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REVIEW

Use of virtual or augmented reality in informal caregivers of stroke survivors: rapid review

Uso de realidad virtual o aumentada en cuidadores informales de supervivientes de un accidente cerebrovascular: revisión rápida

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ABSTRACT

Introduction: the rehabilitation of a stroke survivor has an impact on activities of daily living, physi-cal activity, social interaction and the quality of life. The use of virtual and augmented reality appears as a tool to be explored and incorporated into rehabilitation.
Objective: to identify evidence of the use of virtual reality or augmented reality in informal caregiv-ers of stroke survivors.
Method: a Rapid Literature Review was carried out using the Cochrane Rapid Review Methods recom-mendations. Based on the PICo strategy, the following question was formulated: What is known about the use of virtual reality and augmented reality in informal caregivers of stroke survivors? The search was conducted through the EBSCOhost platform, in November 2024, with the 2017-2024-time frame being assumed.
Results: 8 articles were identified and 3 were included. The use of virtual reality/augmented reality in informal caregivers of stroke survivors revealed potential for empowerment and increased motiva-tion, in addition to generate feelings of satisfaction and acceptance. Using virtual reality/augmented reality in informal caregivers for stroke survivors, allowed to identify barriers and facilitators of this technology.
Conclusions: the use of virtual reality and augmented reality in informal caregivers of stroke survi-vors is an emerging topic, with great potential for development. Due to the scarce evidence found, this rapid literature review does not allow generalizations, but suggests paths for future investiga-tions, on a rising topic.

Keywords: Stroke; Caregivers; Virtual Reality; Augmented Reality; Simulation Training; Virtual Reality Exposure Therapy.

RESUMEN

Introducción: la rehabilitación de un superviviente de un accidente cerebrovascular tiene un impacto en las actividades de la vida diaria, la actividad física, la interacción social y la calidad de vida. El uso de la realidad virtual y aumentada aparece como una herramienta a explorar e incorporar a la rehabi-litación.
Objetivo: identificar evidencia del uso de realidad virtual o realidad aumentada en cuidadores infor-males de sobrevivientes de un accidente cerebrovascular.
Método: se llevó a cabo una revisión rápida de la literatura utilizando las recomendaciones de los Mé-todos Cochrane de Revisión Rápida. Con base en la estrategia PICo, se formuló la siguiente pregunta: ¿Qué se sabe sobre el uso de realidad virtual y realidad aumentada en cuidadores informales de los sobrevivientes de un accidente cerebrovascular? La búsqueda se realizó a través de la plataforma EBSCOhost, en noviembre 2024, asumiendo el periodo 2017-2024.

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Resultados: se identificaron 8 artículos y se incluyeron 3. El uso de realidad virtual/ realidad aumen-tada en cuidadores informales de sobrevivientes de accidente cerebrovascular reveló potencial para el empoderamiento y una mayor motivación, además de generar sentimientos de satisfacción y acepta-ción. El uso de realidad virtual / realidad aumentada en cuidadores informales para sobrevivientes de un accidente cerebrovascular permitió identificar barreras y facilitadores de esta tecnología.

Conclusiones: el uso de la realidad virtual y la realidad aumentada en cuidadores informales de los supervivientes de un ictus es un tema emergente, con un gran potencial de desarrollo. Debido a la es-casa evidencia encontrada, esta revisión rápida de la literatura no permite generalizaciones, pero su-giere caminos para futuras investigaciones, sobre un tema en auge.

Palabras clave: Accidente Cerebrovascular; Cuidadores; Realidad Virtual; Realidad Aumentada; Entre-namiento con Simulación; Terapia de Exposición a la Realidad Virtual.

INTRODUCTION

According to the World Health Organization, 15 million people worldwide suffer a stroke every year, of which around 5 million die and another 5 million are permanently disabled. Although the incidence of stroke is decreasing in many developed countries, the absolute number of strokes continues to rise due to the ageing of the population.[1]

Stroke is the main cause of functional disability, causing various neurological alterations, which have motor and sensory consequences, as well as emotional and social repercussions.[2] Rehabilitation intervention "aims to promote early diagnosis and preventive actions (...), in order to ensure the maintenance of clients' functional capacities, prevent complications and avoid disabilities".[3] It also aims to "provide therapeutic interventions to improve residual functions, maintain or recover independence in life activities and minimize the impact of installed disabilities", mobilizing "specific rehabilitation techniques" and educating people in "discharge planning, continuity of care and reintegration (...) into the family and community, thus providing the "right to dignity and quality of life".[3]

After discharge from hospital, stroke survivors often need help with self-care.[4] In the vast majority of situations, this role falls to the family. In this sense, the concept of the informal caregiver emerges. According to the Social Security Institute, I.P., the informal caregiver (IC) "is always the spouse or the cohabiting partner, relative or family member up to the 4th degree of the straight line or collateral line of the person being cared for (e.g. children, grandchildren, great-grandchildren, great-great-grandchildren, siblings, parents, uncles, grandparents, great-grandparents, great-uncles or cousins)". Informal caregivers can also be those who "do not have family ties with the person being cared for, but live in communal housing with them"; or "parents with shared custody of the person being cared for".[5]

Virtual reality (VR) is an emerging method that is proving effective in health education. It allows interaction with a virtual environment, the creation of rich sensory environments and the replication of real-world situations in safe conditions. Although the use of VR in the rehabilitation of people with stroke is emerging, it is increasingly being used to improve people's health outcomes and is often used to support the physical and cognitive rehabilitation of stroke survivors.[6] However, its use with caregivers is a new concept and more research is needed to provide clear evidence of its effectiveness, as it can occupy an important place in caregiver education.[7]

This study aims to identify relevant studies in the literature that show evidence of the use of VR and augmented reality (AR) in informal caregivers of stroke survivors.

METHOD

A rapid literature review (RLR) was carried out using the recommendations of the Cochrane Rapid Review Methods.[8] The aim is to shorten or limit a literature review in order to speed up the production of the research, reducing the time taken or the size of the research.[8] To this end, articles published in the last 10 years were selected, covering the years 2015 to 2024 (although the search platform assumes the date range 2017-2025). The research was carried out in November 2024. As this was an RLR, the research protocol was not submitted to any Ethics Committee.

To formulate the research question, we used the PICo strategy,[9] which allows clinical questions to be asked using keywords. In this acronym, P means population of interest, person or problem; I means area of interest; Co, means context. Thus, the following were defined:

- Population (P) - informal caregivers.
- Area of interest (I) - virtual or augmented reality.
- Context (Co) - stroke survivors.

This led to the following research question: "What is known about the use of virtual or augmented reality (I) for informal caregivers (P) of stroke survivors (Co)?

The inclusion criteria were original articles dealing with the proposed topic, published in English and with full text available, between 2015 and 2024. Articles that did not correspond to the objective of the study and with less than 75 % of the JBI quality criteria ("pocket rule") were excluded.[10] The use of gray literature was also limited.

The electronic search was carried out on the EBSCOhost platform, using the following databases CINAHL, MEDLINE,

COCHRANE, MEDICLATINA, NURSING & ALLIED HEALTH COLLECTION and LIBRARY, INFORMATION SCIENCE & TECHNOLOGY ABSTRACTS. We used the controlled descriptors (MeSH): "stroke", "caregivers", "virtual reality", "augmented reality", "simulation training" e "virtual reality exposure therapy" and the keywords "cerebral stroke", "cerebrovascular stroke", "cerebrovascular accident", "informal caregiver", "family caregiver", "carer", "care giver", "spouse caregiver", "virtual realities", "augmented realities", "virtual reality simulation" and "immersive technology". The AND and OR operators were used for the search strategy, crossing the aforementioned descriptors according to the following Boolean equation: (("stroke" OR "cerebral stroke" OR "cerebrovascular stroke" OR "cerebrovascular accident")) AND (("informal caregiver*" OR "family caregiver*" OR "carer*" OR "caregiver*" OR "care giver*" OR "spouse caregiver")) AND (("virtual reality" OR "augmented reality" OR "virtual realities" OR "augmented realities" OR "virtual reality simulation" OR "immersive technology" OR "simulation training")).

Study protocol

For this review, the guidelines of the *Preferred Reporting Items for Systematic Reviews and Meta-Analyses* (PRISMA),[11,12] in order to obtain the best available evidence for the topic under study. The selection of studies was based on an independent analysis by the researchers of the titles and abstracts in the first phase, and an appraisal of the entire article afterwards. The process of selecting the studies was recorded on an analysis grid by two researchers, and they were compared and, in the event of disagreement, analyzed by another researcher.

Data extraction

To extract the data, an adapted tool was used containing the main information to be extracted from the article, such as identification (author, year, country), reference levels of evidence, study design, objectives and results found.

The level of evidence of research is structured based on the evaluation of its methodological design, where: level I - evidence from systematic reviews or meta-analyses of randomized controlled clinical trials; level II - evidence from at least one well-designed randomized controlled clinical trial; level III - evidence from well-designed clinical trials without randomization (quasi-experimental studies); level IV - evidence from well-designed case-control and cohort studies (observational studies); level V - evidence from systematic reviews of descriptive or qualitative studies; level VI - evidence from a single descriptive or qualitative study; level VII - evidence from opinions of authorities, expert committee reports or literature/narrative reviews.[13]

RESULTS

Study selection

By searching the databases, a total of 8 articles were identified (CINAHL Complete = 5; MEDLINE Complete = 3), of which 1 was rejected due to its title, 3 due to its abstract and 1 due to the exclusion criteria in the JBI tables. The results of the search are described and presented in figure 1.

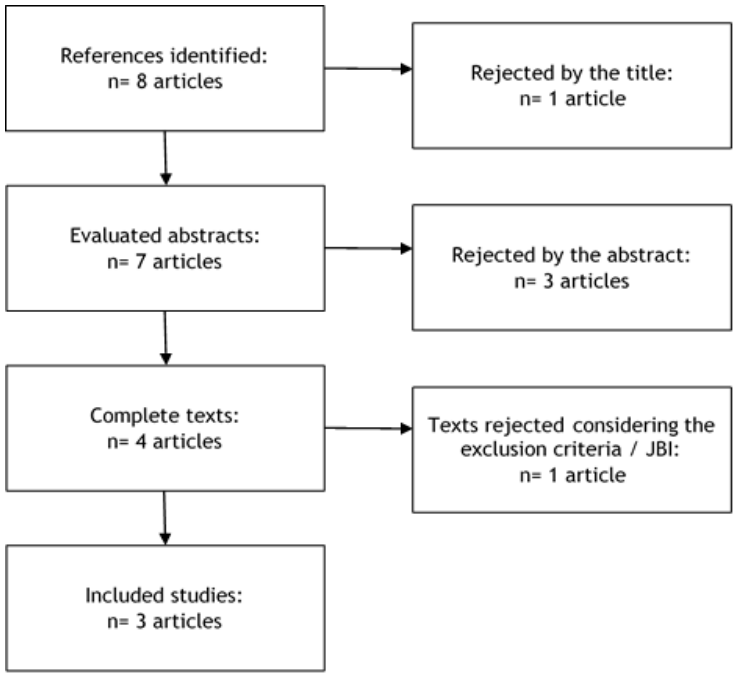


Figure 1. PRISMA flowchart

Characteristics of the studies

This RLR included 3 articles. The most recent study was published in 2022 and the other two were published in 2017 and 2019. The studies were conducted in Australia, the United Kingdom and the United States of America. The sample sizes are small, ranging from 8 to 16 participants. Two studies were qualitative and one was mixed. All the articles correspond to level of evidence VI,

reflecting evidence from a descriptive/qualitative study.

In the study conducted in Australia, participants (people with stroke and caregivers) were subjected to educational sessions to improve their understanding of the disease, using a three-dimensional VR display. This approach promoted an increase in knowledge about stroke, accompanied by increased satisfaction, feelings of acceptance and motivation to manage their own risk of stroke.

In the UK study, the aim was to explore users' perspectives on the use of VR as a tele-rehabilitation tool for spatial neglect. Its main results pointed to barriers and facilitators of this technology. The barriers consisted of the clarity of the instructions, the equipment (cost, availability) and the level of experience with the technology. The facilitators were feedback, involvement, fun and the associated psychological benefits.

Finally, the study carried out in the United States of America evaluated the feasibility of an intervention combined with VR technology, called MetacogVR, concluding that the study provided preliminary evidence for the use of this technology. The intervention under analysis showed cost-efficiency, transportability, motivation and individualization. It also demonstrated feasibility in terms of guided discovery, cognitive strategies and repetition intensity. Table 1 summarizes the characteristics of the three articles included.

To assess the methodological quality of the articles, the quality criteria defined by the JBI were used (table 1), and a summary table was structured, containing the analysis of methodological quality and the analysis of bias, as explained in table 2.

It can be seen that this study has a bias, as the studies also have a bias. As the table above shows, criteria 6 ("Are beliefs and values and their potential influence stated in the study?") and 7 ("Is the potential influence of the researcher on the study and the potential influence of the research process itself on the researcher and the interpretations he or she makes acknowledged and addressed?") are not present in the studies analyzed.

This RLR has some limitations. First of all, reference should be made to the small number of articles that this review generated. The fact that this is an emerging topic, with still few published evidence studies, focused on a very specific population, such as caregivers of people with strokes, limited the search results, justifying the small number of articles found. This limited number of articles does not allow generalizations to be made. The number of databases used and the language selected are also another limitation, as they may reduce the possibility of identifying complementary information in other studies included in other databases.

Table 1. Characteristics of the articles included in the rapid literature review

Authors/Year	Country	Level of Evidence	Type of Study and Sample	Objective	Main results
Thompson-Butel et al.[14] / 2019	Australia	VI	Qualitative study; 8 participants (4 patients and 4 caregivers)	Carry out a preliminary evaluation of an educational session with guided and personalized visualization through the use of VR	Increased knowledge (areas such as brain anatomy and physiology, neurological injury and recovery, risk factors for stroke and the benefits of acute phase treatment. High satisfaction and feelings of acceptance and motivation to manage their own risk of stroke.
Morse et al.[16] / 2022	United Kingdom	VI	Mixed study (quantitative/ qualitative); 16 participants (7 patients, 3 caregivers and 6 doctors)	Explore users' perspectives on the use of self-administered VR in spatial neglect, identifying barriers and facilitators of this tool	Barriers: clarity of instructions, equipment (cost, availability), level of experience with technologies; Facilitators: feed-back performance, involvement, fun, associated psychological benefits
Boone et al.[17] / 2017	United States of America	VI	Qualitative study; 15 participants (5 patients, 5 caregivers and 5 occupational therapists)	To evaluate the perceived acceptance and practical feasibility of a complex intervention (Metacog VR) aimed at motor limitations, sequelae of stroke	The intervention is cost-effective and transportable. It is also highly motivating and client-centered. The intervention was facilitated by guided discovery, cognitive strategies and high repetition.

Table 2. Methodological quality and risk of bias of the articles included in the RLR

Criteri (JBI) Articles	1	2	3	4	5	6	7	8	9	10	Methodological quality
1 Thompson-butel et al.[14] / 2019	Yes	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes	8/10 (80 %)
2 Morse et al.[16] / 2022	Yes	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes	8/10 (80 %)
3 Boone et al.[15] / 2017	Yes	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes	8/10 (80 %)
Bias analysis	100 %	100 %	100 %	100 %	100 %	0 %	0 %	100 %	100 %	100 %	

DISCUSSION

The applicability of VR/AR in training both the caregiver and the stroke survivor stands out, across the three studies included in this RLR. In the study conducted in Australia, participants (people with stroke and caregivers) underwent education sessions

to promote understanding of the disease, through VR technology, using a three-dimensional display.[14] This approach has proved to be a promising educational tool for both people with stroke and their caregivers, increasing their overall perception of the experience. Boone et al [15] also recognize the viability of VR/AR intervention in terms of guided discovery, cognitive strategies and high repetition, important factors that influence learning. Morse et al [16] point to performance feedback as a facilitator of VR/AR technology. This dimension, closely associated with positive reinforcement, is, along with individualization, repetition and active methods, a health education strategy with an apparent impact on changing lifestyles.[17] In this regard, Rocha et al[18] point out that the reward system is intrinsically linked to the limbic system, which is responsible for organizing and integrating emotions. The feedback provided by VR/AR, whether through visual or auditory stimuli, generates emotional experiences which, combined with repetition, can increase brain activation, triggering learning. The literature emphasizes the importance of training, particularly educational activities aimed at the family and caregiver about stroke and its risk factors.[19,20] These should be a priority for the healthcare team and nurses, as they promote health, prevent disease and enhance the quality of life of both the caregiver and the person being cared for.[19] They also allow for increased self-efficacy in accessing information and satisfaction with the information received.[20]

It is worth noting the value of VR/AR in motivating its users, both caregivers and stroke survivors. Boone et al.[15] recognize it as an important outcome of VR/AR intervention and Thompson-Butel et al.[14] associate it with the prevention/management of stroke risk itself, following educational intervention with VR/AR. Motivation promotes the retention and commitment of those involved in the rehabilitation process, as well as making the experience more satisfying, as it gives immediate meaning to a task performed. In the study by Morse et al.[16], conducted in the UK with stroke survivors and caregivers, barriers and facilitators to the use of this technology were identified. This identification is useful because it allows future strategies to be developed to address the constraints encountered, such as the clarity of instructions, the cost and availability of equipment and the user's level of experience with technology. The design of self-administered VR/AR tools, adapted to home environments, which respect principles such as cost-efficiency, transportability and individualization,[15] is a challenge to which Rehabilitation Nurse Specialists (RNS) can contribute, both because of their knowledge of functional re-education and training in activities of daily living, and because of their empathy and understanding of the limitations faced by stroke survivors.[21,22] Involvement, fun and the psychological benefits that come from using these technologies are also pointed out as facilitators of VR/AR. Kokorelias et al.[23], in a study on the use of VR/AR in caregivers of people with dementia, report the potential impact of these technologies on improving empathy, understanding, developing skills, increasing feelings such as confidence and competence, as well as resilience. They also point to the ability to reduce depressive symptoms and increase well-being. Along the same lines, Thompson-Butel et al.[14] point to the acceptance of rehabilitation, as well as increased feelings of independence and confidence.

CONCLUSIONS

The use of VR and AR in IC and stroke survivors is an emerging topic with great potential for development. There are few studies on this subject, which do not allow for strong scientific evidence of its effectiveness in this specific context. Nevertheless, this review has shown that VR and AR can have a positive impact on stroke survivors and their ICs, improving their quality of life.

In general terms, in response to the starting question, there are indications that the use of VR/AR in the IC of stroke survivors has the potential to increase their training (associated with increased knowledge, performance feedback, guided discovery, cognitive strategies, intensity of repetitions), allowing not only the training of motor skills, but also cognitive skills. It has also been shown to increase motivation (both for the use of VR/AR and for the prevention of the disease itself), as well as generating feelings of satisfaction, promoting acceptance of rehabilitation, independence and confidence. The RNS can make an important contribution, both in terms of their knowledge of functional re-education and training in activities of daily living, and in promoting empathy and understanding of the limitations felt by stroke survivors.

The barriers encountered could help to outline strategies for future studies. This is a topic that needs more evidence of its real applicability and concrete benefits for the IC training of people with strokes, particularly in the area of rehabilitation nursing.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

AUTHORSHIP CONTRIBUTION

Conceptualization: Cláudia Ferreira, Sónia Ferreira, Manuel Cardoso, Vera Esteves.
Data curation: Cláudia Ferreira, Sónia Ferreira.
Formal analysis: Cláudia Ferreira.
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Validation: Sandy Severino, Helena José, Luís Sousa.
Display: Cláudia Ferreira.
Drafting - original draft: Cláudia Ferreira.
Writing - proofreading and editing: Isabel Rabiais, Sandy Severino, Helena José, Luís Sousa.

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