Virtual reality in child-oriented physical rehabilitation: A review

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Abstract

In the healthcare industry, Virtual Reality (VR) is emerging as a promising tool for aiding the physical rehabilitation of hospitalized children. This research paper investigates the effectiveness of virtual reality as a medium to aid in the physical rehabilitation of hospitalized children. The study utilized desk research to gather and analyze relevant academic papers, reports, and white papers, primarily focusing on children but also drawing from broader audience-oriented sources, as child-oriented sources were limited. The findings reveal that the immersive and game-like experiences VR offers enhance patient engagement, improve physical condition, and reduce pain during treatments, as well as offer practical benefits for doctors. However, limitations related to software and hardware customization and safety concerns require further investigation. While early research shows promise, larger and longer-term studies are essential to better understand the potential and limitations of VR in healthcare. Ongoing research and innovation are crucial before widespread implementation can be considered. This paper contributes valuable insights to the current state of VR in pediatric healthcare, underlining the need for continued exploration and advancements in the field.

Author Keywords

Virtual Reality; Healthcare; Rehabilitation; Injury; Children; Serious Games.

Introduction

Virtual reality (VR) is a technology with countless innovations and applications across various industries, such as education and healthcare. Healthcare, a field specialized in innovative technologies, is currently researching ways to implement VR (Kip et al., 2019). However, virtual reality possesses many uncertainties, due to limited research, posing risks for patient treatments (Voinescu et al., 2021).

Injury rehabilitation requires patients to participate in long-term physical training, where motivation and user engagement are crucial for recovery (Meyns et al., 2017). Gamified experiences in virtual reality applications could contribute to both aspects, especially for children. Therefore, the goal of this paper is to explore the effectiveness of virtual reality as a medium to aid in the physical rehabilitation of hospitalized children.

This paper consists of three parts, first questioning the impact of VR on the engagement and recovery of physically injured child-patients. The second part focusses on debating the effectiveness of virtual reality from the perspective of doctors. The third part will cover side effects from usage of VR. The conclusion states the findings in perspective to the goal, by concluding each main section.

Methodology

In this study, extensive desk research was conducted by analyzing secondary sources such as reports, white papers, conference papers and other types of academic papers. These papers were collected, compared, and analyzed and form the base of this paper. To ensure reliability, only academic peer reviewed papers were used for this research, which were properly credited in APA. The primary focus of this study was on children, and efforts were made to identify academic papers specifically addressing this demographic. However, due to the limited availability of such papers, broader audience-oriented sources were included, particularly for topics related to safety concerns. This approach allowed for a comprehensive examination of the subject matter while maintaining academic standards.

Context

In today's ever-changing healthcare field, virtual reality has emerged as a potentially useful tool, particularly in pediatric rehabilitation. The usual ways of helping child patients recover can struggle to keep them engaged (Burke et al., 2009), which creates a need for fresh, innovative solutions. Hospitalized children, who are dealing with injuries and the clinical environment, pose a unique challenge.

VR, with its immersive and playful experiences, can completely change how young patients experience rehabilitation. However, it is crucial to determine its efficiency and the limits it possesses. This study looks at how VR can help hospitalized children recover physically by making their treatment more engaging and improving their chances of getting better.

Virtual reality in the healthcare industry is only just starting to be introduced, and the benefits are still in question, especially when looking at specific age groups. Therefore, the benefits and risks of VR in use for children need to be explored.

Child Engagement

To ensure effective rehabilitation, participation is crucial. To demonstrate participation, engagement can be used to define whether children are willing to participate and complete the program. VR provides an immersive experience, being both visually and auditory stimulating, which is especially engaging for children (Sanpablo et al. 2022). The stimuli, as demonstrated by Phelan et al. (2021) can help distract children from the pain and boredom of therapy, while improving their movement. And while VR is engaging, one of the key interests for children is the gamification aspect. Choi et al. (2023) researched VR as a rehabilitation method to use from home, and all children reported positive experiences and improvements in their mobility. Thus, due to stimuli, VR provides an engaging experience which can help participation and provides a distraction from the pain.

With the increase in engagement when using VR, the efficiency of recovery programs increased. When comparing VR to standard non-VR procedures, virtual reality massively increased engagement (Griffin et al., 2020; Shen et al., 2022). Furthermore, Huang et al. (2022) argue that when comparing VR to non-VR, VR led to better patient conditions, with VR causing a higher muscle demand and heart rate. This is further proven by Biffi et al. (2017) who demonstrated that due to higher engagement, children had increased their walking abilities after VR therapy. Thus, VR offers benefits for engagement, which can lead to children putting in more effort and thus resulting in a higher condition and efficiency of recovery.

The doctors' perspective

VR is engaging and motivating for children, but doctors also see benefits from using VR. Cano Porras et al. (2019) performed a clinical trial and found that VR is both effective and practicable, showing significant improvements for the patients. Panzeri et al. (2022) further demonstrates that VR can be a large benefit for rehabilitation in children, arguing that the earlier it is used, the better. One reason VR is of such help, is that it massively reduces pain due to distractions (Ali et al. 2022). This increases effectiveness, and combined with a good rehabilitation plan leads to effective recoveries. Thus, VR provides a useful tool for doctors when used in a rehabilitation plan and is especially effective for children.

While there are many benefits to using VR, it also lacks in certain aspects, such as software availability and complexity. A current key flaw in VR currently is the lack of games. Alrashidi et al. (2023) argue that the market currently only offers commercial non-immersive VR games, which lack adjustability to meet goals of therapy programs. Goh et al. (2009) also claim that in-game intelligence cannot achieve the complex skills and knowledge required, nor understand user context enough, to achieve an efficient recovery for patients. Furthermore, due to the limitations of physical customizability of controllers for instance, Choi et al. (2023) stated that while engagement increased, the controllers could not fit demands for the program. Thus, while VR can provide an engaging experience, in the current state it is lacking in both patient-tailored hardware and software.

Prolonged use effects of VR

Virtual reality can be used as a tool for rehabilitation, but safety and cybersickness are a large concern. However, Shen et al. (2022) demonstrated that children have low levels of negative side effects while using VR. This is further backed up by Tychsen & Foeller (2020) who concluded that children tolerate fully immersive virtual environments without negative side effects during and after the experience. While

the effects seem hopeful from these studies, there are little studies that report on effects after high usage of VR in the recovery of children (Voinescu et al., 2021). The research into prolonged usage of VR for adults is more abundant. Da Silva Marinho et al. (2022) found that all first-time adult VR players experienced cybersickness. Furthermore, Al Janabi et al. (2020) surveyed that 10% of adults experienced mild problems consisting of eyestrain, neck strain, headaches, and nausea. While virtual reality might thus work without any negative side effects in some studies, there is not enough data to safely conclude whether VR possesses no risks for use with children in the future.

Discussion

There are many benefits and risks when virtual reality is discussed. Although many shared positive reports, the trials completed are limited in capacity and often do not take safety into account. Virtual reality research is still in an early phase, but the tests done do show promise.

As the field of VR research is still in its preliminary stages, future studies should aim for larger-scale, longer-term investigations to better understand the full potential and limitations of VR. These studies will not only contribute to evidence-based practices but also address the safety concerns associated with VR applications in healthcare.

While this study provides valuable insights into the current state of VR in healthcare, it is crucial to recognize that ongoing research will further shape the landscape of VR applications and their role in improving patient outcomes and well-being.

Conclusion

The goal of this paper was to explore the effectiveness of virtual reality as a medium to aid in the physical rehabilitation of hospitalized children. To attain an effective recovery, patient engagement and motivation is crucial, and VR aids in this regard. It helps child patients with maintaining a proper condition and helps distract them from the pain that comes with their injuries. VR is a good fit in a rehabilitation plan as a tool to progress more efficiently in an enjoyable way for children. However, there are safety concerns due to the limited research conducted on the topic. It furthermore lacks both software and hardware related requirements that allow it to fit in all rehabilitation plans due to limitations in customizability. Thus, while virtual reality is a promising tool for doctors to use in their rehabilitation plans, more research and innovations in VR are necessary before it can be used on a large scale.

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