squatting. This may demonstrate that VR assists individuals to transition to movement patterns learned prior to kinesiophobia developing. The trial also showed clinical implementation was feasible, as participants reported finding the game engaging ("I would be willing to play the game again"); would recommend it to others; and would like to continue independently ("I would play this game at home"). This shows non-immersive VR games can be effective, acceptable and could facilitate engagement with GET (even if it increases pain).

Immersive VR

The "Virtual immersive gaming to optimise recovery" (VIGOR) randomized controlled trial is a planned 5-year prospective examination of the effects of VR-guided GET on CLBP [89]. The immersive VR system uses a HMD, hand controllers and motion trackers, allowing control of an avatar. To address kinesiophobia, it encourages lumbar flexion during the game, and will examine both the clinical outcomes of the intervention and postulate mechanisms of action. The trial is statistically powered and will undertake an intention-to-treat analysis. The VR group will involve 18 visits over 9 weeks to play a game where players reach to a set of cubes at progressively greater degrees of flexion. The control group will be exposed to the same game with less flexion required. Immersion is enhanced through the addition of in-game 3D-audio stimuli. The trial aims to recruit 230 participants who suffer kinesiophobia. Primary outcomes will be pain and disability between baseline and 1-d post-intervention and associated expectations of pain and harm will be also examined. Treatment gains will be evaluated longer term, up to 48 weeks post-intervention. Whilst this study is not yet completed, it may provide stronger insight into the effectiveness of VR-GET for CLBP, and should be waited for in expectation. The enhanced immersion may provide GET with even greater potential to reduce pain-related fear of movement.

Implications for practice

Ethics

Recommendations for the ethical application of VR have been provided [111]. VR exposes individuals to a realistic, although false, environment. Control of experiential content has potential for mental and behavioural manipulation and lasting side effects. Clinicians using VR should be cautious of the effects of mispresentation of an individual's embodiment and change to self-perception. It is worth considering the unintended consequences of embodying a "stronger" back temporarily to an individual's well-being, and whether they may conform to behaviour which extends them beyond their physical capacity. Alternatively, does a return to their normal self-perception have a negative psychological effect? Screening of individuals with underlying psychiatric vulnerability [112] or depersonalization [113] should be undertaken and informed consent should include the potential of lasting effects explicitly. Additionally, privacy must remain paramount, particularly with the convergence of VR and social networks [114] to ensure patient data remains protected.

Clinical application

Identification of factors which relate to susceptibility to the kinaesthetic illusions of VR is essential. It may be that disorders with greater central nervous system involvement may show more effectiveness [46] or that response is altered dependent upon pain complexity [72]. Investigating sensitivity to the illusion would assist in predicting treatment efficacy. It is possible that treatment success is dependent upon various characteristics, including digital literacy or socioeconomic status [8].

Transfer to the non-clinical environment is probable with the increasing accessibility of VR, and device portability allows VR use outside hospital [31,115]. The application of VR in a community setting for an older population with chronic pain disorders shows both a general exercise (patient-guided) and a clinician-guided intervention were effective in significantly improving pain ($p<.05$) [116]. This shows promise for the use of VR for home-based care.

Although studies show benefits for pain reduction this remains speculative and further research is required to isolate the underlying mechanisms of VR analgesia [1]. Caution should be taken when using in clinical practice.

Conclusions

The analgesic benefits of VR for CLBP are underpinned by a small amount of clinical evidence. The therapeutic mechanisms remain unclear; however, it is possible that neuromodulatory effects are increasingly strengthened through greater immersion into simulated reality. It is still to be demonstrated whether immersive VR can provide benefits beyond those seen with passive distraction. VR-GET is a useful structure to employ the intervention, due to the inherent modifiability of the systems. Accessibility and cost may increasingly support transfer to practice, yet caution must guide clinical application due to ethical risks. Stratification of the CLBP population should guide who is appropriate for exposure to VR.

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