

Virtual Reality used to distract eczematous children from distressing symptoms: a pilot evaluation

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Abstract/Summary

Background

Atopic dermatitis (AD) is a debilitating disease with high disease burden. Virtual Reality (VR) could be used as a more sophisticated and immersive version of guided imagery to manage AD.

Aim

To co-create and evaluate prototypes for immersive and non-immersive VR software designed to distract eczematous children from their pruritis.

Methods

Through an online survey and online semi-structured interviews, children codesigned VR games and a 360 video with software developers, which they evaluated by completing the Children's Dermatology Life Quality Index cartoon questionnaire (n=4) and a usability questionnaire (n=10).

Results

Children accessed the VR software using a fully immersive Oculus Quest² headset. All children felt their skin was less affected both during and after playing the VR Chillout games, relative to pre-play. Nearly all (n=9) reported that the games were very or quite easy to use.

Conclusions

VR software has potential to improve pruritis and quality of life in eczematous children. Technical challenges to resolve include 'fittings' of VR equipment to small faces. Subsequent work will extend these findings with a more diverse range of families to support children with eczema.

Declaration of interest.

This study was funded via a small fund HEIF award.

Key words

atopic dermatitis, virtual reality, 360 video, distraction techniques, children's nursing

Key Points

- Low-cost and scalable 360 video can be used to distract children from distressing symptoms of atopic dermatitis
- The use of haptic controllers (for example when using immersive virtual reality accessed via an Oculus Quest² headset) has the potential to limit the opportunity for children to scratch their atopic dermatitis

Introduction

Atopic eczema, (atopic dermatitis (AD)) is a long-term inflammatory skin condition and one of the most common childhood illnesses. It is a debilitating disease with high levels of disease burden for the patient (1). The main symptoms are itch and dryness. AD is the most common long-term disorder in children, affecting up to 20% of children in industrialised countries (2).

The standard treatment for atopic eczema is trigger/irritant avoidance and regular application of emollients and topical steroids/calcineurin inhibitors (3). However, concerns around steroid withdrawal have been raised amongst some patients with very severe AD. With advances in non-medical interventions, parents are calling for alternative methods to bring about relief and are keen to identify new ways of managing AD symptoms using non-pharmacological approaches (4). Mindfulness, relaxation, and guided imagery techniques have been used to distract children from the scratch-itch cycle that contributes to insomnia and impacts quality of life (5). The most recent Cochrane review of psychological and educational interventions revealed no robust interventions to enhance effective guided imagery in this context (6).

Traditionally, guided imagery has been used in the form of audio scripts spoken to the patient to guide their imagination away from any stress and the itching sensation (7). However, there are no robust studies applying this in dermatology.

Virtual reality (VR) displaces a person to an imagined 'other' location, with complete immersion as the goal (8), physically blocking out the real world and replacing it with a computer-generated

world which includes visual, auditory, and haptic stimuli. Whilst no previous studies have evaluated VR to treat eczema, it has been used to treat anxiety, burns and pain (9). Since itch and pain can be triggered from the same receptive fields in the skin (10), it is proposed that VR could be used as a more sophisticated and immersive version of guided imagery. VR may potentiate the distractive effect, building on the more limited reach of existing guided imagery interventions. We hypothesise that VR would provide immersive diversion from unpleasant symptoms of AD.

This research aimed to:

1. co-create and develop prototypes of both immersive and non-immersive VR Chillout Zone software based on the guided imagery approach to treating moderate to severe AD to distract eczematous children (aged 5 to 11 years) from their pruritis and reduce stress; through gathering perspectives from key stakeholders' (children with AD and their families).
2. evaluate the pilot materials with children

Methods

Participants

Co-creation: Participants were children with moderate to severe AD aged 5-11 years, from across England and Wales. Children and their families were recruited via the twitter feed of Nottingham Support for Carers and six children from six families volunteered.

Evaluation: Ten children attended the university to evaluate the final products; four with AD (from the initial sample) and six without AD (who saw the university research blog and contacted the research team).

Ethics

Prior to initiating the study, ethical clearance was obtained from the Faculty Research Ethics Committee. Participants completed a consent/assent form prior to taking part in the intervention and were fully informed about the purpose of the study, data protection and anonymity, via an age-appropriate information sheet. Data collected was kept confidential and interview recordings stored on a secure network drive and deleted after transcription. Participants

received pseudonyms to guarantee that when accumulating, storing, and reporting qualitative findings, individual participants could not be identified.

Procedure:

Stage 1

Using an online survey (n=6) and online semi-structured interviews (n=6), children worked with our software developer and 360 video developer to codesign the VR games and 360 video. Semi-structured interviews meant children could present their own opinions and elaborate on their views as required (11). The children were invited to select settings, interactions, music, and sound effects that they felt would best help them relax and distract them from their AD.

Stage 2

To evaluate the final products, Children with eczema (n=4) completed the CDLQI (Children's Dermatology Life Quality Index) cartoon questionnaire (12), the recommended questionnaire for children with AD. Ten children (n=4 with eczema) completed a usability questionnaire about the VR games. Questions were drawn from the Technology Acceptance Model (13) to optimise validity and reliability.

Data Analysis:

The lead author executed simple, exact transcriptions of interview recordings. Transcripts were imported into the package NVivo Version 11, to code and analyse the qualitative data using thematic analysis. Both inductive and deductive coding techniques were utilized to identify themes emerging from the data. Quotes were selected based on the quality and succinctness with which participants expressed points, and the representativeness of the quote to the theme. Thematic analyses followed Braun & Clarke's (14), six-step procedure: 1) Familiarization of data, 2) generating initial codes, 3) search for themes, 4) review themes, 5) define and name themes, and 6) producing the report. Study findings were reported according to the Consolidated Criteria for Reporting Qualitative Research checklist (COREQ) (15).

Materials

We developed two key resources for evaluation with children: a) a relaxing 360 video of a woodland scene, with poetry narration, and b) immersive VR games, comprising mobile phone games (two prototypes) and Oculus Quest 2™ games (three prototypes). The 360 video was filmed by Virtual Heritage Ltd. using a 360 camera, in response to ideas chosen by the child participants and uploaded to YouTube to be streamed via phones and low-cost VR headsets and Oculus Quest 2™ headsets.

The VR Software was built using Unity and Unity assets by a research assistant and is accessible via android devices and Oculus Quest2™. Two immersive games were developed based on existing research with children. The first game, Snowy World, aims to create a visually and acoustically immersive cold environment to ease the uncomfortable feeling of AD. In the second game, Flying over Sakura, the participant is inside an airship and can look around and interact with birds. This game focuses on using immersive virtual flying/physical experience to distract the child.



Figure 1 Flying over Sakura landscape low-cost VR headset game

For the Oculus Quest 2™ system, three games were developed. The subject chooses game content after standing in the lobby and watching a tutorial video on how to use the system. The first game, Lovely Fruit Grocery (Figure 2), provides the subject with an immersive interaction experience which involves using virtual hands (using haptic controllers) to feed fruit to cartoon animals and stroke them. The second game, Hand Jet Flying, provides subjects with an immersive flying experience using hand jets, which not only keeps their hands busy but also produces a highly immersive VR experience. The third game, Nature Wonderland, focuses on presenting a visually and acoustically immersive and peaceful VR environment with animals, water, and natural elements.



Figure 2 Lovely Fruit Grocery Oculus Quest Game

Results

Evaluation of the 360 Video

Children were posted a low-cost cardboard VR headset with which to view the 360 video using a mobile phone. For the video, participants were emailed the YouTube link. All children (n=6) reported enjoying the experience and feeling immersed in the VR world.

"I found it quite cool because it like transformed you until you don't feel like you're in the room".
(C2)

"I liked that I felt like I was in a forest!" (C6)

The children found it was a good distraction from their AD:

“It stopped me from scratching, sometimes. Easy to use, no issues at all. The voice made me feel safe and calm.” (C4)

In terms of future improvements, some comments were made about the practicalities of wearing the cardboard headset on a very small nose: *“the cardboard did press on my face a bit; it was not that comfortable around my nose.” (C2)*

Additionally, participants discussed when to use the video. Although it induced sleep, viewing the 360 headsets in bed would not be suitable and taking off the Velcro head strap could unsettle a calmed child: *“If you actually fall asleep taking the Velcro off can wake you up.” (C4)*

Children scored the experience of viewing the 360-video using a low-cost headset in relation to how much it helped (them) forget (their) AD from 8 to 10, (1 = not at all; 10 = completely). Scores ranged from 3 to 9, with a mean score of 6.6 out of 10. One child responded:

“10 out of 10, because I got really into the video and forgot everything else.” (C3)

Another explained how it stopped her from reaching her hands, and therefore helped her AD:

“Probably about like 8 out of 10. Because... I really did relax with it, but the poem was a little advanced for me. When I saw it that it just stopped me being fidgety. And I like it is, as I literally just that it stops you from reaching your hands, because that’s a major isn’t it. My eczema is very bad if I don’t do all my creams, and if I don’t do all my steroids, and my probiotics and all of that,... I am always rubbing my hands on the sofa if they are itchy. So, when I used the headset, my hands were actually calm and not moving.”. (C2)

Evaluation of the Immersive VR software

Children were shown a video of a prototype of the VR software that was developed using their online survey responses. All suggested using relaxing music. Children thought both a snowy world and a world with water distract from AD as they were perceived as “cool” and “calming”.

“I have had hypnosis in the past because my eczema is so bad ..., and I have treatment with cold. I think it is important for the world to be cold and snowy. I do not think a desert island would be good because it would be hot and that would make me feel hotter and itchier. So not hot worlds in the game. Using your hands is clever so you cannot itch.” (C1)

They also provided useful insights into how using VR games might distract them from their AD, by keeping their minds and hands busy:

“I Keep myself busy, playing with toys. I play with wrestling figures to keep my mind and hands busier, so I do not itch.” (C3)

The youngest child (aged 5.5 years) was particularly keen to interact with the animals and spot different things in the environment:

“Snowy world, I liked it when the fox rolled, and you could interact with him. You could have pretty snowflakes and snow tracks to follow and a snowman. I liked the noises the animals made, as they made you look and were interesting” (C5)

The children accessed the VR software using a fully immersive Oculus Quest² headset. From the four children who completed the Children’s Dermatology Life Quality Index cartoon questionnaire, they reported that over the last week their skin had been very itchy (n=2) or quite itchy (n=2). All four felt that their skin was less affected both during and after playing the VR Chillout games, compared to how it had felt prior to playing the games. All mentioned that animals had helped distract them from their eczema whilst playing the VR Chillout games. One child found it relaxing to *“fly over to the animals and watch fish jumping around in the water.”* (C7) To improve the games, two children felt that being able to float or swim in the water in a game would be relaxing and help them feel less itchy.

Usability:

Ten children aged 5-12 years (three girls, seven boys) completed the usability questionnaire. Nearly all (n=9) described the VR Chillout games as very easy or quite easy to use. The five-year-old girl struggled to use the hand controllers, though would likely have been able to play

more independently with a little more practice (e.g., via completing the tutorial prior to playing the VR Chillout games). The flying games (Hand Jet Flying and Nature Wonderland) were easier to play than the animal feeding game (Lovely Fruit Grocery). Most children (n=7) found the Oculus Quest™ Headset quite comfortable to wear, and **all** found the Oculus Quest 2™ with Elite Oculus strap very comfortable to wear (n=10). Nearly all (9/10) children felt very immersed in the VR Chillout games, and one felt quite immersed.

Potential improvements:

Younger children would have preferred all text to be narrated (e.g., the labels on the action buttons). Children enjoyed flying in the games and found it very relaxing. The animals were also popular, with one child commenting “*the animals were very realistic. I enjoyed playing with them and giving them food to eat. ... I think they would help me to forget my itching.*” (C10).



Figure 3 Child using Oculus Quest² to view VR Chillout Software

Discussion

Children co-created and evaluated three different approaches to distraction from eczema, a 360 Woodland scene, mobile VR software and fully immersive VR software via an Oculus Quest² headset. Children found the 360-video experience relaxing and felt they were transported to a different space. With the mobile VR software, they appreciated the additional interactivity offered by snowy world animals and flying over Sakura landscapes. Finally, when evaluating the immersive VR software, children used haptic hand controllers and reported being very immersed in the game. Other researchers, e.g., (16) have reported that VR games with high fidelity (e.g., fully isolating head-mounted display, stereo sound, and controllers) components provide a high level of immersion, presence, and narrative engagement.

In this study the lower cost, least immersive approach (360 video) distracted children from eczema and transported them mentally to another world. This approach is the quickest and easiest to develop, and more importantly most straightforward to scale. Producing 360 videos requires only a 360 camera, and the user can access content using a low-cost VR headset made of cardboard or plastic (approximate cost £7 per headset).

By comparison the more interactive nature of the mobile VR software (approximate cost of Oculus Quest 2™ is £300) was evaluated more favorably than the 360 video. The cost of course is an element which may not make it accessible to all, however non-pharmacological approaches to managing conditions are beginning to be prescribed to patients, perhaps VR could be prescribed in the future. In addition to the immersive quality of VR distracting from their eczema, children recognized the use of haptic hand-held controllers of the Oculus Quest² VR hardware as a physical way of limiting scratching whilst interacting with VR content.

Some children mentioned that the cardboard VR headset caused irritation, particularly on their noses. This needs to be explored further and consideration given to identifying headsets that do not cause irritation. This will be important in future iterations of the intervention because eczematous children frequently have eczema on their faces. Whilst various breathable fabrics for head straps are available, a tightly fitting VR headset on the face will not be suitable for some children.

This pilot project included a very small sample size which limits the generalisability of the findings. However, the evaluation enabled us to develop a prototype of both mobile VR software and fully immersive VR software which was evaluated positively by children with eczema, as a step towards testing the software in a larger scale randomized controlled trial.

Conclusions

Meeting an established health need, this pilot study has enabled us to join with eczematous children and their families to co-design a prototype VR resource for evaluation. It has enhanced our understanding of how VR can be used with children aged 5-11 years to help distract them from their AD, providing us with insight into how children might be able to interact with immersive technology.

Regarding the first aim, co-creation of VR prototypes with children and their families was achieved during a pandemic by advertising for volunteers on an established twitter special interest group. However, the recruitment method excluded children with parents who are not regular and knowledgeable internet/ social media users, meaning the sample lacked diversity. Follow-up research will need to address this. Regarding aim two, all children enjoyed using the immersive VR. Furthermore, the evaluation demonstrated potential in relation to the immersive and distractive nature of virtual reality games, and in particular bespoke games such as the ones evaluated in this project.

Children and families enjoy co-creation and personalization. We have identified some technical challenges to resolve in subsequent work, including 'fittings' of VR/ equipment to small faces and the limitations of standard straps supplied by industry. Subsequent work will seek to draw upon a wider and more diverse range of families to refine and enhance the co-creation methodology for scale and take forward this encouraging finding as part of the clinical work to bring relief to children suffering with eczema. Further intervention development is needed to test this in a feasibility trial.

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