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Systematic Review

Health-Related Issues of Immersive Technologies: A Systematic Literature Review

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Abstract: The adoption of immersive technologies, such as virtual reality (VR) and augmented reality (AR), is transforming sectors like healthcare, education, entertainment, and retail by offering innovative, simulated experiences. These technologies provide significant benefits, such as enhanced learning, improved patient outcomes, and innovative rehabilitation tools. However, their use also raises concerns about user comfort and potential health impacts. This systematic literature review examines the positive and negative health implications of immersive technologies, drawing insights from 104 peer-reviewed articles. The findings highlight therapeutic and rehabilitation benefits, such as treating anxiety and improving motor skills, alongside physical health concerns like eye strain and cybersickness, and mental health challenges, including cognitive overload and addiction. The study identifies key demographics most susceptible to these effects, such as children, the elderly, and individuals with pre-existing health conditions. Recommendations for mitigating risks include ergonomic device design, synchronized sensory inputs, and user training. This research underscores the need for the responsible and ethical development of immersive technologies, ensuring they enhance real-world experiences without compromising user well-being. Future studies should focus on long-term health implications, inclusive design, and establishing guidelines to maximize benefits while minimizing risks.

Keywords: immersive technology; virtual reality (VR); augmented reality (AR); health implications; simulator sickness

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1. Introduction

The immersive era has created a shift in the way individuals navigate life and the way organizations conduct business. Innovators and developers are always looking for new ways to solve societal problems and as well as to simplify the nature of doing things. Among new technologies that are currently being hyped is immersive technology. Immersive tools that involve virtual reality (VR) and augmented reality (AR) are being highly explored in various sectors (entertainment, tourism, medicine, research, engineering, education, art, gaming, etc.) because of their features and capabilities. By recreating real-world situations and offering practical experiences, immersive technologies provide a unique chance to build knowledge, skills, and experiences.

Immersive technologies create a powerful sense of presence, allowing users to feel as though they are fully situated within a simulated environment [1,2]. This is achieved through realistic visuals, spatial audio, and interactive elements that engage multiple senses, making the experience feel tangible and authentic. As users participate in virtual spaces, they can explore, manipulate, and respond to the environment as they would in real life. This immersive experience is valuable, especially in decision-making processes. Businesses can simulate the anticipated end products, allowing investors to experience and evaluate the product's potential impact, functionality, and appeal before it physically exists. Retailers are incorporating VR in shopping to create a more immersive and engaging shopping experience. Customers can now look forward to virtual try-ons to see how a product will feel, appear, or to check the material quality [3]. The experiences are not only social, but further extend to the corporate world. In the past, many professions required individuals to be physically present in their area of work. Recently, virtual courts can hold judicial forums, and the automotive industry is simulating models to accelerate innovation. Lab spaces are set up to offer work-integrated learning and training for young professionals and corporate learners [4,5]. This allows for practical training in a risk-free environment, allowing novice professionals to build confidence and competence in their respective fields [6]. Immersive technologies further act as an assistive tool for individuals with disabilities [7]. The literature has also reported on the rehabilitation or therapeutic benefits of VR and AR on individuals, such as healing anxiety, and improving motor skills [8,9]. According to Statista's report on VR and AR adoption, there will be more individuals using VR and AR technology by 2027, the number will surpass 100 million users worldwide [10]. This suggests a positive user attitude toward the adoption and use of immersive technology.

There are risks associated with the use of immersive technologies, especially health-associated risks. A primary concern which has been noted is VR and AR-induced sickness, which affects a significant portion of users, and LaMotte [11] cited young children as users at risk. Children may not know how to communicate the discomfort they are experiencing, such as visual discomfort or motion sickness. Older adults have previously complained about the dizziness they experience when using immersive technologies [12]. Psychophysical and user experience research indicates that discrepancies between real-world environments and those generated by VR tools can lead to discomfort or disorientation for users [11,13]. Sari et al. [13] cautioned users against cognitive overload, which might affect the experience of using immersive technologies. Reports also suggest that some cases are a result of an unsuitable environment for using immersive technologies [14]. Despite these concerns, there is a lack of research to better understand who is most susceptible to these effects and the underlying reasons for this susceptibility [15]. There is also limited literature focusing on motion sickness caused by VR and its effect on human physiology [16].

This study aims to identify the positive and negative health outcomes associated with the use of immersive technologies while identifying susceptible demographics and effective strategies to mitigate adverse effects. It also seeks to highlight gaps in the current research, provide recommendations for safer design practices, and explore the long-term consequences of immersive technology on human health. By contributing to the growing body of knowledge, this study helps guide the safe and effective use of immersive technologies [1]. The contributions of this study can be summarized in three points: (1) identification of demographic groups that are most susceptible to health issues associated with the use of immersive technologies; (2) list of common health issues associated with the use of VR and AR, and (3) identification of strategies to mitigate the health risks associated with the use of immersive technology. The remainder of the paper is structured as follows: the next section presents the methodology used, which details how papers were identified, selected, and analyzed. The final section presents the conclusions, implications, limitations, and areas for further research.

2. Methodology

A systematic literature review (SLR) is a structured approach to any evaluation by using a predefined process to evaluate a particular topic. In the given paper, an SLR aimed at ascertaining all relevant research articles addressing a particular research question while limiting selection bias. According to Siddaway et al. [17], an SLR is characterized by being methodical, comprehensive, transparent, and replicable. In essence, an SLR involves gathering both published and unpublished research to answer a research question. Rather than generating new knowledge, the goal of an SLR is to synthesize and summarize the existing body of knowledge [9]. In these views, this study aimed to answer the research questions provided in Table 1.

Table 1. Study research questions.

ID	Research Question	Motivation
RQ1	What are the potential benefits of immersive technologies in medical contexts?	This question is motivated by the growing interest in utilizing immersive technologies (like VR and AR) in healthcare, especially as these technologies evolve and become more accessible.
RQ2	What are the most common health issues associated with the use of immersive technologies (e.g., VR, AR)?	Knowing common health issues may inform the design and use of immersive technologies.
RQ3	Which demographic groups are most susceptible to health issues associated with the use of immersive technologies?	Understanding the likely demographic that could be influenced by the immersive technologies could assist in customizing the interventions, creating user-friendly interfaces, and developing appropriate procedures considering various groups, such as the older population or people with existing health issues.
RQ4	What strategies or guidelines have been proposed to mitigate the health risks associated with immersive technology use?	A practical question that looks at existing solutions, including best practices, ergonomic design, or user recommendations to reduce health risks.

2.1. Protocol

The study followed the PRISMA framework (Preferred Reporting Items for Systematic Reviews and Meta-Analyses), which offers a rigorous method to enhance reporting quality, maintain transparency, reduce bias [18], and improve the documentation of the review protocol [19].

2.2. Eligibility Criteria

The eligibility criteria were set as studies and reports published in the last 10 years, from 2014 to 2024. Only articles reported in the English language were eligible for inclusion.

2.3. Information Sources and Search

Immersive technologies are presently adopted in multiple disciplines, and therefore, several academic databases were accessed to retrieve peer-reviewed research articles: IEEE Xplore digital library, Scopus, Science Direct, Google Scholar, and ACM Digital Library. The specific search terms that were used in each of the databases were as follows: “immersive technology*”, “virtual reality*”, “augmented reality*”, “mixed reality*”, and “extended reality*". Using the search terms, the following search string was formulated using Boolean operators "AND" and "OR":

> *"immersive technology" OR "virtual reality" OR "VR" OR "augmented reality" OR "AR" OR "mixed reality" OR "XR" OR "extended reality") AND ("health implications" OR "health risks" OR "physical health" OR "mental health" OR "psychological health" OR "cognitive effects" OR "psychological effects" OR "physiological health" OR "physiological effects".*

The search strings were customized for each database queried. A detailed listing of the search strings and their associated databases is available in the Supplementary Materials (Table S1: Search Strings).

2.4. Inclusion and Exclusion Criteria

Table 2 describes the inclusion, exclusion, and quality criteria of the systematic review of immersive technologies and health issues.

Table 2. Inclusion, exclusion, and quality criteria.

Inclusion	Exclusion	Quality
Articles published between 2014 and 2024	Publications outside the range specified	Reputable sources such as accredited and peer-reviewed publications (to avoid predatory outlets)
Peer-reviewed articles	Studies not related to immersive technologies and health issues	
Studies in English	Studies that focus on training or teaching using VR or AR	
Full-text articles and open access	Articles not published in conference proceedings and journals	
	Reviews, editorials, and non-empirical studies	

2.5. Study Selection

Figure 1 describes the process used to select the final set of studies. The systematic review followed a thorough selection process, as illustrated in the PRISMA flow diagram. Initially, 2828 records were identified from five databases: Google Scholar (n = 1590), IEEE Digital Library (n = 195), ACM Library (n = 376), Scopus (n = 493), and ScienceDirect (n = 174). Before screening, 1668 records were removed due to duplication (n = 1215), being reports, reviews, books, or abstracts (n = 215), inaccessible full text (n = 123), non-English language (n = 18), lack of peer review (n = 64), or irrelevance after the title review (n = 33). After this, 762 records proceeded to screening, and 322 full-text articles were assessed for eligibility. A further 300 studies were excluded based on specific criteria: 105 studies did not report any medical benefits or issues, and 195 focused on VR and AR education and training, which were outside the scope of the review. Eventually, only 104 studies met the eligibility criteria and were included in the final review (Table S2: Summary Table of Analyzed Publications).

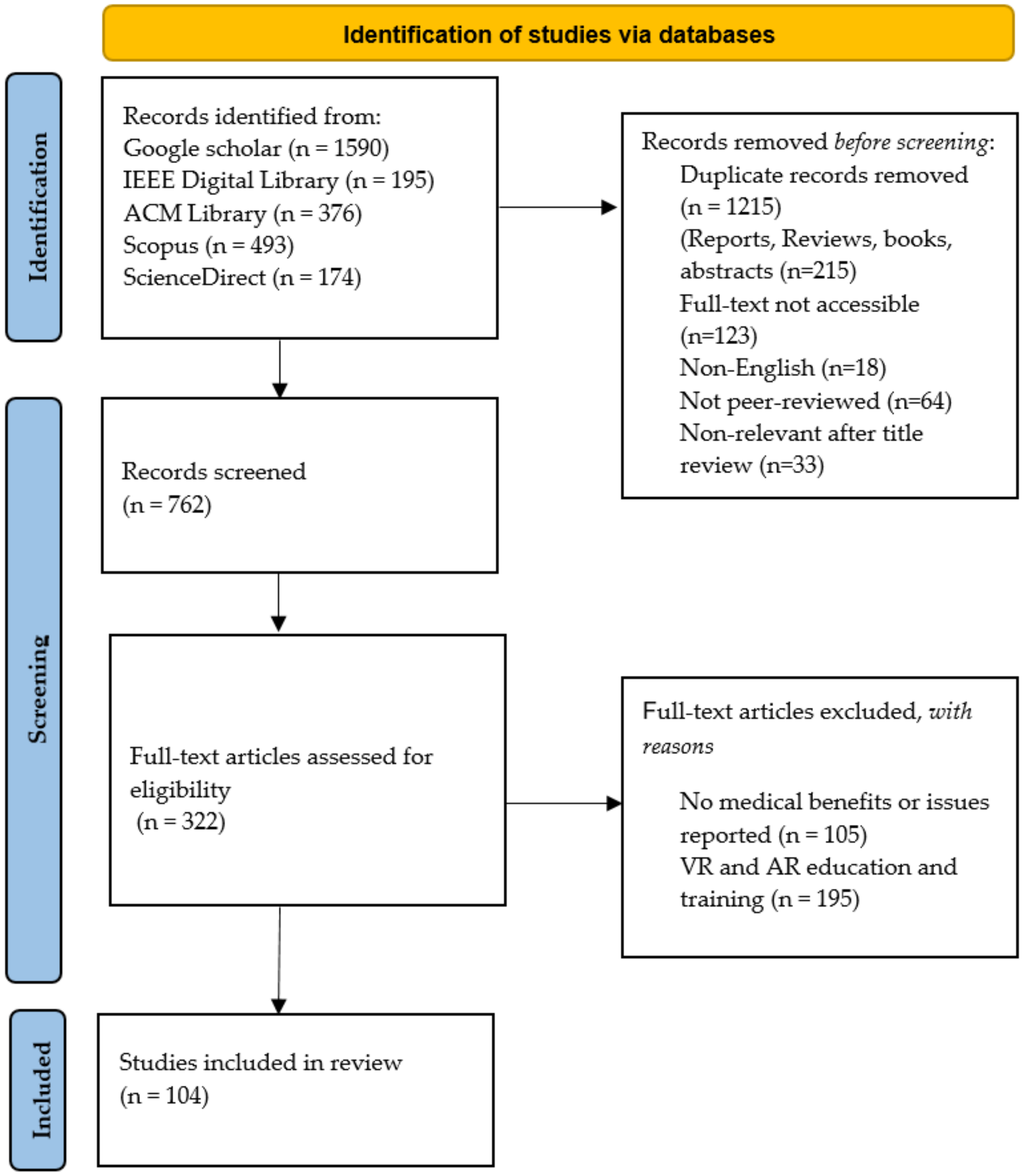

Figure 1. PRISMA flow diagram.

2.6. Data Collection Process and Analysis

The initial search and identification were conducted by a single researcher who used predefined search terms to identify potentially relevant studies. Following this, a more rigorous review process was undertaken by two researchers working independently. These researchers carried out the selection process, carefully screening the identified studies against the established eligibility criteria. This approach ensured that the selection process was thorough, unbiased, and aligned with the study's objectives, with discrepancies between the two researchers resolved through discussion to achieve consensus. In cases where there was disagreement on the inclusion or exclusion of a study, the reviewers engaged in a discussion to reach consensus. If consensus could not be reached, the authors consulted an independent reviewer, who assessed the study and made the final determination.

The extracted data were then analyzed thematically, guided by predefined research questions. This thematic analysis involved identifying patterns, recurring ideas, and significant insights across the studies. Each reviewer systematically recorded relevant data points, including study objectives, methodologies, key findings, and conclusions, using a standardized data extraction template.

2.7. Study Grouping and Thematic Synthesis Approach

To ensure a structured synthesis aligned with the study's objectives, we employed a thematic analysis approach guided by the four predefined research questions (RQ1–RQ4). The final set of 104 studies was grouped into four analytical categories based on their primary focus:

Category 1: Therapeutic and medical benefits of immersive technologies (RQ1). This group included studies that evaluated the positive outcomes of immersive technologies in healthcare settings, such as rehabilitation, anxiety reduction, and inclusivity.

Category 2: Health issues associated with immersive technology use (RQ2). Studies in this group discussed physical or mental health effects such as cybersickness, cognitive overload, visual strain, or addiction.

Category 3: Vulnerable or susceptible demographic groups (RQ3). Articles were categorized here if they focused on age-related vulnerabilities, individuals with pre-existing conditions, or gender-based susceptibility.

Category 4: Risk mitigation and design guidelines (RQ4). This group included studies proposing ergonomic design solutions, environmental safety practices, or user training to minimize health risks.

Each study was categorized using a standardized data extraction template, enabling systematic mapping to one or more thematic groups. This classification facilitated the synthesis of findings in alignment with the research questions, while also revealing both converging and diverging themes across varied study contexts.

3. Results and Discussion

The findings demonstrate that immersive technologies offer transformative potential in therapeutic and medical contexts, but also reveal significant health implications that must be addressed. The complementary strengths of VR and AR, such as VR's effectiveness in rehabilitation and AR's suitability for anxiety reduction, indicate their potential when thoughtfully integrated into healthcare. However, addressing challenges like sensory conflicts, cognitive overload, and demographic susceptibilities are critical to ensure their safe adoption while promoting user productivity and wellness.

3.1. Benefits of Immersive Technologies in Therapeutic or Medical Contexts

The literature has presented some benefits of immersive technologies in addressing health issues. Figure 2 below illustrates the themes extracted from data as benefits of immersive technologies categorized into themes such as rehabilitation and physical therapy, mental health and anxiety reduction, inclusivity and accessibility, enhanced therapeutic travel, and transformative potential. Each theme highlights the unique advantages offered by VR and AR.

As seen in Figure 2, VR demonstrates greater applicability in areas like inclusivity and rehabilitation, while AR shows stronger relevance in addressing sensory conflicts and anxiety [20]. This visualization highlights the complementary strengths of AR and VR in improving therapeutic and medical experiences [21,22]. As a rehabilitation tool, immersive technologies can develop and improve physical activity, motor, and soft skills [23–26]. They are considered a breakthrough, as certain conditions previously thought to be permanent could not be addressed due to a lack of resources or knowledge [27,28]. For instance, Yeh et al. [29] found that AR could be used to treat claustrophobia. The therapeutic mechanism allows professionals to simulate and control the environment to gradually assist individuals in facing their fears. It is for these reasons that immersive technologies are now viewed as an innovative method to alleviate stress and anxiety during vascular procedures [30]. The study also noted that the tourism sector has innovated by developing affordable, inclusive, and therapeutic travel options to promote mental well-being through the use of immersive technologies. Studies highlight how tourists' experiences are significantly improved through immersion, allowing them to engage deeply with destinations, cultures, and activities in ways that foster relaxation, emotional rejuvenation, and a sense of connection [31]. Even individuals with disabilities can gain access to experiences that were once considered unattainable or seemingly impossible. This was noted by Mokmin and Ridzuan [31,32], who highlighted the transformative potential of VR in providing physically disabled individuals with opportunities to engage in activities that might otherwise be inaccessible. VR enables users to participate in immersive simulations of sports like mountain climbing, swimming, or even skiing. These experiences not only foster a sense of inclusion, but also contribute to physical rehabilitation, mental well-being, and the enhancement of motor skills [33,34].

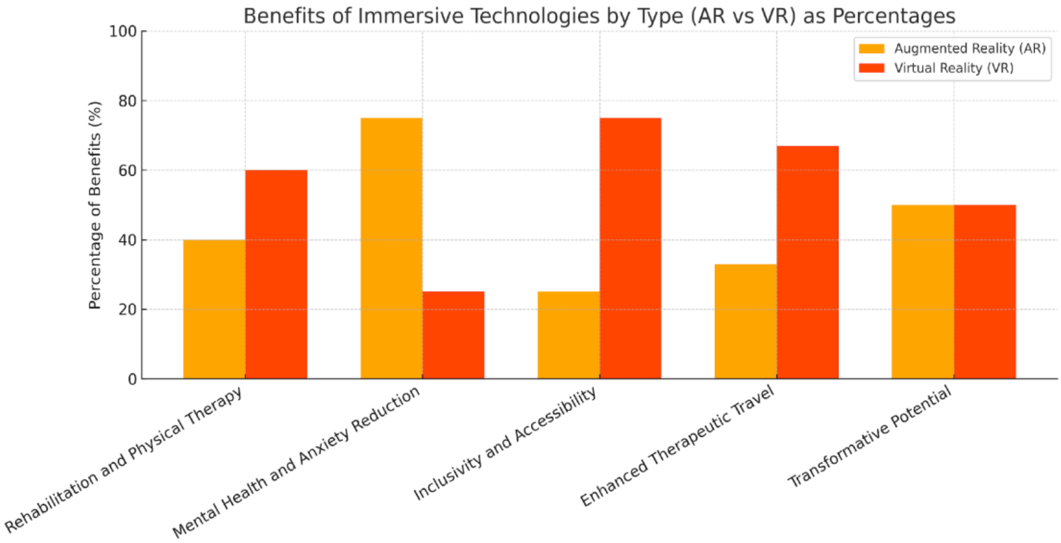

Figure 2. Benefits of immersive technologies in the medical context.

Despite their transformative potential, the adoption of immersive technologies comes with a range of challenges. Authors have cited the high costs of VR/AR hardware, maintenance, and infrastructure being a leading barrier, especially for resource-constrained organizations [8]. Collaboration between institutions may avail these resources depending on the terms of agreement and institutional policies in place to support immersive initiatives [31,35]. These partnerships can play a vital role in advancing the implementation of virtual human applications in therapeutic settings. Notably, trustworthy virtual humans have shown promise in contexts such as exposure therapy, social anxiety interventions, and PTSD treatment, where the ability to build rapport with virtual agents is critical to achieving meaningful therapeutic outcomes [36,37].

In addition to financial challenges, Zsigmond and Buhai [38] raised an issue of a lack of awareness. Immersive technologies have not been fully explored due to limited understanding of their value and long-term benefits, which leads to underutilization. From a pedagogical standpoint, the absence of well-defined instructional design models for immersive learning impedes the alignment of immersive experiences with learning objectives and assessment criteria. Poorly designed simulations can lead to a cognitive overload, simulator sickness, or diminished learning outcomes, especially among novice users [30,36,37]. In many cases, educators and trainers lack the necessary skills or confidence to design and implement immersive content effectively [37]. User interaction with immersive technologies results in large amounts of data being collected, leading to concerns around user privacy, psychological safety, and data protection [39,40]. Therefore, a multi-faceted approach involving inclusive design, training, infrastructure investment, partnerships and collaborations, and the development of ethical and pedagogical frameworks is necessary to ensure ethical and responsible use of immersive technologies in all sectors.

3.2. Health Issues Associated with the Use of Immersive Technologies

Studies suggest that complex interactions between hardware, content, and individual characteristics cause VR and AR sicknesses [41]. For instance, high-speed motion, complex rotational movements, and discrepancies in visual and vestibular input were noted as major contributors to discomfort among VR users [16]. Grassini and Laumann [42] noted that VR may introduce a higher level of simulator sickness than AR. This increased impact in VR comes mostly from its immersive aspect, with users being completely encased within a virtual space, leading to possible conflicts between the visual and physical elements. On the other hand, AR introduces digital components to the real scenery, thus allowing for more natural cues to the senses, which usually leads to fewer cases of nausea and discomfort. In addition, Table 3 below provides a summary of health issues associated with the use of immersive technologies. The health issues were divided into physical and mental health issues to highlight their distinct impact on the body and mind. Physical problems, such as eye strain, cybersickness, and injuries, arise from device ergonomics, sensory conflicts, and prolonged use. Mental health concerns, including cognitive overload, anxiety, addiction, and social isolation, stem from the immersive and engaging nature of these technologies.

Table 3. Health issues associated with the use of immersive technologies.

Health Concern	Explanation	Sample Sources
	Physical Health Concerns	
Eye-related issues (such as eye strain)	Human eyes are prone to experiencing eye strain when viewing displays that deliver 3D images, often leading to discomfort and fatigue.	[42–47]
Cybersickness (also known as motion sickness)	Motion sickness can be associated with headache, nausea, vomiting, dizziness, and cold sweats. Users have reported that VR headsets make them feel dizzy when watching 3D movies.	[16,20,42,48,49]
Skin irritation and skin conductance	Prolonged or improper use of VR and AR devices can cause skin-related issues like irritation, rashes, or allergic reactions.	[48,50]
Musculoskeletal disorders	Musculoskeletal disorders include conditions affecting the muscles and joints, and they are often associated with prolonged periods of improper posture, repetitive motions, and stress on the body. Immersive technologies are reported to have the potential to cause and alleviate musculoskeletal discomfort, depending on how they are used.	[42,51]
Physical injuries	Lack of spatial awareness and an unsuitable environment can significantly increase the risk of accidents and injuries when using VR or AR technologies. Immersive experiences often limit users' awareness of their real-world surroundings, leading to collisions, trips, or falls.	[14,34,52–54]

Table 3. *Cont.*

Health Concern	Explanation	Sample Sources
Mental health concerns		
Cognitive overload	There are reported cases of cognitive effects that negatively affect individuals' alertness and attention after using VR technologies.	[21,31,55–59]
Anxiety	The intense sensory stimulation and highly realistic experiences can overwhelm users, especially those prone to anxiety or those who are unfamiliar with such environments. Additionally, some VR scenarios may deliberately simulate stressful situations, such as heights or confined spaces, which can trigger fear or panic responses, leading to anxiety.	[13–17,36,37]
Addiction	There has been a misconception that immersive technologies are designed particularly for gaming and entertainment and that they can provide an escape from the stresses and challenges of real life. If applied in a learning environment, individuals may highly depend on them.	[51,60–65]

Grassini and Laumann [42] explored the Sensory Conflict Theory, which describes the phenomenon where a conflict arises between the visual and vestibular systems. This occurs when motion perceived visually in a VR environment does not align with the absence of corresponding physical movement [60]. Such sensory mismatches can lead to symptoms of motion sickness, including nausea and dizziness. Individuals who are inexperienced with VR systems or have a history of motion sickness are particularly susceptible, with the severity of symptoms potentially posing significant risks [61–63]. The observation that participants experiencing pronounced nausea also displayed an elevated heart rate suggests a physiological response to the discomfort induced by VR or AR environments [66]. This increase in heart rate is likely the result of the body's autonomic stress response, part of the "fight or flight" mechanism triggered by sensory conflicts, such as mismatched visual and vestibular cues [16,64,65]. The physiological reaction reflects the body's attempt to manage the perceived imbalance or distress, with the elevated heart rate serving as an indicator of the severity of discomfort and stress [41,66]. These findings stress the need for further research into the long-term effects of VR, particularly in areas like cognitive load and the physiological impacts of prolonged exposure. In addition, Dick [67] emphasized the importance of VR and AR research focused on health, safety, and efficacy to support the broader adoption of immersive technologies. This is especially crucial for the older generation, who may be more susceptible to sensory overload, motion sickness, and cognitive fatigue due to age-related changes [68,69]. For learning institutions, developers and curriculum or course designers should consider physiological and cognitive limits when designing immersive content [60,70] The simulated environment should not be overly stimulating or disorienting, but rather reduce user fatigue and any potential health risks. Policy implementation must address safe usage durations, scheduled breaks, and user readiness.

3.3. Demographic Groups Susceptible to Health Issues Associated with the Use of Immersive Technologies

While VR technology has advanced to address health-related concerns, its increasing use in treating medical conditions necessitates a thorough evaluation of its potential negative side effects. Some patient groups with specific conditions may experience heightened discomfort compared to healthy individuals, which could diminish or negate the benefits of VR treatments [42,68].

3.3.1. Older Adults and Individuals with Disabilities

Concerning the vulnerable demographic group, there are well-known health issues that are associated with age or being obese, such as high blood pressure, cognition, which might affect user experience with VR and AR [68–70].

User friendliness is one of the drivers for many individuals to use technology. In one study by Svecova et al. [51], some elderly participants reported negative experiences with VR devices, describing them as unpleasant or even "terrible". In contrast, Doré et al. [71] found that immersive technologies were generally well-accepted by older adults, suggesting variability in user perception across different contexts and implementations. It is essential to explore the factors that influence the adoption and acceptability of immersive technologies across diverse user groups [68–73]. For instance trust in social VR environments is strengthened by authentic visual indicators, while metaverse-integrated technologies (e.g., AI, digital twins) signal transformative potential for personalized, and decentralized healthcare. However, challenges around safety, privacy, and standardization remain, particularly for vulnerable populations such as older adults and those with disabilities [74–80].

Moreover, evidence suggests that seniors perform better on non-immersive platforms, while head-mounted displays (HMDs) may induce greater fatigue in both younger and older users, albeit with minimal reported side effects and comparable user experiences across age groups [46,48]. Future efforts should focus on optimizing immersive platforms like HMDs to reduce fatigue and improve usability for seniors while considering non-immersive options for tasks where performance is critical [80,81].

3.3.2. Individuals with Pre-Existing Health Conditions

The cybersickness-induced prolongation of reaction time raises obvious concerns regarding the safety of this technology [34]. Based on these findings, we can assume that individuals with a high blood pressure or Attention-Deficit/Hyperactivity Disorder (ADHD) may have difficulties in using immersive technologies [73,74]. Nevertheless, the use of VR could limit its usability in some contexts, as in the case of patients with psychological or physiological conditions who show impaired control of movements and balance, as they may easily damage the VR systems and put their physical health at risk [75,76]. Furthermore, those people who are especially sensitive to simulator sickness may see the possible benefits of VR-based treatment negatively moderated by the ill effects of experiencing VR environments [77].

3.3.3. Children and Adolescents

Research also revealed that VR can impact the development of young brains, making children and young teenagers particularly vulnerable to the effects of immersive technologies [65,67,68,78]. For instance, VR may influence sensory processing and even cognitive development in ways that are not yet fully understood [62]. While VR offers educational and recreational benefits, its prolonged use by children raises concerns about potential long-term developmental effects [57,80]. Research on this subject remains in its early stages, and the extent of VR's impact on young users' neural and cognitive growth is still unclear. As

VR technology becomes more accessible, understanding these developmental implications is crucial for establishing safe usage guidelines and creating age-appropriate content [80].

In addition to the identified groups, studies have highlighted that certain immersive technologies can increase blood pressure, regardless of genre or gender [16]; therefore, individuals with high blood pressure need to be careful or monitored while using immersive devices. Future studies should also consider moderating factors such as gender and age to understand their influence on the adoption and acceptance of VR and AR [16,51,81]. This observation aligns with prior studies indicating that females are generally more susceptible to motion sickness than males, while males are often more inclined to adopt new technologies with greater ease than females [68].

3.4. Strategies or Guidelines Proposed to Mitigate the Health Risks Associated with Immersive Technology Use

With the growing rate of the pervasiveness and adoption of immersive technologies, it is necessary to promote the safe and ethical use of these technologies [82]. Research has suggested some initiatives to minimize health risks when using AR or VR tools. Below is a summary:

1. Multimodal Fidelity Hypothesis aims to understand the balance between the visual and vestibular systems in VR [30,41,83–85]. It suggests that sensory inputs should be synchronized to reduce sensory conflict, improving user experience while maintaining immersion [41]. This initiative will encourage the participation of users.
2. In inclusive design, technology's permanence highlights the need for developers and manufacturers to design inclusive solutions that consider health and accessibility [49,86–88]. Svecova et al. [51] and Lanyi and Withers [82] recommended ergonomic VR devices that consider the physiological needs of the elderly and disabled users to minimize discomfort, but also ergonomic devices to make sure that users are comfortable when using immersive technologies. The integration of features like motion sickness mitigation tools, blue light filters, reminders for breaks, posture correction alerts, and better eye tracking systems will encourage healthy usage habits [42,80,89].
3. For a safe physical environment, the venue or lab setup should be free from sharp objects, obstacles, and other potential hazards to ensure a safe environment for engaging in immersive activities [82,90–92].
4. Training on safe usage practices, especially in the educational or workplace setting is recommended [23,93]. Users should be educated on the potential risks of prolonged immersive technology use, such as eye strain, dizziness, or reduced physical activity [21,22].
5. Physical assessment may be recommended on certain occasions before diving into the VR or AR experience [16]. Especially on occasions that may require a longer engagement with immersive technologies, or activities that increase blood pressure [53,94].

Understanding that strategies may not address all the needs of vulnerable groups, it is critical to identify specific mitigation strategies that are tailored to the unique characteristics of these groups [80,95,96]. For instance, ergonomic design features, such as lightweight headsets and adaptive input controls, have proven especially beneficial for elderly users and individuals with musculoskeletal limitations, as they reduce physical strain and enhance comfort during extended use [12,72,95]. Population groups such as children, the elderly, and users with sensory processing sensitivities, the integration of break reminders, visual comfort settings (e.g., blue light filters), and motion sensitivity calibration were noted as crucial to minimizing overstimulation and reducing the risk of simulator sickness [23,90].

Furthermore, the importance of customized onboarding and training protocols were emphasized for individuals with disabilities, enabling them to navigate immersive environments safely and confidently through guided orientation and tailored user support [12,24,80,96]. While designing innovative systems that accommodate all user needs may present challenges, it remains essential for designers and developers to prioritize inclusivity and adaptive design principles in the development and implementation of immersive technologies [80,96].

4. Conclusions, Recommendation, and Future Studies

Immersive technologies, such as VR and AR, have made significant advancements across various sectors, particularly in healthcare, where they play a pivotal role in enhancing patient outcomes and providing innovative therapeutic and rehabilitation tools. This SLR has highlighted both the benefits and challenges associated with these technologies. While immersive technologies offer therapeutic advantages, such as treating anxiety, improving motor skills, and enhancing inclusivity for individuals with disabilities, they also pose health risks, including eye strain, cybersickness, cognitive overload, and addiction.

The findings emphasize the importance of designing these technologies responsibly, considering user characteristics, and addressing potential risks. Strategies such as inclusive design, ergonomic device development, synchronized sensory inputs, and user training can help mitigate adverse effects while maximizing the benefits of immersive experiences. Policymakers and developers must prioritize safety and ethical considerations to ensure these tools are accessible and beneficial to diverse user groups, including vulnerable populations such as children, the elderly, and individuals with pre-existing conditions.

While this review provides valuable insights into the health-related implications of immersive technologies, several limitations should be acknowledged. Firstly, the review was limited to studies published in English and sourced from peer-reviewed academic databases, which may introduce publication bias and exclude relevant findings from grey literature or non-English sources. Secondly, although a structured search strategy was employed, selection bias may still exist due to variations in indexing across databases and the exclusion of studies with inaccessible full texts. Thirdly, the heterogeneity in study designs, populations, and outcome measures made it impractical to conduct a meta-analysis, limiting the review to a narrative synthesis. Therefore, future reviews could benefit from including grey literature, applying more robust quantitative synthesis methods, and using validated, domain-specific bias assessment tools to enhance the rigor of analysis.

Future research should explore the long-term health implications of immersive technologies, investigate effective risk mitigation strategies, and develop comprehensive guidelines for safe use. Additionally, studies should focus on designing systems that integrate biometric feedback and usage monitoring to promote user well-being. As immersive technologies become increasingly integrated into daily life, their development must aim to complement and enhance real-world experiences rather than replace them, ensuring users remain grounded in reality. This approach will promote the responsible adoption of immersive technologies, maximizing their potential while minimizing risks to physical and mental health.

Supplementary Materials: The following supporting information can be downloaded at: https://www.mdpi.com/article/10.3390/informatics12020047/s1, Table S1: Search String.; Table S2: Summary Table of Analyzed Publications. Refs. [20–36,40–45,47–63,65,66,68,70–129].

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Conflicts of Interest: The authors declare no conflicts of interest.

Abbreviations

The following abbreviations are used in this manuscript:

SLR	Systematic Literature Review
VR	Virtual Reality
AR	Augmented Reality
HMD	Head-Mounted Display

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