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REVIEW

Virtual reality used to distract children and young people with long-term conditions from pain or pruritus: A scoping review using PAGER

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Abstract

Aims and Objectives: To map out the primary research studies relating to how virtual reality (VR) has been used to distract children and young people with long-term conditions from pain or pruritus.

Background: Pharmacologic treatment of chronic pain and pruritus may have side effects; hence, non-invasive non-pharmacological treatments are being sought.

Design: The scoping review followed the methodology recommended by the Joanna Briggs Institute, PAGER framework and PRISMA-ScR checklist. The protocol was registered with the Open Science Registration on 14 February 2022 https//doi.org/10.17605/OSF.IO/K2R93.

Methods: Five databases (Medline, CINAHL, PsycINFO, Web of Science and Scopus) were searched. Data were extracted from primary research studies published between 2000 and 2022 involving children and adolescent populations (<21 years) with a long-term condition that had an element of enduring pruritus and/or pain.

Results: Of 464 abstracts screened, 35 full-text papers were assessed with 5 studies meeting the eligibility criteria. Three main themes emerged from the included studies: (1) Improvements in pain and daily functioning; (2) positive perceptions of VR and (3) accessibility and feasibility of VR. No papers were found on the effect of VR on alleviating pruritus.

Conclusion: VR is feasible, acceptable, and safe for children and adolescents with chronic pain in a range of long-term conditions and offers promise as an adjunctive treatment for improving chronic pain and quality of life. No studies were identified that targeted pruritis or measured pruritis outcomes; thus, the effects of VR for pruritis are unknown. There is a need for rigorously designed, randomised controlled trials to test the clinical and cost-effectiveness of VR interventions for chronic pain and pruritis in children and adolescents. The use of the PAGER (Patterns, Advances,

Gaps, Evidence for Practice and Research Recommendations) framework for scoping reviews helped to structure analysis and findings and identify research gaps.
Relevance to Clinical Practice: VR interventions offer promise in improving chronic pain related to long-term conditions.

KEYWORDS
children's nursing, chronic itch, chronic pain, digital health, non-pharmacological, virtual reality

1 | BACKGROUND

Chronic pain and chronic pruritis (or itch) are debilitating symptoms that profoundly impact quality of life. Both signal potential harm to the body (Anzelc & Burkhart, 2020) and are multidimensional, involving emotions, mood, consciousness, attentiveness, and personal sensory discrimination (Liu & Ji, 2013). While closely related, they are distinct sensations (Ji, 2015; Liu & Ji, 2013); for example, pain suppresses itch, while analgesics such as morphine can provoke itch (Ji, 2015). In chronic conditions, pain and itch appear to have many similarities, sharing mechanisms of action (Ji, 2015) and potential treatment modalities, including psychological approaches (Anzelc & Burkhart, 2020).

Chronic pain is defined as persistent pain, or pain lasting longer than 3 months, and can have a profound impact on children and adolescents (Treede et al., 2015). According to the 11th International Classification of Diseases (ICD-11), chronic pain can be classified into seven categories: primary, cancer-related, post-traumatic and post-surgical, neuropathic, visceral, musculoskeletal and headache/orofacial (Treede et al., 2015). Hence, chronic pain in children can be caused by a range of factors and conditions, including conditions with intermittent flares as well as conditions that could lead to increasing pain over time (e.g. cancer). If this pain is poorly managed then children and young people are at increased risk for depression and anxiety, social isolation, and poorer quality of life (Tutelman et al., 2021). Chronic pain impacts 15%–25% of school-aged children (Vervoort et al., 2014), particularly girls and is on the increase (Miró et al., 2023). Approximately 5% of children with chronic pain experience severe levels of pain which significantly impact their daily functioning (Fisher et al., 2019; Huguet & Miró, 2008). Recent research has focused on the development of effective distraction methods for pain management in children and young people, which may easily be integrated into nursing care (Comparcini et al., 2023). These pain coping strategies have included the use of music, massage, breathing exercises, hypnosis, behavioural therapy, mindful attention, distraction and guided imagery (Comparcini et al., 2023; Lovas et al., 2017).

Chronic pruritus is defined as an itch persisting for more than 6 weeks and is characteristic of several dermatological diseases such as atopic eczema lichen planus and scabies (Yosipovitch & Bernhard, 2013). It is associated with reduced quality of life and can be as debilitating as chronic pain. Non-pharmacological types of therapy are increasingly being used for long-term conditions such as pruritus because of their complex neuroendocrine and psychological aspects (Leibovici et al., 2009). Pharmacologic treatment of chronic pain associated with long-term conditions may have side effects and contraindications (Chou et al., 2015). Hence, the use of non-invasive, non-pharmacological treatment is being sought.

What does this paper contribute to the wider global clinical community?

- VR is feasible and acceptable for children and adolescents with chronic pain and may lead to improvements in pain, daily functioning, and quality of life.
- VR interventions, in a range of settings (including inpatient, outpatient and the home) offer promise not only in improving chronic pain, but also may be associated with improvements in daily functioning, better movement, and disease-related quality of life.
- Well-designed RCTs of VR interventions to support the alleviation of chronic pain and pruritis in children and adolescents with long-term conditions are needed.

Virtual reality (VR) has been introduced to distract patients from distressing symptoms caused by long-term conditions such as pruritus (Leibovici et al., 2009). VR displaces a person to an imaginary location, physically blocking out the real world and replacing it with a computer-generated world, focusing attention, with immersion as the goal (Brigham, 2017). Immersive VR is the presentation of an artificial environment replacing users' real-world surroundings. This is usually achieved using a head-mounted display or, what is known as, a cave automatic virtual environment system (an immersive virtual reality environment where projectors are directed to between three and six of the walls of a room-sized cube) (Qiao et al., 2023). Non-immersive virtual reality provides a window into a virtual world that is displayed on a computer screen (Qiao et al., 2023).

Virtual reality (VR) is helpful as a distraction in the context of acute and procedural pain in patients (Dreesmann et al., 2022; Ridout et al., 2021; Scapin et al., 2018). However, a recent Cochrane review (Lambert et al., 2020) concluded that the evidence of the effectiveness of VR distraction for acute pain in children was of low-certainty with only a small number of studies and noted the need for well-designed trials. A systematic review of VR for pain,

anxiety, and fear in paediatric cancer patients reported improvements but noted that larger, more rigorously conducted, studies are needed. (Cheng et al., 2022).

While the use of VR for distraction from acute pain in adult patients is well-established, there are fewer studies of VR for the alleviation of chronic pain. A systematic review by Goudman et al. (2022) highlighted the potential application of VR to chronic pain. Since both chronic pain and chronic pruritis can be triggered from the same receptive neurological fields in the skin (Sharif et al., 2020), we hypothesise that VR could be used to provide distraction from unpleasant symptoms of either pruritus or pain, such as those caused by eczema (Harper et al., 2022). Two small studies have explored the use of VR for pruritis in adults (Baschong et al., 2021; Leibovici et al., 2009) with promising preliminary findings. The focus of this scoping review is on the use of VR to distract from chronic pain and/or pruritis in children and adolescents.

2 | METHODS

This scoping review was conducted according to the checklist for Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA-ScR) extension for Scoping reviews (Tricco et al., 2018) to enhance the quality of reporting, following the five-stage protocol methodology developed by Arksey and O'Malley (2005), this has been included (File S1). The latter was further enhanced by using the PAGER framework (Pattern, Advances, Gaps, Evidence for Practice and Research Recommendations) (Bradbury-Jones et al., 2022). This scoping review followed a protocol developed by the authors and has been registered on the Open Science Framework.

2.1 | Stage 1: Review questions

Guided by the evidence the following specific review questions were proposed:

1. What VR interventions have been used to distract children and adolescents from pain and pruritis caused by long-term conditions?
2. What is the evidence for acceptability, feasibility, and effectiveness?
3. For identified studies using controlled designs, what controls/comparators were used?

2.2 | Stage 2: Search strategy

As recommended by the Joanna Briggs Institute, keywords and phrases were identified before database searches, to return a comprehensive and targeted search (Peters et al., 2020). https://onlinelibrary.wiley.com/doi/10.1111/jocn.16630. Following a pilot search, the search terms were modified. We searched the following databases: Medline, CINAHL, PsycINFO, Web of Science and Scopus. The full search strategy is provided in Appendix 1. Handsearching was performed using Google Scholar and reference lists of the selected articles were searched. In addition, we searched the trial registry ClinicalTrials.gov.

2.3 | Stage 3: Study selection

Inclusion and exclusion criteria for literature selection were developed and revised by the research team. The inclusion and exclusion criteria are shown in Table 1.

Individual databases were searched using slightly modified search terms. The obtained results were exported to the bibliographic software EndNote 20, where duplicates were removed. After this step, the remaining studies were exported to Covidence™ software for primary screening of the study results. Two independent reviewers (PM and HS) first conducted title and abstract screening, according to the inclusion and exclusion criteria, to select studies for full-text review. Next, the full texts of the selected articles were read and screened for eligibility. In cases where the two authors failed to

TABLE 1 Inclusion and exclusion criteria.

	Inclusion criteria	Exclusion criteria
Population	Children and adolescents aged up to 21 years with any long-term conditions that had an element of enduring pruritus and/or pain.	
Year of publication	Year 2000 onwards as there was little research involving the use of VR for long-term conditions prior to 2000.	
Context	Chronic pruritus and chronic pain as those symptoms lasting for more than 6 weeks and 3 months, respectively.	VR used for education, acute or procedural pain or perioperative or peri-investigational phases of care were excluded.
Concept	Therapeutic or psychological interventions for pruritus or pain that were VR based, including those used for distraction	Interventions for mental health conditions including depression; neurodevelopmental conditions including ADHD and autistic spectrum disorder
Study design	Published peer reviewed primary research studies encompassing a mix of designs (qualitative, pilot, experimental, quasi-experimental, and randomised controlled trials).	Secondary review studies, abstract-only journals, editorials, letters, commentaries, conference proceedings, poster presentations

reach a consensus, a third author (EAC) was consulted and there was a discussion between authors until a consensus was reached.

2.4 | Stage 4: Charting data

The included articles in the scoping review were charted (by PM) using a data extraction tool developed by the authors. The charted data included specific details about authors, year of publication, title of paper, country where research was undertaken, study population, study design, sample size, type of intervention, intervention delivery mechanism, comparator (if applicable), outcome measures used for pain/pruritus, results, and conclusions.

Quality assessment of the selected articles was completed using the Joanna Brigg's Institute (JBI) Critical Appraisal Tools (Briggs, 2014) by two independent reviewers (PM and HS). PM conducted a quality appraisal of all the selected studies and HS performed a quality appraisal for one-third of these. We had to deviate from our original protocol and used the JBI critical appraisal tool rather than the Critical Appraisal Skills Programme (CASP) tool because all included studies were non-randomised, which is not covered by the CASP checklist.

2.5 | Stage 5: Collating, summarising and reporting results

In the next stage, data synthesis and analysis were performed narratively by grouping and summarising the results based on themes according to stage five of Arksey and O′Malley's framework (i.e. collating, summarising, and reporting the results). The PAGER framework (Bradbury-Jones et al., 2022) was used to achieve a comprehensive analytic description and critique of the literature and to strengthen reporting of stage five of Arksey and O'Malley (2005).

2.6 | Stage 6: Consultation: Patient and public involvement

The review design included patient and public involvement (PPI) to provide valuable insights and positively impact research priorities. A PPI advocate (AR), who had lived experience of pruritus, was invited to join the research team and agreed to participate in the development of the study's protocol, review questions, and discussion of the findings.

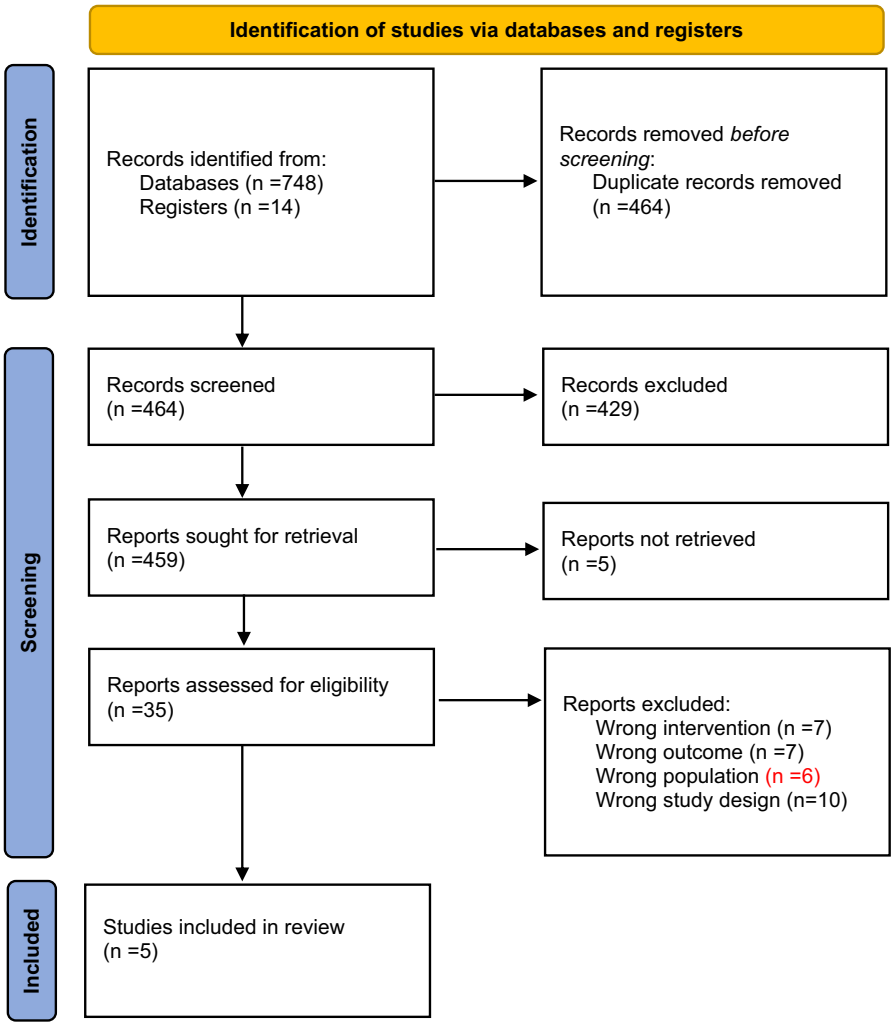

FIGURE 1 PRISMA diagram. [Colour figure can be viewed at wileyonlinelibrary.com]

3 | RESULTS

A total of 748 articles were identified by searching the five databases in 2022. An additional 14 articles were identified via hand-searching. From these 762 articles, 307 duplicates were removed using EndNote and Covidence. The remaining 464 articles were screened based on title and abstract, following which 35 were selected for full-text review. The study selection process for the included studies is outlined in the PRISMA-ScR flow diagram in Figure 1. articles were screened based on title and abstract, following which 35 were selected for full text review. The study selection process for the included studies is outlined in the PRISMA-ScR flow diagram in Figure 1.

3.1 | Characteristics of included studies

The five included studies were published between 2000 and 2022, with four studies from the USA (Agarwal et al., 2017; Griffin et al., 2020; Won et al., 2015; Wren et al., 2021), and one from Israel (Shiri et al., 2013). Regarding study design, all were non-randomised, pilot, feasibility, or proof-of-concept studies. No studies had a control group. We did not find any examples of published VR used to distract from scratching because of pruritus. This is important as pruritus is a key symptom of childhood eczema and, as such, remains a key area for further investigation.

All studies included children and young people with chronic pain, arising from a variety of clinical conditions, including inflammatory bowel disease (Wren et al., 2021), sickle cell disease (Agarwal et al., 2017), chronic headache (Shiri et al., 2013), complex regional pain syndrome (CPRS) (Won et al., 2015), and mixed conditions causing chronic pain (Griffin et al., 2020). Sample sizes varied from four (Won et al., 2015) to sixty-two (Wren et al., 2021). The interventions used in the selected studies included: immersive VR (Agarwal et al., 2017; Griffin et al., 2020; Won et al., 2015; Wren et al., 2021;) and non-immersive VR (Shiri et al., 2013). Characteristics of the included studies are summarised in Table 2.

3.2 | PAGER framework analysis

Three different patterns (improvement in pain and daily function, positive perceptions of VR and the accessibility and feasibility of the intervention) were identified through the analysis using the PAGER framework (Table 3).

Concerning 'Improvements in pain and daily function', positive associations with improvements in pain (Wren et al., 2021), anxiety/fear/avoidance (Griffin et al., 2020; Wren et al., 2021), quality of life (Shiri et al., 2013) and daily/physical functioning (Griffin et al., 2020) were reported.

Relating to 'Perceptions of VR', participants found the VR interventions to be safe, fun, and enjoyable. (Griffin et al., 2020; Won et al., 2015; Wren et al., 2021). They had a strong desire to use VR again when in pain (Agarwal et al., 2017; Won et al., 2015).

Finally, relating to the 'Accessibility and feasibility' of VR as an additional approach to managing chronic pain, the immersive VR interventions used in four studies were feasible, acceptable and comfortable (Agarwal et al., 2017; Griffin et al., 2020; Won et al., 2015; Wren et al., 2021) In terms of adverse events, only 5/122 participants experienced adverse events (four dizziness-Agarwal et al., 2017; Griffin et al., 2020; Wren et al., 2021) one of whom also had photophobia (Agarwal et al., 2017) and anxiety (Wren et al., 2021). Griffin et al. (2020) reported that one participant felt 'trapped' and out of control when wearing the VR headset during an initial first session and so delivery of VR was switched to wall projection instead. They noted that two patients reported feeling 'dizzy' or 'weird' after sessions. However, one of these patients had a headache before participating in the VR session. One patient reported that the headset was too heavy.

Lightweight VR headsets including those that use patients' mobile phones are now available, which allays concerns reported by Griffin et al. (2020) around headsets being too heavy for smaller children. Such headsets can also be taken off the face easily at any time if patients feel claustrophobic.

4 | DISCUSSION

VR was found to be acceptable in the five included studies and satisfaction levels were high. Thus, VR is promising as an adjunctive treatment to help manage chronic pain in children and young people. In addition to improvements in pain, the use of VR was positively associated with improvements in movement, daily function, and quality of life.

VR has been used with growing frequency to manage acute and procedural pain in adults (Dreesmann et al., 2022; Scheffler et al., 2017), but has been used less frequently for chronic pain in adults (Goudman et al., 2022) and, as this scoping review shows, less still for chronic pain in children and adolescents. We did not identify any studies using VR for chronic pruritus in children and adolescents, and to our knowledge, only two studies have explored its use in adults (Baschong et al., 2021; Leibovici et al., 2009). This scoping review outlines the current state of play of the literature for using VR for children with chronic pain or pruritus. VR could be particularly relevant as a treatment option for children because it is fun, engaging, and can be made age appropriate. Using VR in the home would mean children can access additional pruritus management on a regular basis, in between appointments with a healthcare professional, and it offers a more compelling distraction at the point of need, as an alternative to additional medication. Hence, it is a promising adjunctive intervention for future chronic pain management for children and adolescents.

Our review highlights the high acceptability and feasibility of VR interventions for children and young people with chronic pain. Patients perceived the VR interventions to be 'cool', 'enjoyable', and 'fun' suggesting engagement. Similar levels of acceptability for VR were reported in an Australian pilot RCT comparing VR

TABLE 2 Characteristics of included studies ($n=5$).

Study No.	Author and year	Country	Method/design	Study population and no. of participants	Intervention and comparator if applicable	Intervention delivery mechanism	Outcome measures	Results
1	Wren et al., 2021	USA	Pilot feasibility & acceptability study	62 children to young adults with inflammatory bowel disease	6-min guided mindfulness based virtual reality application ('MediMindfulness-Transitions') delivered via a VR headset. This included a description and rationale of mindfulness, practical suggestions, guidance on breath and physical sensations. The mindfulness scene was a peaceful meadow with a waterfall and butterfly.	Relaxation	Measuring level of anxiety and pain using a 100 mm visual analogue scale (VAS) pre and post intervention. Pain intensity was measured with a 0–100 mm VAS. Participants were asked to indicate their level of pain intensity by marking along a 100 mm line (0 = no pain, 100 = worst pain).	**Qualitative**–Participants reported a significant decrease in pain post-intervention. **Quantitative**–Qualitative findings highlighted that participant found MBVR relaxing, calming, and soothing leading to less anxiety, stress and pain post intervention. The themes identified were: (i) found MBVR enjoyable and relaxing; (ii) would like to use MBVR in a variety of clinical settings; (iii) would like more access to MBVR in their daily lives
2	Griffin et al., 2020	USA	Pilot feasibility study	17 paediatric patients enrolled in an intensive interdisciplinary program (IIPT)	30-min virtual reality (VR) incorporated into the patient's IIPT schedule. The intervention was 'Fruity Feet' involving a farm setting where players have to stomp and kick as many virtual fruits as they can before a timer runs out. There was a range of game modes including the use of upper extremities as well as lower.	Immersion and distraction	The Child Daily Questionnaire consisting of 13 items assessing pain and functioning in the last 24 h. Eleven items were pain-related. These items are derived from validated full-version measures. The 11 items are rated on a 100-point Visual Analogue Scale (VAS) ranging from 'strongly disagree' to 'strongly agree'. Item 12 assessed current pain felt in the last 24 h on a numeric scale of 0 (no pain) to 10 (worst pain)	**Quantitative**–The multi-session daily reports (based on $n=8$) indicated decreased pain, fear, avoidance and functional impairments across VR sessions. **Qualitative**–The participants enjoyed the VR sessions; felt distracted from pain while engaged in the VR task; VR increased duration of sessions that could be tolerated, increased physical function/movement; and reduced pain behaviours/symptoms. Patients felt ownership and control over their avatar during sessions. One patient felt 'trapped' and out of control in the first session while wearing the VR headset. Subsequent sessions used wall projection rather than a VR headset. Two patients reported feeling 'dizzy' or 'weird' after sessions. One of these had had a headache prior to commencing the session. One patient reported finding the headset heavy.
3	Agarwal et al., 2017	USA	Feasibility study	30 consecutive patients with sickle cell disease admitted to a children's hospital for vaso-occlusive episodes	15-min VR session VR involved an underwater world called 'Aqua' in which participants could explore underwater objects and interact with underwater creatures using an Oculus Rift VR headset. Participants could look for treasure and feed the creatures. Staff were trained how to use the VR headset and Aqua software as well as how to clean the headset.	Immersion and distraction	Safety and acceptability were evaluated with a brief survey before and after the session. Pain was evaluated utilising the validated Adolescent Paediatric Pain tool (APPT).	**Quantitative**–(1) Patients had significant improvement in all aspects of the APPT after the 15-min VR session. (2) There was decrease in median pain intensity, median number of affected body areas. (3) The median percentage of all qualitative measures as well as individual qualitative pain domains was statistically decreased. **Qualitative**–The patients were satisfied, and the VR was acceptable. The VR headset and software were comfortable. The patients wanted to use the VR again at clinic and at home. The participants found the VR game to be fun, relaxing and immersive.

TABLE 2 (Continued)

Study No.	Author and year	Country	Method/design	Study population and no. of participants	Intervention and comparator if applicable	Intervention delivery mechanism	Outcome measures	Results
4	Shiri et al., 2013	Israel	Prospective single-arm open-label pilot study	10 children with chronic headache	Up to 30 min VR biofeedback for 10 sessions involving photograph-based images of the user acquired during an introductory meeting shown on a desktop computer. Images showed different facial expressions (happy, neutral, agony etc.) and were integrated with a pain score. During sessions patients looked at the screen and tried to relax as it showed a virtual representation of their pain. They were led from a painful state to a pain-free state using galvanic skin response data.	Relaxation	The patient's pain was measured using a VAS to report the average pain level over the past week, as well as the level of functional limitation imposed by the pain attacks. Data were collected prior to the intervention, immediately following its completion, 1 month later, and at 3 months follow-up.	**Quantitative**–(1) The values of the VAS declined from the pre-test to the post-test and to the final follow-up. A Wilcoxon signed-rank test showed a significant pre-post improvement for the question 'To what extent does your headache limit your daily function?'. It approached significance for the question 'On average how severe was your headache during the previous week?'. (2) The Friedman nonparametric test for related samples suggested improvements for both VAS ratings persisted beyond the duration of the intervention (analysis included four time points—pre, post treatment and 1-month and 3-months post-treatment). **Qualitative**–Children were satisfied with their experience and found the treatment helpful to the degree that they would recommend to others. One patient withdrew after six sessions due to feeling disappointed with progress. Seven patients reported high levels of satisfaction and two provided low-ratings.
5	Won et al., 2015	USA	Proof-of-concept	Four adolescents with complex regional pain syndrome who were receiving concurrent multidisciplinary therapy including physical and occupational therapy, psychological support and medical visits.	Six successive sessions of immersive VR therapy given for 5-min Participants wore a virtual headset and completed target hitting tasks via an avatar (popping balloons) using their lower limbs (i.e. kicking the leg upwards from a seated position). Haptic and audio feedback was provided. In Study 1 ($n = 2$) participants' legs controlled the avatar's legs and in Study 2 ($n = 2$) participants' legs controlled the avatar's arms.	Immersion	Movements of injured leg during VR session and average distance moved as logged by tracking data	**Quantitative**–(1) No complaints of pain, tolerated the therapy well, actively moved the affected extremity during 5-min VR session in 3 out of 4 participants. (2) Whereas the physical therapy sessions lasted for 30–60 min but the subjects were active only for 2–3 min before wincing, complaining of pain or needing to rest during individual exercises. (3) The participants completed 96% of the requested activities **Qualitative**–The qualitative finding responses were positive and described the game as cool, interesting, motivating and fun.

TABLE 3 Analysis using PAGER framework.

Theme	Pattern and advances	Gaps identified	Evidence for practice	Research recommendations
Improvement in pain and daily functioning	• Use of VR associated with improvements in pain (Wren et al., 2021) anxiety/fear/avoidance (Griffin et al., 2020; Wren et al., 2021), quality of life (Shiri et al., 2013), and daily/physical functioning (Griffin et al., 2020) were reported post-VR intervention. VR intervention was used in rehabilitation as adjunct treatment for the condition that led to hospitalisation (Agarwal et al., Agarwal et al., 2017; Griffin et al., 2020; Won et al., 2015).	• Small sample sizes and variability in study participants. • Lack of longer term follow-up	VR has been suggested as an adjunct therapy to help manage pain in hospital patients and to treat conditions such as chronic headache in children (Shiri et al., 2013).	There is a need for well-conducted fully powered trials with longer term follow-up.
Positive perceptions of VR:	• Overall, the VR interventions used in the studies had a positive influence on participants and they found the approach flexible. • Participants found the VR intervention safe, fun, and enjoyable. (Griffin et al., 2020; Won et al., 2015; Wren et al., 2021) and relaxing and soothing (Wren et al., 2021). • Participants were highly satisfied and wanted to use VR again (Agarwal et al., 2017, Griffin et al., 2020, Shiri et al., 2013).	• Duration of the VR interventions varied from 5 min (Won et al., 2015) to 30 min (Griffin et al., 2020) with a mean duration of 23 min. • The number of sessions delivered varied from one (Agarwal et al., 2017; Wren et al., 2021) to ten (Shiri et al., 2013), with a mean of two sessions.	Patients had a strong desire to use VR again when in pain (Agarwal et al., 2017; Won et al., 2015) and were interested in using VR in the home (Agarwal et al., 2017).	Further research should evaluate service user perceptions around optimal VR delivery and dose required to achieve short- and long-term effects and satisfaction among paediatric populations.
Accessibility and feasibility	• Overall, immersive VR interventions (used in 4/5 studies) were found to be safe, feasible, acceptable and comfortable (Agarwal et al., 2017; Griffin et al., 2020; Won et al., 2015; Wren et al., 2021). However, in the Griffin et al. (2020) study one patient reporting feeling 'trapped' and 'out of control' when using the VR headset and delivery modality was changed to wall projection. Two patients reported feeling 'dizzy' or 'weird'. One of these had a headache prior to participating in the session. One patient reported finding the headset too heavy. • Participants expressed interest in continuing to use the VR intervention, both in the clinical setting (Wren et al., 2021) and at home (Agarwal et al., 2017).	• The treatment occurred alongside other multidisciplinary therapies (Griffin et al., 2020; Won et al., 2015; Wren et al., 2021), therefore improvements cannot be wholly attributed to VR. • The expensive equipment, staffing and space constraints may also limit the adoption of and access to VR (Griffin et al., 2020).	The four participants in Won et al. (2015) reported becoming so engaged with the VR treatment that they remained distracted enough to forget their pain for periods of time; they further reported enjoying their treatment session.	• VR interventions need to be conducted and tested in a variety of medical settings to determine their accessibility. • Immersive VR headsets can be claustrophobic and/or too hot for some users. This area requires further investigation and intervention development.

with traditional cognitive behavioural therapy to improve emotional well-being in children and adolescents hospitalised with cancer (Tennant et al., 2020). The VR technology in question used a 360° video viewed via a headset. It was well-received and strongly endorsed by healthcare professionals, caregivers and patients. Patients rated the video high on feasibility of use, immersion, and sense of reality were keen to use VR in the future and would recommend it to others. Such high levels of acceptability and feasibility suggest that VR has the potential to make a significant contribution to children and young people's enjoyment of hospital stays, leading to increased satisfaction from both children and their parents.

Findings from this scoping review suggest that the potential application of VR could extend beyond the hospital to outpatient and home settings. As noted by Birckhead et al. (2021), using VR in the home for the management of chronic conditions could reduce the need to travel to the clinic or hospital and could reduce barriers related to scheduling and staffing. This shift to self-management also has significant implications for cost-effectiveness, and in potential reductions in medications prescribed.

Our first two review questions related to the types of VR interventions that have been used and their acceptability, feasibility, and effectiveness. In this scoping review, we have identified a range of VR interventions that have been used for distraction from chronic pain in children and adolescents. Despite the small sample sizes and preliminary and heterogenic nature of the included studies, the evidence suggests that such interventions are appropriate in this group and may be associated with benefits in terms of pain and quality of life.

The final review question related to what kinds of controls or comparators have been used. As we did not identify any controlled studies, we were unable to gain insights from the included studies in this scoping review. In the wider literature active distraction controls for chronic pain have included watching a video on an iPad (Hundert et al., 2022), playing a video game (Wohlheiter & Dahlquist, 2013), and using toys, mobile phones and books (Armstrong et al., 2022). Possible active distraction controls for pruritis could include toys for example, fidget spinners, and audio-visual or music/imagery distraction (Leibovici et al., 2009). Controlled studies are needed to determine the efficacy and effectiveness of VR relative to current best practice.

Overall, this review demonstrates that VR is feasible and acceptable for children and adolescents with chronic pain and may lead to improvements in pain, daily functioning, and quality of life. Immersive VR was received positively in the four studies in which it was used and found to be safe and acceptable. However, the studies in this review were all non-randomised, pilot, feasibility, or proof-of-concept studies, not intended or powered to determine efficacy or effectiveness. Future fully powered, rigorously designed trials are therefore needed to assess the clinical and cost-effectiveness of VR for chronic pain and pruritus in children, to enable implementation in clinic settings. Future research should also evaluate optimal dose and service user satisfaction and preferences for delivery modality.

5 | LIMITATIONS

Five papers were identified for inclusion in the analysis. Sample sizes of the included studies were small; for more robust studies in the future, larger sample sizes will be required. A wider limitation was the heterogeneity both in the types of VR described in the included studies and the outcome measures that were used for estimating pain.

6 | CONCLUSION

This is the first scoping review of virtual reality used to distract children and young people with long-term conditions from pain or pruritus. It revealed that VR interventions may be useful in improving chronic pain related to different long-term conditions and may help to support improvements in daily functioning, movement, and disease-related quality of life. The focus of VR chronic pain-related studies in children and adolescents was on feasibility and acceptability (review question 2) rather than efficacy or effectiveness. The high-acceptability and feasibility of VR in the identified studies warrant further research. Testing such interventions in settings other than hospitals is also needed. Well-designed, rigorously conducted RCTs with longer-term follow-up and embedded process evaluations are much needed. It will be important to work closely with patients and public contributors when designing and planning such studies.

7 | RELEVANCE TO CLINICAL PRACTICE

Implementation and scale of VR devices requires operational adjustments; however, the papers do not point to these as a significant barrier to use. The technicalities can be addressed by IT workers already in post, with the more regular queries such as logging in and connecting to Wi-Fi. Typical familiarisation training is around 2 h as newer VR headsets are relatively intuitive and straightforward to use. Nursing staff can support patients using VR by ensuring the headset and haptic controllers (used by the hands) have been cleaned between use; ensuring patients know what to expect (including possible side-effects, such as potential headaches, though uncommon), and ensuring the environment is suitable and comfortable (e.g. a cool environment for patients with conditions aggravated by heat (such as pruritis) and with adequate space to move around and seating, as required).

In home use of VR would provide a convenient, portable, and accessible distraction from pain. The price of VR headsets has gone down in recent years with prices currently range from around $8 for a headset that combines with the users' cellular phone, to a standalone wireless headset, for example the Meta Quest$^{2™}$ costing $450. As a result, many hospitals own several headsets, and they are being used by simulation teams globally; and as the price decrease, use across a wider range of homes becomes increasing possible. The digital healthcare agenda that is transforming ways

in which health professionals working with their service users is fast moving, and papers such as this are early identifiers of potential trends.

AUTHOR CONTRIBUTIONS

All authors were involved in conceptualization and funding acquisition. Preeti Mahato, Heidi Singleton, Emily Arden-Close, Sarah Thomas, Steven Ersser, and Debbie Holley were involved in formal analysis. Heidi Singleton, Preeti Mahato, Emily Arden-Close, Sarah Thomas, and Debbie Holley were involved in investigation. Heidi Singleton and Preeti Mahato were involved in project administration. Heidi Singleton, Sarah Thomas, Steven Ersser, Emily Arden-Close, and Debbie Holley were involved in supervision. Steven Ersser, Sarah Thomas, and Emily Arden-Close were involved in validation. Heidi Singleton and Preeti Mahato were involved in visualisation. Preeti Mahato and Heidi Singleton were involved in writing—original draft preparation. Heidi Singleton, Preeti Mahato, Sarah Thomas, Steven Ersser, Emily Arden-Close, Debbie Holley, and Amanda Roberts were involved in writing—review & editing.

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CONFLICT OF INTEREST STATEMENT

The authors declare they have no potential conflict of interest with respect to the research, authorship and/or publication of this article.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are openly available in Boarder at https://bordar.bournemouth.ac.uk/cgi/users/home.

PATIENT OR PUBLIC CONTRIBUTION

A PPI advocate participated in the development of the study's protocol, review questions, and discussion of the findings.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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APPENDIX 1

Search strategy.

Database	Search strategy
Medline	TI (CHILD* OR ADOLESCEN* OR YOUTH* OR "YOUNG PERSON" OR TEEN* OR PAEDIATRIC* OR PEDIATRIC*) OR AB (CHILD* OR ADOLESCEN* OR YOUTH* OR "YOUNG PERSON" OR TEEN* OR PAEDIATRIC* OR PEDIATRIC*) AND TI (PAIN* OR PRURIT?S OR ITCH* OR SCRATCH* OR ECZEMA "ATOPIC DERMATITIS" OR AD) OR AB (PAIN* OR PRURIT?S OR ITCH* OR SCRATCH* OR ECZEMA OR "ATOPIC DERMATITIS" OR AD) AND TI (VR OR "VIRTUAL REALITY") OR AB (VR OR "VIRTUAL REALITY")
CINAHL	TI (CHILD* OR ADOLESCEN* OR YOUTH* OR "YOUNG PERSON" OR TEEN* OR PAEDIATRIC* OR PEDIATRIC*) OR AB (CHILD* OR ADOLESCEN* OR YOUTH* OR "YOUNG PERSON" OR TEEN* OR PAEDIATRIC* OR PEDIATRIC*) AND TI (PAIN* OR PRURIT?S OR ITCH* OR SCRATCH* OR ECZEMA "ATOPIC DERMATITIS" OR AD) OR AB (PAIN* OR PRURIT?S OR ITCH* OR SCRATCH* OR ECZEMA OR "ATOPIC DERMATITIS" OR AD) AND TI (VR OR "VIRTUAL REALITY") OR AB (VR OR "VIRTUAL REALITY")
PsychInfo	TI (CHILD* OR ADOLESCEN* OR YOUTH* OR "YOUNG PERSON" OR TEEN* OR PAEDIATRIC* OR PEDIATRIC*) OR AB (CHILD* OR ADOLESCEN* OR YOUTH* OR "YOUNG PERSON" OR TEEN* OR PAEDIATRIC* OR PEDIATRIC*) AND TI (PAIN* OR PRURIT?S OR ITCH* OR SCRATCH* OR ECZEMA "ATOPIC DERMATITIS" OR AD) OR AB (PAIN* OR PRURIT?S OR ITCH* OR SCRATCH* OR ECZEMA OR "ATOPIC DERMATITIS" OR AD) AND TI (VR OR "VIRTUAL REALITY") OR AB (VR OR "VIRTUAL REALITY")
Web of Science (topic search)	((TS=((CHILD* OR ADOLESCEN* OR YOUTH* OR "YOUNG PERSON" OR TEEN* OR PAEDIATRIC* OR PEDIATRIC*))) AND TS=((PAIN* OR PRURIT?S OR ITCH* OR SCRATCH* OR ECZEMA "ATOPIC DERMATITIS" OR AD))) AND TS=((VR OR "VIRTUAL REALITY"))
Cochrane library (title, abstract, keyword)	((CHILD* OR ADOLESCEN* OR YOUTH* OR "YOUNG PERSON" OR TEEN* OR PAEDIATRIC* OR PEDIATRIC*)):ti,ab,kw AND ((PAIN* OR PRURIT?S OR ITCH* OR SCRATCH* OR ECZEMA "ATOPIC DERMATITIS" OR AD)):ti,ab,kw AND ((VR OR "VIRTUAL REALITY")):ti,ab,kw
Scopus	(TITLE-ABS-KEY ((*child** OR *adolescen** OR *youth** OR *"YOUNG PERSON"* OR *teen** OR *paediatric** OR *pediatric**)) AND TITLE-ABS-KEY ((*pain** OR *prurit?s* OR *itch** OR *scratch** OR *eczema "ATOPIC DERMATITIS"* OR *ad*)) AND TITLE-ABS-KEY ((VR OR *"VIRTUAL REALITY"*)))