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Original research article

Pilot test of a virtual reality-based psychoeducation program for family caregivers caring for post-stroke survivors

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Abstract
According to recent research, many family caregivers lack the necessary knowledge and skills to provide effective care for individuals who have survived a stroke. Interventions such as psychoeducational training have demonstrated the potential to enhance caregiver competence and patient outcomes. Utilizing virtual reality to deliver educational content to family caregivers represents a novel approach to addressing the challenges encountered by caregivers of post-stroke survivors. In a quasi-experimental study employing a one-group, pre-test and post-test design, we recruited a cohort of 30 family caregivers responsible for providing care to stroke survivors within their homes. The study sample was drawn from a hospital in Surabaya, Indonesia. Participating family caregivers of stroke survivors completed a four-week psychoeducational program, following which data on effectiveness and feasibility were collected. The findings revealed a statistically significant reduction in the DASS-42 score after the program ($t = 31.22$, $p < 0.001$), indicating that the psychoeducational program was perceived as beneficial for family caregivers of stroke patients. Subsequently, the next phase will involve the implementation of the psychoeducational program with a broader group of family caregivers of stroke survivors.

Keywords: Family caregiver; Psychoeducation program; Stroke survivors; Virtual reality

Introduction

Stroke is a leading cause of death and disability in Indonesia (Venketasubramanian et al., 2022). The responsibility of caring for stroke survivors often falls on family caregivers, requiring significant time and energy, which profoundly impacts their well-being (Kokorelias et al., 2020; Lu et al., 2019). Family caregivers, who are typically unpaid, provide essential emotional, physical, and practical support to relatives with chronic illnesses, contributing 75–90% of the care needed for community-dwelling adults (Pilapil et al., 2017; Schulz et al., 2020). These caregiving roles often equate to half or even full-time responsibilities (Lacey et al., 2019; Skolarus et al., 2016).

Caring for post-stroke patients long-term can negatively affect caregivers' physical and mental health, leading to emotional burdens, such as stress and sadness, and diminishing their quality of life (Harrison et al., 2017; Koyanagi et al., 2018; Loh et al., 2017; Qiu et al., 2018). Studies show that the cognitive and emotional deficits of stroke survivors impact caregiver well-being more than their motor or functional deficits (Freytes et al., 2021). Depression rates among caregivers in Indonesia are as high as 56.7%, with factors like gender and long caregiving hours contributing to these challenges (Fauziah et al., 2022). Moreover, caregivers' reduced well-being can directly affect the quality of care provided to stroke survivors (Grant et al., 2013; Pucciarelli et al., 2017).

Research highlights that many family caregivers lack the necessary knowledge and skills for effective post-stroke care (Pitthayapong et al., 2017; Simandalahi, 2018). Common knowledge gaps include managing psychological issues, understanding local services, and recognizing stroke risk factors (Mackenzie et al., 2007). Interventions such as psychoeducational training have been shown to improve both caregiver competence and patient outcomes (Bakas et al., 2014). Research suggests that psychoeducational interventions, incorporating relevant skills training such as problem-solving and self-care, have shown positive outcomes in reducing stroke survivors' psychological distress and enhancing family caregivers' quality of life (Bakas et al., 2014).

Advancements in virtual reality (VR) technology present an opportunity to address the challenges faced by family caregivers of post-stroke individuals. Although some studies have utilized VR as an intervention in post-stroke cases, its application has predominantly focused on post-stroke survivors. For example, VR has been employed for motor exercise rehabilitation (Choy et al., 2023), and to alleviate post-stroke depression (Blázquez-González et al., 2023). Regrettably, while VR is more

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commonly utilized in health professions education, there remains a limited understanding of its potential to educate family caregivers (Foronda et al., 2023a). Utilizing virtual reality to deliver educational content to family caregivers represents an innovative strategy for alleviating the challenges faced by family caregivers of post-stroke survivors. This approach also holds promise for enhancing the overall well-being of family caregivers.

Materials and methods

Study design

This study employed a one-group quasi-experimental design, incorporating pre-test and post-test measurements, to assess the impact of a psychoeducational program on family caregivers of post-stroke patients. Additionally, the study aimed to evaluate the feasibility of this program for family caregivers.

Study sample

We employed a convenience sampling method to select family caregivers residing in Surabaya, Indonesia. Hospital staff kindly assisted with recruitment by contacting potential participants on our behalf. The inclusion criteria required family caregivers to be 20 years or older, caring at least 1-month post-stroke, fluent in Indonesian, family caregivers for stroke survivors (spouse, and children), and providing unpaid care.

Intervention

We have designed the education program in two phases, guided by the research conducted by (Chen et al., 2021). The first stage was a review of the literature. The second stage involved a review by a panel of experts to ensure the program's content appropriateness for implementation into practice. We then revised the program based on the panel's feedback and evaluation.

Stage 1: Development of a psychoeducation program

This psychoeducation program was developed by researchers based on theories and evidence obtained from the reviewed literature (Foronda et al., 2023b; Maggio et al., 2024). The program proposes that families adopt effective problem-solving and coping strategies to deal with stressful situations, drawing on the family's available resources as well as their perceptions of the situation (McCubbin et al., 1991). The program is designed to strengthen the resources and perceptions of caregivers of stroke survivors through three main components: information provision, psychological support, and emotional and behavioral regulation. These components were identified through a review of previous literature (Mou et al., 2021) and are expected to enhance caregivers' coping strategies and improve their functional and psychosocial health outcomes.

The primary method chosen for educational sessions is virtual reality (VR). This approach is deemed more effective in enhancing knowledge and skills for therapeutic purposes than traditional digital education methods, such as online education (Baniasadi et al., 2020; Kyaw et al., 2019). The use of VR in health professions education is gaining popularity, and research suggests that most family caregivers perceive these VR experiences as beneficial.

The intervention focused on providing stroke-related knowledge to caregivers through three main sessions.

Session 1: Getting to know strokes

This session aimed to give stroke caregivers basic knowledge about strokes and to change their perceptions about strokes, treatment, and prevention. The materials covered include symptoms and signs of a stroke, the recovery process, and associated risk factors. Caregivers with a solid fundamental understanding of strokes, including symptoms, signs, and risk factors, can be more effective in identifying and managing this condition. This knowledge allows them to respond more quickly and appropriately when stroke symptoms appear, which can improve patient health outcomes (American Stroke Association, 2020).

Session 2: Caregivers' role in helping stroke patients

This session focused on assisting caregivers in supporting the daily lives of stroke survivors, especially in terms of adaptation and management during the recovery and rehabilitation process. Topics covered include managing complications, daily care, and techniques to maximize the stroke survivor's independence in performing basic daily activities. The session also emphasized the importance of caregivers maintaining their functional abilities.

Session 3: Psychological adjustment and stress management

This session focused on guidance for caregivers in dealing with psychosocial stress and negative emotions arising from stroke care. Various emotion management strategies, such as deep breathing exercises and progressive muscle relaxation, were introduced through information and skills training. Caring for stroke survivors often triggers significant psychosocial stress for caregivers. Prolonged stress can negatively impact the mental and physical health of caregivers, making it essential to provide strategies that can help them manage stress effectively.

Stage 2: Expert review

During the second phase, a panel of five esteemed experts convened to comprehensively evaluate the program protocol. A panel of distinguished experts was commissioned to assess each video module of the psychoeducational program delivered in virtual reality format. They provided valuable feedback and evaluated the feasibility of the material through a structured survey. The panel included professionals from diverse disciplines, affiliated with various universities and hospitals in Indonesia, with expertise in intervention research, healthcare quality assessment, family caregiving, stroke management, and rehabilitation. To mitigate bias, the experts assessed the pilot program independently and anonymously. The experts were assigned the important task of reviewing the modules and program strategies, where they provided valuable feedback and recommendations for enhancements. An expert panel evaluated the content's relevance and appropriateness using the Content Validity Index (CVI) framework, which utilizes a structured four-point rating scale (Lynn, 1986). Experts were invited to share their insights and recommendations for each item with a score of 3 or lower. As a result of their evaluations, the program intervention strategy was refined, including removing specific items. These items included: (1) Introduction to stroke from definition to prevention, (2) assistance from family caregivers not only focusing on fulfilling ADLs but also emotional support to patients, and (3) guidance for family caregivers on ways to independently manage stress.

The updated educational program was presented to the expert panel for review and consensus. Upon their evaluation, it was determined that no further revisions were required. The finalized program comprises three modules and an accompanying video. Table 1 details the contents of these modules, the video, and the strategies employed throughout the program.

Table 1. Descriptions of key content in the psychoeducation program

Session	Topics	Activities
Part 1: First session (10–30 minutes)	*Video 1: Getting to know strokes* ➲ Stroke definition ➲ Stroke risk factors ➲ Types of strokes ➲ Stroke symptoms ➲ Stroke prevention ➲ Stroke treatment	Education through VR 3 times a week
Part 2: First session		Follow-up telephone counseling
Part 1: Second session (10–30 minutes)	*Video 2: Caregivers' role in helping stroke patients* ➲ ADL Support strategies for stroke survivors ➲ Emotional support for stroke survivors	Education through VR 3 times a week
Part 2: Second session		Follow-up telephone counseling.
Part 1: Third session (10–30 minutes)	*Video 3: Psychological adjustment and stress management* ➲ Why stress management is important ➲ Signs of stress in caregivers ➲ Stress and emotional management strategies	Education through VR 3 times a week
Part 2: Third session		Follow-up telephone counseling

Procedure

The study obtained approval from the Institutional Review Board of Haji Surabaya Hospital, Indonesia. Thirty volunteers were enlisted and duly provided informed consent. All participants were informed of their right to withdraw from the study without consequence. Following the recruitment of participants, the team organized appointments and facilitated the intervention in the comfort of the patients' residences. The principal investigator thoroughly trained a skilled and qualified interventionist, who holds a bachelor's degree in nursing, on the program protocol. This interventionist successfully implemented the educational program, ensuring both consistency and inter-rater reliability throughout the process. The intervention sessions comprised two parts. Part 1 of each session lasted 10–30 minutes and was conducted thrice a week before the patient's discharge. Research indicates that brief VR sessions, lasting 10–30 minutes per session, can effectively facilitate the acquiring of fundamental skills or core knowledge and significantly improve knowledge retention and understanding (Parong and Mayer, 2018). VR sessions conducted two to three times a week can effectively reinforce learning without overwhelming caregivers (Pottle, 2019).

Section 2 of the intervention entails the evaluation of the education provided. This phase encompasses three follow-up phone calls, each lasting approximately 30 minutes (Fox, 2022), conducted after every VR education session. Throughout these calls, researchers meticulously review the material covered in each session. Caregivers were encouraged to reflect on and identify their unmet needs, including aspects related to self-care, inappropriate caregiving practices, and stressful experiences from the past week. One week after the final telephone session, each participant took part in an interview with a member of the research team. The purpose of this interview was to assess the program's impact on depression, anxiety, and stress, as well as to evaluate its acceptability, relevance, effectiveness, and overall usefulness.

Measurements

Demographics background and DASS-42

The socio-demographic form collected information on age, gender, education level, marital status, occupation, income, type of stroke, relationship with the stroke patient, and daily caregiving hours. The DASS-42, developed by Lovibond and Lovibond in 1996, is a validated instrument used to measure emotional states associated with depression, anxiety, and stress. This study employed the Indonesian version, translated by (Damanik, 2006), which has shown high internal consistency and reliability, with a Cronbach's α of 0.851 in a stroke patient population (Suryani, 2016). Each subscale consists of 14 items assessing symptoms of depression, anxiety, and stress. Responses are recorded on a 4-point Likert scale: 0 ("does not apply to me at all"), 1 ("applies to me to some degree or some of the time"), 2 ("applies to me to a considerable degree or a good part of the time"), 3 ("applies to me very much").

Feasibility

After the fourth weekly session, each participant took part in an individual interview with a researcher. During these interviews, family caregivers rated each video based on four key criteria: (1) acceptability, (2) applicability, (3) helpfulness, and (4) usefulness (Chen et al., 2021). Ratings were given on a 10-point scale, where a score of 1 indicated that the video was highly unacceptable, irrelevant, unhelpful, and ineffective for the caregiver's well-being, while a score of 10 signified complete acceptability, full applicability, high helpfulness, and significant benefit to the caregiver's health. Participants were invited to provide their insights and reflections through open-ended questions: (1) What do you think and feel about this intervention experience? (2) What aspects of this intervention did you find helpful/useful? (3) What aspects of this intervention were unhelpful or should be improved? (4) What aspects of the intervention were difficult to understand or apply? (5) Do you have any other suggestions for this intervention? Responses were meticulously recorded by the interviewer on evaluation forms to ensure accurate documentation of participant feedback. The qualitative interview has been included in the Supplementary materials.

Data analysis

Data analysis was conducted using SPSS version 25.0. Descriptive statistics, including means, frequencies, percentages (%), and standard deviations (SD), were employed to effectively summarize the demographic characteristics of the participants. A paired *t*-test was performed to compare the mean scores for depression, anxiety, and stress before and after the intervention. Statistical significance was established with a threshold *p*-value of 0.05. Feasibility ratings were analyzed utilizing frequency distribution techniques. Additionally, open-ended responses were systematically categorized to facilitate in-depth analysis.

Results

Participants' characteristics and DASS-42

The participants in the study had an average age of 38.47 years, with a standard deviation of 11.12 and a range of 22 to 60 years. The majority of participants were female (*n* = 22). A significant portion of the participants had completed senior high school education (*n* = 18, representing 60%), while most caregivers reported being married (*n* = 25, accounting for 83.3%). Most caregivers were self-employed (*n* = 13; 43.3%) and earned less than $68 monthly (76.7%). The stroke patients that caregivers were supporting mostly suffered from ischemic strokes (86.7%). The most common relationship between caregivers and stroke patients was that of a son or daughter (60.0%). On average, family caregivers spent 7.33 hours per day caring for stroke patients, with a standard deviation of 5.83 hours (range: 0–18). Comprehensive information regarding demographic characteristics is presented in Table 2. The average score on the DASS-42 demonstrated a significant decrease by the program's conclusion ($t = 31.22$, $p < 0.001$; Table 3).

Feasibility

Table 4 outlines the evaluation results of each video. The first video, "getting to know strokes", posed some challenges for participants regarding acceptance and application, with ratings ranging from 8.20 ± 0.40 to 8.53 ± 0.57. In contrast, the second and third videos were more readily accepted and applied by participants, with ratings ranging from 9.30 ± 0.70 to 8.83 ± 0.37. Following the initial intervention (i.e., video 1), 46.7% (14/30) of participants reported experiencing dizziness but remained highly motivated to comprehend the material. Some participants noted improvements, including reduced Depression Scale scores (*n* = 18), decreased Anxiety Scale usage (*n* = 15), and lower Stress Scale scores (*n* = 20).

Table 2. Demographic characteristics of study participants (*N* = 30)

Variable	*N*	%	M	SD
Age (years old)			38.47	11.12
Gender				
Male	8	26.7		
Female	22	73.3		
Education level				
Junior High School	2	6.7		
Senior High School	18	60.0		
University	10	33.3		
Status				
Single	5	16.7		
Married	25	83.3		
Occupation				
Not working	10	33.3		
Self-employed (Business/Self-Employed)	13	43.3		
Temporary (Temporary job)	4	13.3		
Regular (Has a permanent job)	3	10.0		
Income				
<68$/month	23	76.7		
>68$/month	7	23.3		
Type of stroke				
Ischemic	26	86.7		
Hemorrhagic	4	13.3		
Relationship with stroke patients				
Spouse	12	40.0		
Son/daughter	18	60.0		
Time spent in caring for patients in a day (hours)			7.3	5.82

Note: M – mean; SD – standard deviation.

Table 3. Difference between subject pre-test and post-test scores on the DASS-42 (*N* = 30)

Variable	Pre-test		Post-test		*t*	*p*
	M	SD	M	SD		
DASS-42 scale	79.30	9.93	63.50	9.45	31.22	<0.001
Depression scale	24.40	3.16	19.13	3.18	31.79	<0.001
Anxiety scale	25.40	3.74	20.40	3.71	17.62	<0.001
Stress scale	29.50	4.74	23.96	4.46	21.91	<0.001

Note: M – mean; SD – standard deviation; *t* – paired *t*-test; $p < 0.01$.

Table 4. Feasibility evaluation by family caregivers (*N* = 30)

	Acceptability M ± SD	Applicability M ± SD	Helpfulness M ± SD	Usefulness M ± SD
Video 1: Getting to know strokes	8.53 ± 0.57	8.23 ± 0.43	8.20 ± 0.40	8.20 ± 0.50
Video 2: Caregivers' role in helping stroke patients	9.30 ± 0.70	9.03 ± 0.31	8.90 ± 0.48	9.16 ± 0.64
Video 3: Psychological adjustment and stress management	8.86 ± 0.34	8.96 ± 0.18	8.83 ± 0.37	8.90 ± 0.40

Note: M – mean, SD – standard deviation.

Three family caregivers provided feedback that indicated the virtual reality-based psychoeducation program significantly enhanced their ability to care for post-stroke patients. They said that the program improved their understanding of fundamental stroke-related knowledge and skills. Furthermore, they noted that it increased their awareness of unmet needs, including self-care-related, inappropriate caregiving behaviors, and the stressful experiences they had encountered the previous week. It is noteworthy that all participants completed the virtual reality-based psychoeducation program without reporting any adverse events.

Discussion

The pilot study revealed that caregivers experienced a notable reduction in depression and reported decreased stress levels following their participation in the virtual reality-based psychoeducation program (Batool et al., 2022). Although participants initially encountered challenges during the program's first session due to conflicting sensory information from the eyes and ears in the virtual environment, leading to disruptions in normal depth perception and balance (Jammal et al., 2024; Katsavelis et al., 2010), they ultimately acknowledged the program's beneficial impact. The study underscored the importance of balancing the enhancement of family caregivers' self-confidence with opportunities to refine their stress management. Consequently, participants offered favourable feedback regarding the program's feasibility, emphasizing its practical value and usefulness.

The feasibility evaluation of the virtual reality-based psychoeducation program by family caregivers (*N* = 30) revealed varied acceptability, applicability, helpfulness, and usefulness across the different video modules. Getting to Know Strokes had the lowest ratings of the three videos. The relatively lower scores for this video could be attributed to the participants' initial unfamiliarity with the virtual reality format and the complexity of integrating new information about strokes into their existing knowledge base. This initial learning curve may have contributed to the challenges in fully accepting and applying the content during the first session. Video 2: Caregivers' Role in Helping Stroke Patients received the highest ratings in all evaluated areas, scoring notably higher than in the first video. These results suggest that the content of this video was more aligned with the caregivers' needs and experiences, making it easier for them to relate to, accept, and apply the information presented. The higher ratings could also indicate that as participants became more accustomed to the virtual reality environment, they found the content more relevant and directly applicable to their caregiving roles. Psychological adjustment and stress management also received positive evaluations, with scores reflecting strong acceptance and relevance and indicating that participants found the psychological support content valuable for managing stress. The relatively high scores for this video suggest that the caregivers recognized the importance of psychological well-being and could see the immediate benefits of the stress management strategies discussed.

The virtual reality-based psychoeducation program garnered positive feedback overall, with an increasing level of acceptability and applicability observed as participants progressed through the program. The initial challenges encountered with video 1 underscore the importance of adequately preparing participants for the unique demands of a virtual reality environment. This may necessitate a more gradual introduction to the technology and the program content. The subsequent videos received higher ratings, indicating that caregivers found the program increasingly helpful and valuable as they became more familiar with the format. These findings underscore the potential of virtual reality as a tool for providing psychoeducation to family caregivers, provided that appropriate measures are implemented to facilitate the transition into this innovative learning environment.

Researchers developed this program by integrating modern technological advancements. Consequently, family caregivers of post-stroke patients expressed appreciation for the value and assistance provided by the virtual reality-based psychoeducation program. They also emphasized the program's engaging nature and underscored the need for further enhancements to better support family caregivers of post-stroke patients. Most family caregivers involved in the study possessed a high school education, and the Virtual Reality-Based Psychoeducation Program was specifically tailored to meet the needs of individuals with low literacy. The program's objective was to provide support and empowerment to these caregivers by assisting them in addressing specific caregiving challenges, ultimately enhancing their ability to manage stress.

Given that this was a pilot study, it is important to respectfully acknowledge several limitations concerning the sample size, selection process, and the study's overall design. Our observation of notable changes in caregiver stress levels suggests the need for further research in this area. We recommend that future studies incorporate a larger sample size, include a control group, and extend the follow-up period post-intervention duration to enhance the findings' robustness. The initial evaluation of the program's feasibility indicates promising results; however, it is essential to note that this study was conducted in a single regional hospital. Additional research is required to validate these findings further and assess the program's feasibility in various community settings.

Conclusion

This preliminary study was conducted to assess the feasibility and effectiveness of a Virtual Reality-Based Psychoeducation Program designed for family caregivers of individuals who have experienced a stroke. Despite encountering initial challenges related to the unique technical requirements of virtual reality, participants ultimately reported the program to be valuable, beneficial, and engaging. The program effectively addressed the needs of caregivers, particularly those with low literacy levels, by equipping them with essential stress-management techniques. The program exhibited promise in alleviating caregiver stress and improving caregiving practices. Nonetheless, the study's constraints, including the limited sample size, absence of a control group, and specific community setting, emphasize the necessity for further investigation. Subsequent studies should encompass more extensive and diverse demographics, incorporate control groups, and prolong the follow-up duration to more effectively evaluate the program's enduring impact and broader applicability. The favourable feedback from participants implies that, with ongoing refinement, this program could evolve into a valuable resource for family caregivers in diverse communities.

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Ethical aspects and conflict of interest
The authors have no potential conflict of interest to declare in relation to this work's research, authorship, or publication.

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