RESEARCH
www.commprac.com
ISSN 1462 2815

IMPACT OF MOBILE APPLICATION ON QUALITY-OF-LIFE STROKE SURVIVOR: A SYSTEMATIC REVIEW

Dwijayanti Mei Ana Dewi [1], Sidik Awaludin [2] and Yunita Sari [3]*

[1] Master of Nursing Student, Department of Nursing, Jenderal Soedirman University, Indonesia.
[2,3] Department of Nursing, Jenderal Soedirman University, Indonesia.
*Corresponding Author Email: yunita.sari@unsoed.ac.id

DOI: 10.5281/zenodo.13378783

Abstract

Stroke significantly reduces patients' quality of life. Digital technology offers potential solutions, but other studies found that mobile applications did not improve the quality of life. There was a significant gap in understanding the impact of mobile applications on stroke patient’s quality of life. The study aimed to investigate the effect of mobile applications on stroke patient’s quality of life. This systematic review was conducted according to the PRISMA guidelines. Major databases were searched using PICO criteria, including Springer Link, Sage Journals, ProQuest, EBSCOhost, Clinical Key, Scopus, Science Direct, IEEE Xplore, PubMed, and Google Scholar, from 2019 to 2024 for English-language studies, excluding non-research or inaccessible articles. The Joanna Briggs Institute checklist was used for screening and quality assessment, with the goal of a thorough evaluation through descriptive and thematic synthesis. From an initial pool of 35,175 articles, 59 were considered for abstract review after removing duplicates and irrelevant titles. Further screening for relevance to education or mHealth resulted in 18 articles, of which 12 were accessible and met all inclusion criteria for the review. The study, which included 1,490 patients, mainly from randomized trials in different countries since 2020, for 1-6 months, explored technology in stroke rehabilitation. It examined smartphone apps, focusing on education, self-care, monitoring, and engagement to significantly improve patient quality of life. Mobile applications significantly improve stroke rehabilitation outcomes, patient quality of life, and functional abilities, necessitating their integration into patient-centred stroke rehabilitation protocols.

Keywords: Mobile Application, Stroke, Quality of Life.

INTRODUCTION

Stroke is the second most prevalent cause of mortality and the primary cause of disability globally (1). Between 1990 and 2019, there was a significant 70% rise in the number of strokes, in addition to stroke prevalence increased by 85%, mortality increased by 45%, and disability-adjusted life-years (DALYs) increased by 32% (2). Stroke is the cause of global losses reaching 721 billion US dollars (0.66% of global GDP) and bears the most significant burden in low and lower-middle-income countries (86% of deaths and 89% of DALYs) (3). Stroke causes neurological deficits that affect patients' physical, psychological and social aspects, significantly reducing their quality of life (4).

Stroke patients have a worse quality of life (5), where the physical dimension is the main factor affecting the patient's quality of life (6). Motor rehabilitation is one of the efforts that can be done to improve physical function, independence and active participation of stroke patients (7). The results showed that increased daily physical activity can optimize stroke patients' quality of life and confidence to return to daily life (8). However, in its implementation, patients and their caregivers lack knowledge and independence, so monitoring is required in the process (9).

Rehabilitation of stroke patients can be improved by involving healthcare teams and community and family health nursing services (10). As healthcare providers, nurses can improve stroke patient outcomes through appropriate nursing interventions (11).

Studies prove that theory-based and evidence-based health education programs provided by nurses can improve self-efficacy, quality of life and the level of knowledge of stroke patients about the disease (12). Therapeutic education programs have been shown to lower the burden of care and improve stroke patients' quality of life (13). The educational method of providing physical exercise modules for patients shows positive results in improving the gait, balance, daily activities, and functional status (14).

Studies show that the type of mobile app created similar to face-to-face therapy combined with education is very beneficial in stroke recovery (15). Digital technology as a stroke rehabilitation tool and digital treatment, such as online platforms, virtual reality exercises, and iPad/Android applications, have also been widely researched and provide solutions to stroke services (16). However, the other study found that using mobile applications as an intervention did not significantly affect stroke patients' quality of life (17).

Despite prior research, significant gaps exist in understanding the effect of mobile applications on the quality of life for stroke patients. These include methodological variations, population specificity, mobile app diversity, outcome inconsistencies, and limited exploration of long-term effects. Therefore, this study was conducted to analyze the impact of mobile applications on the quality of life of stroke patients based on existing *evidence-based research*. This study is expected to provide benefits in nursing practice and inspire nurses to develop technology-based service innovations.

METHODS

Design

The design of this article is a systematic review concerning Preferred Reporting Items for Literature Review and Meta-Analyses (PRISMA). The search process begins with formulating PICO, which is used to direct authors in clinical search articles. The formulation of PICO is as follows in the table 1:

Table 1: PICO Settings

Study Design	Publication Data
Population	Adult with stoke (stroke non-hemorrhagic or stroke hemorrhagic)
Interest/Exposure	Education based on the mobile application as a media intervention
Comparison	The existence of a control group compared to the intervention group
Outcome	Quality of life

Search methods

Article search for systematic review uses keywords. The keywords used are: "mobile application" OR "mHealth" AND "education" AND "quality of life" AND "post-stroke" OR "stroke" OR "stroke survivor" AND "randomized controlled trial". Primary article search uses an electronic database that aims to obtain relevant articles. The databases used include Springer Link, Sage Journals, ProQuest, EBSCOhost, Clinical Key, Scopus, Science Direct, IEEE Xplore, PubMed, and Google Scholar. The search for articles used has been going on for the last 5 years.

Inclusion and exclusion criteria

The search was limited to English-language studies involving human subjects. The inclusion criteria for this study were: (1) published from 1st January 2019 to 22th January 2024; (2) written in English; (3) including at least one word related to mobile

ISSN 1462 2815

education, application, quality of life, and stroke in the title; (4) Randomized control trials (RCTs), quasi-experimental study, or cross-sectional study; (5) Study population were adult (age 18+) with stroke; (6) The primary intervention studied was mobile application. The exclusion criteria were: (1) reviews, protocols, abstracts, case reports/series or descriptions of mobile applications; (2) articles not accessible; (3) articles not available in full text.

Data extraction

After searching, 35,175 articles were reviewed based on their titles, resulting in the acquisition of 59 articles. Out of the total 43 papers, only 18 focused on android-based educational interventions and their effect on the quality of life of stroke patients. Following the selection process, the researcher identified 12 papers that satisfied the predetermined criteria for inclusion, while 6 other publications were not accessible in their entirety. A total of 12 papers underwent quality assessment utilising the checklist approach for cross-sectional research developed by the Joanna Briggs Institute. This checklist included 8 specific question items.

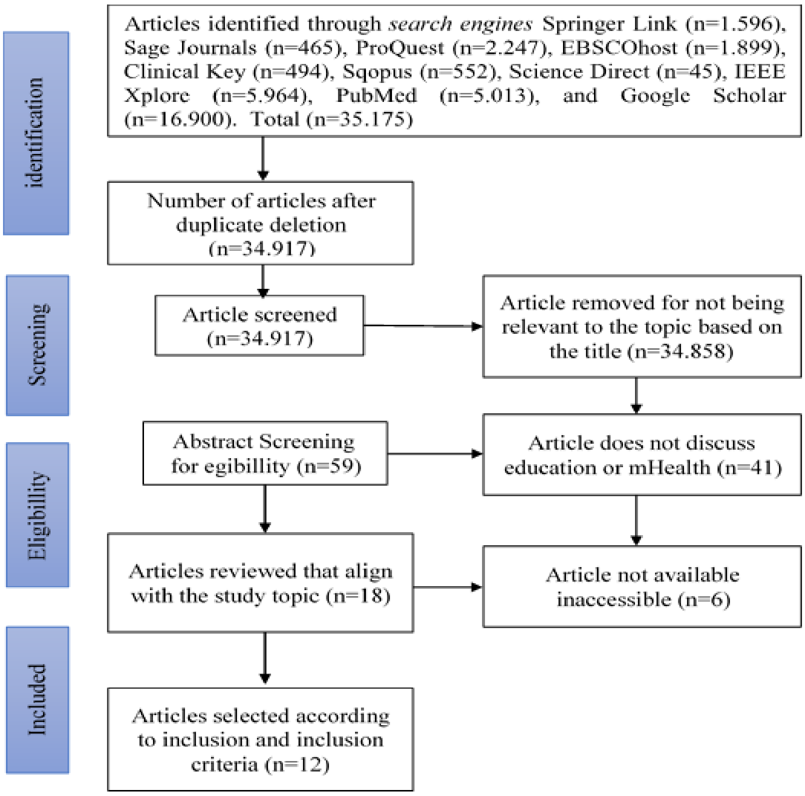

Figure 1: PRISMA flowchart

Quality appraisal

Selected articles undergo an assessment process to evaluate their quality. The assessment employs a questionnaire developed by the Joanna Briggs Institute (JBI) in 2020. This questionnaire assesses the methodology's quality and potential biases in design, behaviour, and analysis. There are multiple forms of JBI questionnaires that correspond to different research designs. JBI questionnaires will be used for experimental research designs, specifically randomized controlled trials (RCTs), in this particular situation. The assessment technique involves responding to the question points outlined in the questionnaire by utilizing yes/no/no clear/no responses, based on the content of the relevant article. Responses of "yes" are assigned a score of 1, while all other responses receive a score of 0. After dividing the scores by the total number of questions, they are multiplied by 100%. The score ranges from 80% to 100% to achieve high quality. The score falls between 50% and 79% to attain sufficient quality. Quality is considered low when the score is below 50%. Here are the assessment results from selected articles:

Table 2: Article Quality Assessment

Article Quality Assessment						
	(Kang et al., 2019)	**(Xu et al., 2023)**	**(BAL & KOÇ, 2024)**	**(Chu et al., 2020)**	**(Brouns et al., 2021)**	**(Sakakibara et al., 2022)**
Focused population?	V	V	V	V	V	V
Intervention given?	V	V	V	V	V	V
Comparator chosen?	V	V	V	V	V	V
Outcome measured?	V	V	V	V	V	V
Randomization system?	V	V	V	V	V	V
Inclusion/ exclusion?	V	V	V	V	V	V
Blind participants?	-	-	-	-	-	-
Blind investigators?	-	-	-	-	-	-
Blind analysis?	-	-	-	-	-	-
Effect of intervention reported?	V	V	V	V	V	V
Confidence intervals reported?	V	V	-	V	V	-
Benefit of experiment reported?	V	V	V	V	V	V
Harm reported?	-	-	-	-	-	-
Result can be applied?	V	V	V	V	V	V

	Article Quality Assessment					
	(Anderson et al., 2022)	**(Aphiphaksakul & Siriphorn, 2022)**	**(Guillaumier et al., 2022)**	**(Zhang et al., 2022)**	**(Kim et al., 2020)**	**(Vloothuis et al., 2019)**
Focused population?	V	V	V	V	V	V
Intervention given?	V	V	V	V	V	V
Comparator chosen?	V	V	V	V	V	V
Outcome measured?	V	V	V	V	V	V
Randomization system?	V	V	V	V	V	V
Inclusion/ exclusion?	V	V	V	V	V	V
Blind participants?	-	-	-	-	-	-
Blind investigators?	-	-	-	-	-	-
Blind analysis?	-	-	-	-	-	-
Effect of intervention reported?	V	V	V	V	V	V
Confidence intervals reported?	V	-	V	V	-	-
Benefit of experiment reported?	V	V	V	V	V	V
Harm reported?	-	-	-	-	-	-
Result can be applied?	V	V	V	V	V	V

Information:

V : Described in the journal

- : Not described in the journal

Data analysis

We selected the analytical procedure in alignment with our study aims. We conducted an analysis of the research findings using descriptive and thematic analytic techniques, and subsequently provided a synthesis of the results through discussion.

RESULTS

A total of 35,175 articles were retrieved from the search results, and 34,917 articles were found after duplicate screening. Of the articles found, 34,858 articles were disqualified because they did not have appropriate titles, resulting in 59 articles that then proceeded to the abstract screening stage. At the abstract screening stage, 41 articles were found that did not discuss education or mHealth and were excluded. This left 18 articles that met the criteria, 6 of which did not have full text. After applying the exclusion criteria, we included 12 articles that fulfilled the inclusion criteria in this systematic review. The following summary is listed in the table:

Table 3: Review Article

Table 3: Details of Selected Articles

Studies	Methods	Sample (I/C)	Participants	Applications	Settings	Times
(Kang et al., 2019)	RCT	76 (38/38)	Patients with a first stroke diagnosis, no major cognitive impairments	Stroke health-education mobile app (SHEMA) Text	Germany	30 days
(Xu et al., 2023)	RCT	101 (51/50)	Patients discharged and reintegrated post-first stroke, confirmed by MRI or CT scans.	The "Rehabilitation Guardian" application provides patients with medical information following their discharge,	China	3 months
(BAL & KOÇ, 2024)	RCT	70 (35/35)	Stroke patients treated as inpatients at a university neurology clinic	Telephone-based education and subsequent monitoring based on Orem's Self-Care Theory	Turkey	12 weeks
(Chu et al., 2020)	RCT	61 (31/30)	Stroke patients aged 18-79, moderate-severe disability, life expectancy over 6 months, BI score of 80.	Mobile application + telephone calls	China	8 weeks
(Brouns et al., 2021)	RCT	318 (165/153)	Patients over 18 with first or recurrent stroke	Fast@home applications on smartphone,	Netherland	6 months

			within the last 6 months	laptop/PC or tablet		
(Sakakibara et al., 2022)	RCT	126 (64/62)	Community-dwelling patients with stroke in the past year, mRS score 1-4	Telephone based application	Canada	12 months
(Anderson et al., 2022)	RCT	106 (53/53)	Ischemic stroke patient with 2+ uncontrolled risk factors in past year	Video-teleconferencing Self-management To Prevent stroke (V-STOP) on smarthphone, tablet or computer	Texas	18 weeks
(Aphiphaksakul & Siriphorn, 2022)	RCT	32 (16/16)	Initial stroke with hemiplegia, home treatment post-discharge, mRS ≥3, can sit unaided, PASS ≤12.5	Balance disc and smartphone application	Thailand	4 weeks
(Guillaumier et al., 2022)	RCT	399 (199/200)	Adult stroke survivors 6-36 months post-stroke, mRS ≥4	Prevent 2nd Stroke (P2S) as mobile education	Australia	12 weeks
(Zhang et al., 2022)	RCT	25 (13/12)	Patients aged 18-70 with ischaemic or haemorrhagic stroke, >6 months post-onset, MRS 2-4.	Coaching-Based Teleoccupational Guidance (Intervention Group) – WeChat coaching video	China	3 months
(Kim et al., 2020)	Prospective, Nonrandomized, Interventional Study	110	Stroke confirmed by symptoms and imaging, age over 19	Mobile Health Care System: Smart Aftercare	South Korea	12 weeks
(Vloothuis et al., 2019)	RCT	66 (32/34)	Stroke patients, lived independently, discharge to own home, MMSE >18, FAC < norm	e-health support after stroke (CARE4STROK)	Dutch	12 weeks

ISSN 1462 2815

Table 3: Details of Selected Articles

Studies	Interventions	Outcomes	Results	Conclusions
(Kang et al., 2019)	Patients were directed to use the SHEMA mobile app for stroke education	Patient knowledge Health- related quality of life	Intervention group's posttest stroke-knowledge scores increased significantly, while EQ-5D index improvements were not significant.	The short-term intervention showed slight EQ-5D score gains and improved stroke knowledge in patients ≤55 years in the SHEMA group versus control
(Xu et al., 2023)	Patients received continual nursing care using a mobile phone application.	Physiological indicators Motof function (MF) Self-efficacy Quality of life Satisfaction toward nursing	OG patients scored higher than CG in self-efficacy and various health domains post-intervention ($P < 0.05$).	Mobile apps in nursing care can boost stroke patients' quality of life, satisfaction, and improve biological and mental outcomes.
(BAL & KOÇ, 2024)	Post-discharge, patients got 12 weeks of phone education and follow-up based on Orem's Self-Care Theory.	Cognitive impairment The dependence/ independence of the individual in carrying out activities of daily living (ADL) Quality of life Self-care ability	The comparison between the intervention and control groups showed significant differences in the Stroke-Specific Quality of Life Scale ($t=11.136$, $p=.001$) and the Exercise of Self-Care Agency Scale scores ($t=14.358$, $p<.001$).	Training interventions improved stroke awareness, lifestyle habits, self-care, and quality of life in the intervention group.
(Chu et al., 2020)	Before discharge, patients and caregivers received training on mobility, self-care, and toileting from nurses. Post-discharge, they got three follow-up calls at 2, 4, and 8 weeks. Caregivers also had a comprehensive mobile app installed on their phones.	Functional independence Health related quality of life Care giver burden	At 6 months post-release, the intervention and control groups had similar EQ-5D (3.67, $p=0.91$) and CBI scores (3.68, $p=0.98$), showing no significant difference.	A new rehabilitation strategy where nurses trained family caregivers improved physical recovery, evidenced by BI scores.
(Brouns et al., 2021)	Patients were administered Fast@Home in conjunction with regular rehabilitation.	Level of disability Healthrelated quality of life Fatigue Self-management Participation and pgysical activity	The study found significant EQ-5D score improvements from T0 to T3 in both groups, with USER-P scores worsening	Post-intervention, lifestyle remained unchanged, but Stroke Coach led to better glucose control (HbA1c) and physical quality

			and FSS scores improving only in the IG. USER-P Restriction and Satisfaction improved in both groups from T3 to T6.	of life (SF-36 PCS) than Memory Training.
(Sakakibara et al., 2022)	Participants engaged in seven 30-60 minute phone sessions and five check-ins over six months with a coach, receiving a manual, monitoring kit, and report card	Lifestyle behavio behavioral and cardiometabolic stroke risk factors health related quality of life cognitive status, depressive symptoms	The study indicates that adding a multifaceted eRehabilitation program to standard stroke therapy helps maintain post-stroke benefits	Lifestyle coaching improves HRQoL and glucose management in community-dwelling stroke survivors with minor disabilities
(Anderson et al., 2022)	Group sessions ran for 6 weeks, with up to 10 participants each, who joined through a mobile link emailed to them. Each session lasted 90 minutes.	Self-efficacy, exercise behaviors, depression and anxiety, disability, and quality of life.	Stroke understanding among participants improved from 8.8 to 9.6 in 12 weeks, with better self-efficacy, exercise, and lower depression, anxiety, disability, and better quality of life ($p < 0.0001$).	SMS implementation is feasible and shows preliminary efficacy of mobile VT for post-stroke care, leading to improved self-management and reduced stroke risk factors.
(Aphiphaksakul & Siriphorn, 2022)	The intervention group underwent 30 minutes of seated balance training plus traditional home rehabilitation program, five days weekly for four weeks.	Balance and activity of daily living	The intervention group showed greater improvements in PASS and BI than controls, with no differences in other parameters.	Home-based training with balancing discs and an inclinometer app improved postural control and daily activity in stroke patients.
(Guillaumier et al., 2022)	The intervention group received biweekly text reminders with usage instructions and contact details, ensuring contact every two weeks during the intervention period.	Health related quality of life	At 6 months, the intervention group's median EQ-VAS HRQoL score was significantly higher than the control's (85 vs 80, $p = 0.020$).	The P2S online program improved stroke survivors' self-reported HRQoL at 6 months, showing online platforms' potential to support these individuals.
(Zhang et al., 2022)	Intervention dyads received a 3-month coaching protocol via WeChat, consisting of six	Participation, Instructive activity daily living, Intrinsic motivatio, Motor function, Quality of life, Perceived benefits,	The CTG program significantly improved stroke survivors' daily home activity engagement and IADL scores,	CTG can improve integration and quality of life for home-based stroke patients, benefit family welfare, and set a standard for

	teleoccupational steps.	Caregiver-related burden	boosting their intrinsic motivation.	chronic disease home rehabilitation.
(Kim et al., 2020)	The intervention included twice-daily blood pressure monitoring, clinic-regulated glucose checks, smart band activity tracking, a stroke education module, and an exercise program with technique education.	Stroke awareness, Depressio, Health-related quality of life	BDI scores improved significantly at 4 and 12 weeks, while EQ-5D scores showed no significant change from baseline.	The smartphone-based mHealth system improved the understanding of stroke, depression, and blood pressure.
(Vloothuis et al., 2019)	Participants in the intervention group underwent 150 extra weekly minutes of CARE4STROKE training with a caregiver	The primary outcomes include the self-reported mobility domain of the Stroke Impact Scale 3.0 (SIS) and the length of stay (LOS). Secondary outcomes include motor impairment, strength, walking ability, balance, mobility, and extended activities of daily living for patients. Additionally, caregiver strain, mood, self-efficacy, weariness, and quality of life for both patients and caregivers are also included.	The intervention group showed significant reductions in patient anxiety and caregiver depression post-intervention, with patient anxiety improvements lasting 12 weeks.	This trial found no significant effects on mobility or LOS, but caregiver-assisted activities improved mood for both patient and caregiver.

Study characteristics

Twelve studies included in this review were published between 2019 and 2024. Only two studies were published in 2019 (18,29), the remaining 10 studies (83.33%) were published in 2020 or later (19,21,23,24,26–28). Of the 12 studies found, 11 used a randomized controlled trial design (18–27,29), and only 1 used the prospective nonrandomised interventional study method (28).

A total of 1,490 stroke patients (both haemorrhagic and non-haemorrhagic) were assigned to control and intervention groups. The number of participants in the studies varied from the smallest of 25 patients (27) to the largest of 399 stroke patients (26). Three of the 12 existing studies were conducted in China (19,21,27), while the rest were conducted in different countries, including Germany (18), Turkey (20), the Netherlands (22,29), Canada (23), Texas (24), Thailand (25), Australia (26), and South Korea (28). In terms of study duration, two studies lasted 1 month (18,25), 1 study

ISSN 1462 2815

lasted 2 months (21), 7 studies lasted 3 months (19,20,23,26–29), 1 study lasted 4.5 months (24), and the longest was 6 months (22).

Application characteristics

Based on the results of the above review, 8 studies used smartphone applications specifically designed for patient education (18,19,21,22,25,26,28,29), one of which combined educational applications with regular telephone calls to patients (21). In addition to using smartphone-based educational applications, other studies have also used telephone-based applications (20,23). This telephone-based application is combined with subsequent monitoring based on Orem's self-care theory (20). Other media used for patient education include video teleconferencing utilising a smartphone, tablet, or computer (24) and WeChat video coaching for patient support and rehabilitation training (27).

Research Interventions

The research interventions implemented in all studies included in the systematic review focused on using mobile applications to enhance stroke rehabilitation and improve patients' quality of life. These interventions included a range of approaches, including providing educational content, facilitating self-care practices, monitoring and support, and promoting engagement in rehabilitation activities. The trials used a multifaceted approach to improve post-stroke care and education. Patients were provided with educational materials via the Stroke Health-Education Mobile App (SHEMA) (18) and received ongoing care via a mobile phone application (19). After discharge, they received telephone-based education and follow-up for 12 weeks based on Orem's self-care theory (20).

Before discharge, patients and caregivers received stroke rehabilitation education focused on mobility, self-care, and toileting delivered by qualified nurses (21). After discharge, patients received regular phone calls, and caregivers were provided with a comprehensive mobile application (21). In addition, patients received Fast@Home and regular rehabilitation (22) and participated in one-on-one telephone sessions and group sessions facilitated by certified lifestyle coaches (23). The intervention also included seated balance training (25), teleoccupational support via WeChat (27), and regular monitoring of vital signs and physical activity (28). In addition, participants in the intervention group received supplemental text message reminders and additional CARE4STROKE program training with caregivers (29). This comprehensive intervention aimed to improve post-stroke outcomes by providing ongoing support, education, and rehabilitation.

DISCUSSION

Quality of Life Impact of Intervention

mHealth, telehealth or telemedicine is an intervention in health services and promotion by utilizing technology such as *mobile technology*. The use of this technology uses telecommunications technology to deliver health care, information and education related to health sciences. mHealth can empower individuals to actively contribute to the treatment process, raise awareness to optimize health and minimize health financing (30). Integrating mobile health (mHealth) applications and telehealth interventions into stroke rehabilitation has emerged as a promising avenue for improving stroke survivors' quality of life (QoL), as evidenced by a growing body of

ISSN 1462 2815

research spanning 2019-2024. This systematic review focuses on different methods, including mobile apps, phone-based education, and online platforms. It shows different effects on quality of life in different demographics and stages of stroke recovery.

The study by (18) highlights the ability of educational technology, namely the Stroke Health-Education Mobile App (SHEMA), to improve stroke knowledge. However, it did not significantly improve quality of life as measured by the EQ-5D index. Without additional rehabilitative measures, the effect of educational treatments on quality of life may be limited. In contrast, (19) demonstrated the substantial impact of continuous nursing care using mobile applications on improving self-efficacy and multiple dimensions of quality of life, highlighting the benefits of integrating mobile technology into nursing care.

The study conducted by (20)emphasizes the importance of structured telephone-based instruction in improving self-care agency and quality of life. It highlights the potential of telecommunications in rehabilitation. Nevertheless, the findings of (21) suggest that providing caregiver-focused rehabilitation training alone may not improve quality of life (QoL), emphasizing the need for more comprehensive intervention strategies. (22) and (23) both found that complete therapy and lifestyle coaching led to significant improvements in QoL. This highlights the effectiveness of holistic and lifestyle-oriented approaches in stroke rehabilitation. Collectively, these studies support the use of comprehensive rehabilitation programs that address not only physical healing but also lifestyle and behavioral changes.

(24) demonstrated that virtual treatment is highly effective in enhancing stroke rehabilitation. This approach provides significant benefits in terms of self-efficacy, mental well-being, and overall quality of life. This suggests that virtual platforms can be effective in delivering rehabilitation treatment, especially in situations where typical face-to-face interventions are not possible. Furthermore, studies conducted by (25), (26), and (27), highlight the importance of physical training, continuous engagement, and teleoccupational help in improving quality of life. These therapies, by improving physical abilities and providing ongoing support, improve stroke patients' overall quality of life.

In analyzing these findings, it is clear that a comprehensive approach that includes technology, individualized guidance, and ongoing involvement is an important method for improving the quality of life of people who have experienced a stroke. Although the direct effects on quality of life are important, the indirect benefits associated with improved knowledge, confidence, and daily functioning are also critical. Future research should prioritize the integration of these different therapies into comprehensive rehabilitation programs to optimize their combined benefits for the quality of life of stroke patients.

Physiological and Self-efficacy Impact of Intervention

A collection of recent studies tells a compelling story about how well these mobile application interventions work, highlighting two types of benefits, real changes in important physiological markers and a stronger belief in one's ability to manage one's health. mHealth technologies have made it much easier to manage and keep an eye on important body chemicals like homocysteine (Hcy), high-density lipoprotein cholesterol (HDL-C), and total cholesterol (TC) levels (19). This paradigm shift toward mobile applications for continuous care not only improves physiological outcomes but also embodies the personalized care ethos that is integral to contemporary stroke

ISSN 1462 2815

rehabilitation frameworks. Conversely, the other study highlights an indirect pathway to physiological improvement through a comprehensive mHealth system that includes blood pressure and blood glucose monitoring intertwined with an exercise program. This method subtly emphasizes the overall effect of technological interventions on health factors not directly related to stroke recovery, such as depression scores, expanding the range of benefits of mHealth (28).

Mobile and telehealth interventions clearly highlight the central role of self-efficacy in stroke rehabilitation. Findings converge on a salient point: technology-assisted care and virtual therapy sessions significantly increase self-efficacy levels (19,24). This increase puts patients on a more confident path to recovery and underscores the symbiotic relationship between technological advances and psychological well-being. Furthermore, as explored here, the innovative integration of balancing discs and smartphone inclinometer apps for seated balance training exemplifies the potential of home-based, technology-enabled interventions to strengthen postural control and, by extension, self-efficacy (25).

The synthesis of these studies reveals a multifaceted landscape in which mobile and telehealth interventions act as pivotal levers in stroke rehabilitation. Not only do they provide a platform for enhanced physiological monitoring and improvement, but they also cultivate a nurturing environment for patient empowerment through increased self-efficacy. This dual impact paves the way for a more holistic, patient-centered approach to stroke recovery and highlights the indispensable role of technology in the development of personalized and effective rehabilitation strategies. As a result, the current conversation is urging the increased use of mobile health technologies and virtual platforms in stroke care plans to improve patient care's physical and mental aspects.

Cognitive and physical function impact of intervention

The cognitive domain had positive effects from using mobile health applications and tele-rehabilitation. This was demonstrated by increased stroke-related knowledge and cognitive function scores reported by (18) and (20). These findings indicate that digital and remote interventions might substantially enhance traditional therapy by offering easily accessible and customized educational material, thus addressing a crucial element of stroke recovery.

(25) and (29) emphasize the importance of integrating technology and human elements, including caregiver participation, in physical rehabilitation to achieve substantial improvements in postural control, activities of daily living, and emotional well-being. The diverse effects on mobility outcomes and mental health markers observed in this research highlight the intricate nature of physical recovery processes and emphasize the necessity for comprehensive strategies that cater to the specific requirements of stroke survivors.

The incorporation of technology into rehabilitation tactics is becoming a significant focus, providing novel methods to enhance patient involvement, consistency of treatment, and self-confidence. The improvements noted in self-efficacy and quality of life measures, as documented by (19) and (28),validate the capacity of mobile and telehealth therapies to establish rehabilitation environments that are tailored, adaptable, and supportive. The revolution in technology implies that using digital methods to connect patients and healthcare providers might greatly aid in the comprehensive rehabilitation of stroke survivors.

Furthermore, the combined results of these studies support the need for a complete rehabilitation method that works on both cognitive and physical function at the same time using a mix of traditional and innovative methods. This approach aligns with the increasing acknowledgment of stroke recovery as a multifaceted process that necessitates comprehensive, patient-cantered care solutions. A future study should focus on identifying the precise elements of technological treatments that are most advantageous for stroke rehabilitation and investigating the mechanisms via which these tools promote cognitive and physical recovery. Furthermore, it is necessary to conduct longitudinal studies in order to evaluate the long-term effectiveness of these interventions, ensuring that the positive outcomes reported in clinical trials result in lasting enhancements in the quality of life and functional autonomy of individuals who have suffered a stroke.

CONCLUSIONS

This review confirms the significant role of mobile application interventions in improving stroke rehabilitation outcomes. The findings from twelve studies involving 1,490 patients from 2019 to 2024 validate that these technologies improve the quality of life, physical abilities, self-efficacy, and cognitive and physical function of stroke survivors. Highlighting the significance of incorporating modern digital technologies into stroke care protocols, these technology techniques prioritize patient-cantered care. The findings support the need to increase the use of technology-based resources in rehabilitation practices in order to enhance patient recovery and improve quality of life after a stroke. Future studies should enhance understanding through extensive and varied population studies, customizing rehabilitation for the changing requirements of stroke patients.

Declaration of Interest

The study was free of any conflicts of interest.

Funding

This study was funded by “Penelitian Tesis Magister” research grant from Kementerian Pendidikan, Kebudayaan, Riset, dan Teknologi, Indonesia.

Data Availability

The datasets collected and examined in this study can be obtained from the relevant author upon inquiry.

References

1) Katan M, Luft A. Global Health Neurology. Seminars in Neurology. 2018;38:208–11.

2) Feigin VL, Stark BA, Johnson CO, Roth GA, Bisignano C, Abady GG, et al. Global, regional, and national burden of stroke and its risk factors, 1990-2019: A systematic analysis for the Global Burden of Disease Study 2019. The Lancet Neurology. 2021;20(10):1–26.

3) Feigin VL, Brainin M, Norrving B, Martins S, Sacco RL, Hacke W, et al. World Stroke Organization (WSO): Global Stroke Fact Sheet 2022. International Journal of Stroke. 2022;17(1):18–29.

4) Taştekin N. Rehabilitation and quality of life in stroke patients. Turkiye Fiziksel Tip ve Rehabilitasyon Dergisi. 2015;61(2):97–8.

5) Parikh S, Parekh S, Vaghela N. Impact of stroke on quality of life and functional independence. National Journal of Physiology, Pharmacy and Pharmacology. 2018;8(9):1.

6) Adigwe GA, Tribe R, Alloh F, Smith P. The Impact of Stroke on the Quality of Life (QOL) of Stroke Survivors in the Southeast (SE) Communities of Nigeria: A Qualitative Study. Disabilities. 2022;2(3):501–15.

7) Kwakkel G, Stinear C, Essers B, Munoz-Novoa M, Branscheidt M, Cabanas-Valdés R, et al. Motor rehabilitation after stroke: European Stroke Organisation (ESO) consensus-based definition and guiding framework. European Stroke Journal. 2023;

8) Ellepola S, Nadeesha N, Jayawickrama I, Wijesundara A, Karunathilaka N, Jayasekara P. Quality of life and physical activities of daily living among stroke survivors; cross-sectional study. Nursing Open. 2022;9(3):1635–42.

9) Paryono P, Ar Rochmah M, Setyopranoto I, Trisnantoro L. Postacute-Stroke Management Problems in Home Care Service: A Qualitative Single-Centered Study in Yogyakarta, Indonesia. Journal of Neurosciences in Rural Practice. 2022;13(1):50–9.

10) Poomalai G, Prabhakar S, Sirala Jagadesh N. Functional Ability and Health Problems of Stroke Survivors: An Explorative Study. Cureus. 2023;15(1):1–6.

11) Permata EN, Irawati D. the Appropriate Intervention To Improve Patient Outcome Among Stroke Patients: a Literature Review. International Journal of Nursing and Health Services (IJNHS). 2019;2(2):75–81.

12) Lin S, Xiao LD, Chamberlain D, Ullah S, Wang Y, Shen Y, et al. Nurse-led health coaching programme to improve hospital-to-home transitional care for stroke survivors: A randomised controlled trial. Patient Education and Counseling. 2022;105(4):917–25.

13) Abd-elkhalik EF, Ibrahim BAM, El-houfey AA, Saad K. Impact of therapeutic educational program on patients with stroke andcare burden among family caregivers. 2023;21(5):1300–15.

14) Lasheen AK, Basal AA al A, El-Sadany HM, Bahgat ZF. Effect of Nursing Intervention by Using Physical Exercises Modules on Gait and Balance for Stroke Patients. 2022;20(20):615–30.

15) Szeto SG, Wan H, Alavinia M, Dukelow S, MacNeill H. Effect of mobile application types on stroke rehabilitation: a systematic review. Journal of NeuroEngineering and Rehabilitation. 2023;20(1):1–18.

16) Choi MJ, Kim H, Nah HW, Kang DW. Digital therapeutics: Emerging new therapy for neurologic deficits after stroke. Journal of Stroke. 2019;21(3):242–58.

17) Cao W, Kadir AA, Tang W, Wang J, Yuan J, Hassan II. Effectiveness of mobile application interventions for stroke survivors: systematic review and meta-analysis. BMC Medical Informatics and Decision Making. 2024;24(1):1–22.

18) Kang YN, Shen HN, Lin CY, Elwyn G, Huang SC, Wu TF, et al. Does a Mobile app improve patients' knowledge of stroke risk factors and health-related quality of life in patients with stroke? A randomized controlled trial. BMC Medical Informatics and Decision Making. 2019;19(1):1–9.

19) Xu J, Qian X, Yuan M, Wang C. Effects of mobile phone App-based continuing nursing care on self-efficacy, quality of life, and motor function of stroke patients in the community. Acta Neurologica Belgica. 2023;123(1):107–14.

20) BAL C, KOÇ Z. Technology-Based Health Promotion Training Among Stroke Patients: A Randomized Controlled Trial. Clinical Nursing Research. 2024;33(1):81–94.

21) Chu K, Bu X, Sun Z, Wang Y, Feng W, Xiao L, et al. Feasibility of a Nurse-Trained, Family Member-Delivered Rehabilitation Model for Disabled Stroke Patients in Rural Chongqing, China. Journal of Stroke and Cerebrovascular Diseases. 2020;29(12):105382.

22) Brouns B, Bodegom-Vos L Van, De Kloet AJ, Tamminga SJ, Volker G, Berger MAM, et al. Effect of a comprehensive erehabilitation intervention alongside conventional stroke rehabilitation on disability and healthrelated quality of life: A pre post comparison. Journal of Rehabilitation Medicine. 2021;53(3).

23) Sakakibara BM, Lear SA, Barr SI, Goldsmith CH, Schneeberg A, Silverberg ND, et al. Telehealth coaching to improve self-management for secondary prevention after stroke: A randomized controlled trial of Stroke Coach. International Journal of Stroke. 2022;17(4):455–64.

24) Anderson JA, Kimmel B, Sansgiry S, Venkatasubba Rao CP, Ovalle AP, Cerra-Stewart CA, et al. Using Mobile Video-Teleconferencing to Deliver Secondary Stroke Prevention Interventions: A Pilot Study. Telemedicine Reports. 2022;3(1):175–83.

25) Aphiphaksakul P, Siriphorn A. Home-based exercise using balance disc and smartphone inclinometer application improves balance and activity of daily living in individuals with stroke: A randomized controlled trial. PLoS ONE. 2022;17(11 November):1–13.

26) Guillaumier A, Spratt NJ, Pollack M, Baker A, Magin P, Turner A, et al. Evaluation of an online intervention for improving stroke survivors' health-related quality of life: A randomised controlled trial. PLoS Medicine. 2022;19(4):1–17.

27) Zhang L, Yan YN, Sun ZX, Yan DR, Chen YW, Lin KC, et al. Effects of Coaching-Based Teleoccupational Guidance for Home-Based Stroke Survivors and Their Family Caregivers: A Pilot Randomised Controlled Trial. International Journal of Environmental Research and Public Health. 2022;19(23).

28) Kim DY, Kwon H, Nam KW, Lee Y, Kwon HM, Chung YS. Remote management of poststroke patients with a smartphone-based management system integrated in clinical care: Prospective, nonrandomized, interventional study. Journal of Medical Internet Research. 2020;22(2):1–11.

29) Vloothuis JDM, Mulder M, Nijland RHM, Goedhart QS, Konijnenbelt M, Mulder H, et al. Caregiver-mediated exercises with e-health support for early supported discharge after stroke (CARE4STROKE): A randomized controlled trial. PLoS ONE. 2019;14(4):1–14.

30) Gajarawala SN, Pelkowski JN. Telehealth Benefits and Barriers. Journal for Nurse Practitioners. 2021;17(2):218–21.