Iran J Public Health, Vol. 54, No.10, Oct 2025, pp.2114-2126

Review Article

mHealth Apps for Family Caregivers of Stroke Patients: A Systematic Review

Anwar Fazal Abu Bakar [1], Azimatun Noor Aizuddin [1], Roszita Ibrahim [1], Muhammad Zulfakhar Zubir [1], Wan Asyraf Wan Zaidi [1], Hamed Khazaei [2]

1. *Department of Public Health Medicine, Faculty of Medicine, Universiti Kebangsaan Malaysia, Kuala Lumpur, Malaysia*
2. *Scipeline, Ontario, Canada*

***Corresponding Author:** Email: dr.anwarfazalabubakar@gmail.com

(Received 23 Apr 2025; accepted 10 Jul 2025)

Abstract

Background: Family caregivers of stroke patients play a critical role in post-stroke recovery, yet they often face significant challenges, including physical and emotional stress, lack of knowledge, and limited access to resources. Mobile health (mHealth) apps offer a promising solution to support caregivers by providing education, task management, and mental health resources. However, gaps remain in understanding the effectiveness, functionalities, and limitations of these apps. This study aimed to 1) identify and categorize existing mHealth apps for family caregivers of stroke patients, 2) evaluate the effectiveness of these apps in supporting caregivers, and 3) analyze the gaps in current mHealth offerings to inform future app development.

Methods: A systematic literature review was conducted, analyzing 30 studies published between 2014 and 2024 from databases such as IEEE Xplore, Scopus, Web of Science, and PubMed. The studies were evaluated based on app functionality and effectiveness in caregiver support, and limitations were identified.

Results: The findings revealed a diverse range of mHealth apps offering functionalities such as caregiver education, rehabilitation guidance, task management, communication tools, and health monitoring. However, notable gaps were identified, including limited multi-functionality, insufficient support for caregiver well-being, a lack of customization for diverse needs, and minimal validation through rigorous trials.

Conclusion: While mHealth apps provide valuable tools for family caregivers of stroke patients, addressing the identified gaps is essential to maximize their impact. Future Development should focus on creating comprehensive, user-centered, and evidence-based apps that integrate education, mental health support, and task management.

Keywords: mHealth apps; Stroke caregivers; Rehabilitation; Digital health; Caregiver burden

Introduction

In the global context, stroke is a primary cause of severe cognitive and physical impairments that necessitate ongoing care and support (1-3). Family members frequently assume the role of primary caregivers, administering medications, managing rehabilitation tasks, and providing assistance with daily activities (4). Nevertheless, caregiving responsibilities can result in a significant emotional,

DOI: https://doi.org/10.18502/ijph.v54i10.20132

physical, and financial toll on family caregivers, frequently resulting in caregiver fatigue and a reduced quality of life (5).

Mobile applications have appeared as a potential solution to assist caregivers by offering tools for health management, communication, and administration, because of the widespread adoption of mobile health (mHealth) technology. Existing research has investigated the role of mHealth applications in the management of a variety of chronic diseases, including hypertension, diabetes, and cancer (6,7). Nevertheless, the specific requirements of caregivers, particularly those who support stroke patients, have received less attention. These caregivers require distinctive features that are specifically designed for post-stroke recovery and daily caregiving tasks (8). The present study aims to conduct a systematic review of the available mHealth applications that are specifically designed for family caregivers of stroke patients, in recognition of this gap.

The objective of this study was to emphasise the effectiveness of existing app features, evaluate their efficacy, and offer suggestions for future app development to more effectively address the requirements of this population by concentrating on these caregiver-facing tools.

Methods

This study utilized a systematic literature review (SLR) methodology to identify, evaluate, and synthesise existing mobile phone applications developed for family caregivers of stroke patients. The review follows established protocols for conducting systematic reviews, with specific adaptations to address the focus on caregiver-facing mobile health (mHealth) applications. This approach was modelled after previous mHealth app scoping reviews that have evaluated mobile applications for chronic disease management and patient support across various health conditions.

Applications were classified based on their principal functions, including educational assistance, rehabilitation direction, task management, communication enhancement, mental health support, or remote monitoring. Furthermore, applications were assessed for their alignment with target users, confirming that they explicitly catered to the need of family caregivers rather than solely to patients or healthcare professionals. Technological attributes were also evaluated, encompassing interaction, customisation, language support, data privacy protocols, and integration with healthcare systems. This classification enabled a systematic examination of application diversity and usefulness, while aiding in the recognition of strengths and deficiencies in current caregiver-oriented solutions. Only applications that fulfilled the criteria for caregiver relevance and functional specificity were incorporated into the final synthesis. Table 1 shows some mHealt applications and their functions.

Table 1: A list of mHealth applications

Application name	Findings/ Function
Stroke Riskometer	Calculates annual stroke risk through weight, age, diet and other risk factors data. Gives information on managing risk factors through videos
JoinTriage	GPS, CDSS NA Provides a series of questions to assess eligibility for revascularization
Stroke Management	It helps patients self-screen stroke symptoms through clinical scales.
Act-Fast	Contains several clinical scales and checklists for revascularization therapy. Also presents sharing and messaging features among physicians.
SRP	Records data about the recovery rate through smartphone.
Movies4Stroke	Provides educational videos on stroke

Table 1: Continued…

CareZone	This app helps caregivers manage medications, track health information, and organize caregiving tasks. It offers features like medication lists, calendar scheduling, and note-taking to streamline caregiving responsibilities.
Stroke Riskometer	Developed to assess and manage stroke risk, this app provides personalized risk assessments and educational resources to help caregivers and patients understand and mitigate stroke risk factors.
MyTherapy	A medication reminder and health tracker app that assists caregivers in ensuring patients adhere to their medication schedules. It also allows tracking of symptoms and health metrics.
Caregiver's Touch	This app offers a centralized platform for caregivers to manage medical information, appointments, and daily tasks. It includes features like document storage, contact management, and task lists to keep caregiving organized.
Medisafe	A user-friendly medication management app that sends reminders for medication doses and tracks adherence. It also provides drug interaction warnings and health reports, aiding caregivers.
StrokeAware	An educational app that provides information on stroke symptoms, prevention, and recovery. It serves as a resource for caregivers to better understand stroke and support their loved ones effectively.
RehabCoach	Designed to support stroke rehabilitation, this app offers exercises and therapy routines that caregivers can facilitate at home, promoting continuous recovery efforts outside of clinical settings.
Stroke Home Care	Feasible and well-received app for post-stroke care training in resource-limited settings
ARMStrokes	Interactive app providing rehabilitation for upper extremity recovery; highly rated for usability and engagement
OASapp	Highly accepted app for medication adherence, health monitoring, and caregiver communication
RecoverNow	Tablet-based app showing feasibility for delivering speech and cognitive therapy post-stroke
9zest	Feasible tele-rehabilitation app for individualized physical therapy in Sub-Saharan Africa
Bern Aphasia App	Highly usable app supporting aphasia rehabilitation through therapist-guided exercises
iADAPTS	Feasible app for strategy training in stroke rehabilitation using mobile health technology

Inclusion and Exclusion Criteria

A comprehensive search was conducted across multiple academic databases, including PubMed, IEEE Xplore, Scopus, and Web of Science, to identify relevant peer-reviewed articles published between 2014 and 2024. The search terms included combinations of keywords such as "mobile health," "mHealth," "stroke caregivers," "family caregivers," "mobile apps," and "stroke rehabilitation." Boolean operators were used to refine search results, and filters were applied to ensure that only studies focusing on mobile phone applications targeting stroke caregivers were retrieved. Studies were included if they:

- Focused on mHealth applications designed specifically for caregivers of stroke patients.
- Included information on app functionalities, usability, or user experience relevant to caregivers.
- Provided an evaluation of the app's effectiveness in supporting caregiver roles (Fig. 1).

Studies were excluded if they:

- Focused solely on patient-facing apps without caregiver-specific functions.
- Did not include stroke as a primary condition.
- They were not available in English.

Data Extraction and Analysis

Data were systematically extracted from eligible studies, focusing on variables such as app name, primary function, target audience, key features, usability ratings, and caregiver support metrics. Each study was evaluated for quality using a modified version of the Critical Appraisal Skills Programme (CASP) checklist, ensuring consistency and rigor in the analysis. A thematic analysis was conducted to identify recurring patterns, features, and limitations across the reviewed apps. Applications were grouped according to their primary purpose, such as medication management, rehabilitation assistance, or symptom tracking, to facilitate a comprehensive synthesis of the available resources for caregivers. Quantitative data, where available, were also extracted and synthesized to assess the effectiveness and user satisfaction of the mHealth apps. Table 2 shows the reviewed studies.

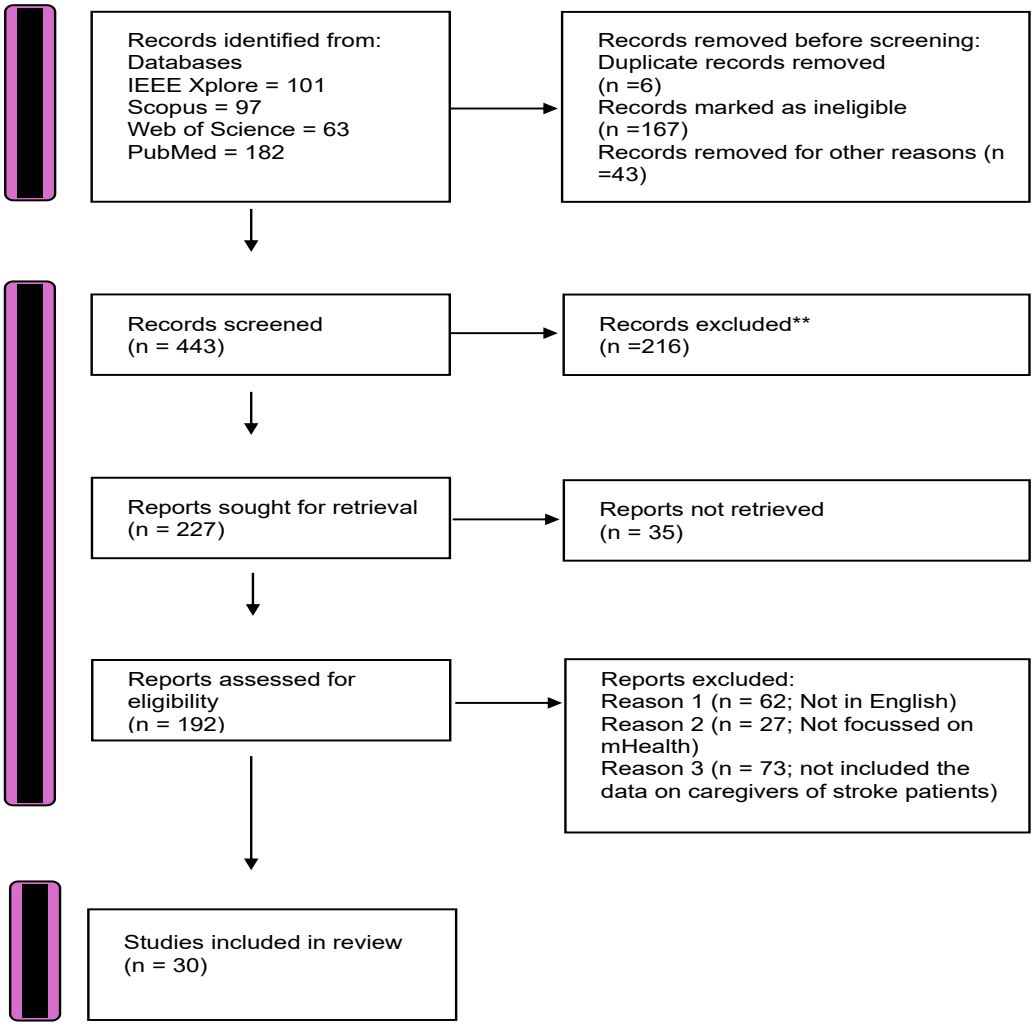

Fig. 1: Prisma flowchart of search strategy and selection process

Table 2: A Sample of studies reviewed

Author	Design	Aim	Results
Ferré-Grau et al (2021) (9)	Randomized Controlled Trial	Evaluate the effectiveness of an app to promote positive mental health for caregivers.	Improved caregiver mental health and satisfaction with app use.
Kumar et al (2024) (10)	Feasibility Study	Develop and assess the feasibility of an app for post-stroke care.	Feasible and well-received app for resource-limited settings.
Cao et al (2023) (11)	Systematic Review	Describe stroke-related apps and analyze their focus and functionality.	Identified gaps in app functionalities and limited focus on caregivers.
Li et al (2020) (12)	A Pilot Randomized Controlled Trial	To evaluate the feasibility and usability of a mobile health (mHealth) application designed to collect post-discharge functional outcome data from stroke patients after inpatient rehabilitation.	The app enabled stroke survivors to submit their rehabilitation progress and functional status using standardized measures (e.g., mRS, BI) after leaving inpatient care. The study demonstrated that mHealth solutions are feasible tools for follow-up data collection and monitoring in stroke care transitions.
Gerber et al (2019) (13)	Usability Study	Develop and test usability of a therapist-guided rehabilitation app.	High usability for supporting aphasia rehabilitation.
Sarfo et al (2018) (14)	Pre-Post Study	Test feasibility of tele-rehabilitation intervention for stroke survivors.	Feasible intervention with improved patient adherence.
Szeto et al (2023) (15)	Systematic Review	Assess the effectiveness of mobile apps in stroke rehabilitation.	Apps show potential for rehabilitation but require further validation.
Garnett et (al. 2022) (16)	Scoping Review	Evaluate apps for supporting caregivers' mental health and burden reduction.	Positive effects on caregiver burden and mental health.
Sidek et al (2023) (17)	Mixed-Methods Study	Explore healthcare providers' perspectives on mHealth apps for caregivers.	High acceptance of mHealth apps by healthcare providers with recommendations for integration.
Pugliese et al (2019) (18)	Pilot Study	Assess feasibility of a tablet-based therapy platform for early stroke rehabilitation.	Demonstrated feasibility of tablet-based cognitive and speech therapy.
Lawson et al (2017) (19)	Mixed-Methods Pilot Study	Evaluate a smartphone-based rehabilitation app for stroke motor recovery.	Positive user feedback on motor recovery features; requires further trials.
Kringle et al (2020) (20)	Sequential Descriptive Case Series	Adapt strategy training interventions for stroke rehabilitation using mobile technology.	Feasibility established for mobile health adaptation of strategy training.
Singer et al (2018) (21)	National Survey	Identify caregivers' preferences for mobile app resources to support caregiving.	Caregivers expressed high interest in apps for scheduling, communication, and resources.
Guo et al (2015) (22)	Focus Groups and System Evaluation	Develop and evaluate ARMStrokes, a mobile app for real-time stroke rehabilitation exercises.	ARMStrokes was positively evaluated by stroke survivors, caregivers, and therapists for interactive rehabilitation and real-time feedback.
Lawson et al (2016) (23)	Pilot Study	Preliminary evaluation of ARMStrokes for stroke rehabilitation and user adherence.	Post-test improvements noted in usability and efficiency; feedback informed system modifications.
Zhou, Du and Zhou (2018) (24)	Systematic search across PubMed, Embase, Web of Science, and CINAHL	To evaluate the effectiveness of mobile apps in post-stroke rehabilitation.	9 out of 12 studies reported significant improvements in targeted functional outcomes. The remaining 3 reported favorable trends, albeit without robust significance
Marwaa et al (2023)(25)	Experience-based co-design (EBCD) approach	To develop mobile/tablet applications that support person-centred and empowering stroke rehabilitation by employing an experience-based co-design (EBCD) approach	Stakeholders reported feeling integral to the development process, which supports acceptance and relevance in real-world rehabilitation contexts.

Results

Mobile Apps Categories

The study identified and categorized mobile apps designed for family caregivers of stroke patients and specifically support caregivers of stroke patients, focusing on their features and functionalities.

Educational Apps for Caregivers

Certain applications concentrate on instructing caregivers about stroke treatment, rehabilitation exercises, and medical care. They frequently comprise instructional films, written manuals, and interactive tutorials. The "Stroke Home Care" application offers videos and instructional resources to instruct caregivers on preventive and therapeutic techniques. Applications that provide video-based teaching on diet, physical activity, and emotional support for stroke patients (26). The "Stroke Home Care" software offers training videos and instructional resources designed to improve caregivers' understanding of stroke care protocols (27). Applications providing functionalities to assist caregivers' mental well-being encompass stress alleviation strategies, mindfulness practices, and connections to mental health practitioners or support groups. Caregiving is critical, as it frequently results in mental and physical exhaustion (6). Applications similar to the intervention program incorporate everyday activities aimed at enhancing caregivers' emotional well-being (28).

Rehabilitation Support Apps

mHealth applications can assist caregivers in promoting the physical and cognitive rehabilitation of stroke victims. They encompass functionalities for monitoring patient advancement and guaranteeing compliance with treatment. "ARM-Strokes" provides interactive games to aid caregivers in facilitating upper limb rehabilitation for stroke sufferers (22). They frequently incorporate alert systems for anomalous readings. These applications aim to alleviate caregiver stress and enhance emotional well-being, maybe incorporating mindfulness exercises, peer support networks, or professional mental health resources (28). Emotional support functionalities were essential in applications designed for caregivers (16). Task Management and Scheduling applications offer resources for structuring caring duties, including the arrangement of medical appointments, oversight of prescription reminders, and monitoring of rehabilitation advancements. Studies indicated elevated usability for applications that facilitate task collaboration, including scheduling and reminders for medical appointments (17, 21).

Communication-Enhancing Apps

Apps that facilitate real-time communication between caregivers, healthcare professionals, and other support networks. These tools improve collaborative care and information sharing. Some mHealths apps provide access to local and online resources, including stroke care centres, emergency contacts, and educational materials. These apps aim to connect caregivers with the necessary support systems. Some apps offer directories of local resources and links to reliable stroke-related information (13,17,29).

Multifunctional Apps

Some mHealth apps can combine multiple functionalities, such as education, rehabilitation, monitoring, and emotional support, into a single platform to provide comprehensive caregiving solutions. "OASapp" for instance, integrates medication management, health monitoring, communication tools, and stroke rehabilitation guidance (30). The need for multifunctional apps is emphasised to avoid the challenges of navigating multiple platforms (16). Some apps can be adaptable to caregivers' individual needs, such as language preferences, ease of navigation, or personalization of features (10). Researchers highlighted the significance of apps with user-friendly designs to accommodate varying levels of technical literacy among caregivers (15).

The Effectiveness of mHealth Apps

This study evaluated the effectiveness of mHealth apps in supporting family caregivers of

stroke patients. The following themes have been developed based on the evidence provided in the reviewed studies. mHealth apps can significantly enhance caregivers' understanding of stroke management and their ability to assist in patient care through educational resources and guided interventions. Apps like "Stroke Home Care" have been shown to improve caregiver skills in post-stroke care, including preventive and therapeutic procedures (10). Video-based educational tools improved caregivers' ability to address patient needs (32).

Enhancement of Caregiver Mental Health and Well-being

Some mHealth apps designed with task management, rehabilitation guidance, and communication tools have been shown to alleviate the physical and emotional burden of caregiving. For instance, a significant decrease is reported in caregiver burden through an app-based mental health intervention (9). Tele-rehabilitation apps reduced the caregiving strain by empowering caregivers with tools to assist patients (14). Mental health-focused apps also provide mindfulness exercises, stress management tools, and access to emotional support networks, resulting in improved caregiver well-being. Some apps were effective in reducing caregiver stress and improving mental health (16). App interventions improved positive mental health indicators such as self-control and problem-solving (9).

User interface design is crucial for usability and accessibility, particularly for caregivers with diverse levels of digital literacy. A user-friendly, organized interface enhances navigation and minimizes cognitive burden, essential for individuals overseeing intricate caregiving responsibilities. The simplification of interface elements and their alignment with users' cognitive and physical abilities markedly improves engagement and pleasure (31).

Improved Patient Outcomes through Caregiver Support

Caregivers can be equipped with better resources and skills, and mHealth apps contribute indirectly to better patient recovery, reduced hospital readmissions, and adherence to care plans. mHealth apps for blood pressure monitoring helped caregivers ensure patient medication adherence, leading to better health outcomes (14). Apps facilitating therapist-guided rehabilitation through caregivers resulted in significant patient progress (13). Caregivers benefit from apps that assist in organizing appointments, managing medications, and setting rehabilitation schedules, leading to more efficient caregiving. Some task management apps enabled caregivers to handle daily responsibilities with less stress (21).

Increased Caregiver Engagement and Adherence

mHealth apps with interactive features might enhance caregiver engagement in caregiving tasks, promoting consistent participation in patient care. Interactive features in "ARMStrokes" and "RecoverNow" motivated caregivers to engage actively in rehabilitation exercises (18, 14). Caregivers generally report satisfaction with mHealth apps, citing their usability, accessibility, and the value they add to caregiving. A 93.9% user recommendation rate is reported for their mental health intervention app (9). Caregivers were highly satisfied with the "Stroke Home Care" app's design and functionality (10). Real-time communication features allow caregivers to connect with healthcare professionals for guidance, improving caregiving quality and reducing uncertainties. Some apps facilitated caregiver-therapist communication for individualized care (11). Researchers highlighted the role of communication features in improving caregiver confidence and effectiveness (23). The findings underscore the importance of user-centred design and functionality in enhancing caregiver experience and patient outcomes.

The ability to customize significantly influences the application's relevance and response to various caring requirements. Static or generic information may inadequately handle the evolving realities of stroke rehabilitation, as caregivers frequently necessitate customized guidance contingent upon the patient's condition, linguistic pref-

erences, or recovery phase. Customized mHealth material enhances adherence and user satisfaction (31). This facilitates the incorporation of adaptive elements, like goal setting, customized reminders, and user-governed information dissemination.

The Gaps in Current mhealth Apps

The study aimed to find the gaps in current mHealth app offerings for stroke patient caregivers. The following themes have been developed based on limitations and missing features identified in the reviewed studies:

Limited multi-functionality

Many mHealth apps focus on single functions, such as education or task management, but fail to integrate multiple functionalities needed for comprehensive caregiver support. Most apps lacked multi-functionality, making caregivers rely on several apps to meet all their needs (16). Two-thirds of caregiver-focused apps primarily supported care recipients rather than addressing caregivers' needs directly (29). User feedback suggested a need for more customizable features in the "Stroke Home Care" app (10). Apps often fail to cater to caregivers with limited technical proficiency (15). Most apps are not specifically designed for older caregivers, who often form a significant portion of stroke caregivers and may face unique challenges. The majority of apps were not geared toward older adults, ignoring their specific accessibility and usability needs. Apps are often designed without considering challenges such as poor internet connectivity, lack of user-friendly interfaces, or affordability, particularly in resource-limited settings (11). App usability issues prevented caregivers from fully utilizing available resources (26). Some apps lack rigorous testing to validate their effectiveness in improving caregiver or patient outcomes, limiting their credibility and adoption (9). Data security constitutes a fundamental component of mHealth apps, particularly in the management of sensitive health information. Caregivers may be reluctant to utilize digital platforms if they perceive threats to the security and integrity of personal or medical information (33). Consequently, mHealth platforms must adhere to data protection standards and ensure transparent communication regarding data management procedures. Implementing strong authentication methods, data encryption, and permission protocols can foster user confidence and promote application adoption.

Inadequate Support for Caregiver

Few applications have elements expressly tailored to enhance caregivers' mental health and overall well-being, such as stress management tools or access to peer networks. The research emphasized the necessity for more applications targeting caregiver exhaustion and emotional well-being (6). Numerous applications are created without sufficient input from healthcare experts or patients, leading to deficiencies in clinical precision and pertinence. That fewer than 50% of the examined applications incorporated healthcare professionals in their development process (11). Research also emphasized the significance of a participatory design methodology to ensure applications properly address user requirements (27).

Insufficient Attention to Social Determinants of Health

Few apps consider the broader social and economic factors that influence caregivers' ability to access and use mHealth solutions effectively (16). These gaps highlight critical areas where existing mHealth apps fall short in addressing the comprehensive needs of stroke patient caregivers. Caregiver well-being is frequently neglected in application design (16). Moreover, the communication technologies enabling caregivers to interact with healthcare practitioners or fellow caregivers are either inadequately developed or nonexistent. Real-time communication technologies between caregivers and healthcare professionals are crucial yet largely underutilized in most applications (13). Incorporating features to mitigate disparities in access to stroke caregiving technologies (31).

Technical Barriers

The uptake and continued utilization of mobile health (mHealth) applications by stroke caregivers can be considerably obstructed by numerous technical impediments. These constraints adversely affect user engagement and happiness, potentially undermining the application's overall efficacy in facilitating caregiving activities. A significant technological difficulty is inadequate internet connectivity and device compatibility, particularly in rural or disadvantaged areas. Inadequate internet connectivity was a principal obstacle faced by caregivers utilizing mobile applications intended for stroke care assistance (26). This infrastructure deficiency limits real-time access to application functionality, including video-based teaching, remote monitoring, and communication tools, thereby compromising the desired continuity of care.
Usability and interface complexity constitute significant obstacles to adoption. A significant obstacle is the absence of personalization and adaptability in several mHealth applications. That generic app designs often neglect the diverse requirements and caregiving settings of individuals, diminishing the technology's perceived use (31). Personalization has been demonstrated to enhance markedly satisfaction and ongoing utilization. Concerns around data privacy and security significantly affect consumer trust and engagement. Furthermore, interoperability with current healthcare systems is frequently constrained, presenting difficulties in incorporating caregiver-oriented applications into extensive clinical workflows. While healthcare providers in Malaysia were generally supportive of mHealth interventions, the lack of seamless integration into hospital systems limited their practical application and long-term feasibility (17).

Lack of Multilingual Support

The lack of multilingual interfaces is a considerable obstacle in multilingual countries such as Malaysia, where caregivers may communicate in Malay, Mandarin, Tamil, or indigenous languages. Numerous mHealth applications are predominantly produced in English or a singular dominating language, disregarding the linguistic variety of consumers. This absence diminishes the accessibility and usability of application material, especially for elderly caretakers or individuals from rural backgrounds with poor skills in the app's default language. Language hurdles could intensify digital exclusion and restrict users' capacity to access essential elements such as stroke education, rehabilitation exercises, and prescription instructions (31). Integrating localized language options is essential for guaranteeing equitable access and significant involvement among various caregiver demographics.

Data Security Issues

Concerns around data security continue to be a significant barrier to the adoption of mHealth technologies. Applications that gather personal health information without sufficient protections may instigate concerns regarding privacy infringements or data exploitation. Caregivers exhibit heightened sensitivity about the management of patient-related data, particularly in applications that incorporate remote monitoring, communication with healthcare providers, or clinical decision support functionalities (33). Insufficient encryption mechanisms, unclear data sharing policies, and the lack of transparent consent procedures erode consumers' trust in the system. Adhering to national and international data protection regulations, while transparently conveying security protocols, is crucial for establishing trust and promoting sustained involvement.

Discussion

This study aimed to explore the design, effectiveness, and gaps in mobile health (mHealth) apps designed for family caregivers of stroke patients. The analysis yielded several significant findings, each contributing to a deeper understanding of the state of mHealth interventions and their potential to support caregivers effectively. The analysis revealed that while these apps address specific caregiver needs, many focus predominantly on single functionalities. Multifunctional apps such

as "OASapp" (25), which integrate multiple caregiving tools, remain limited. This lack of holistic apps reflects an opportunity for developers to design solutions that cater comprehensively to caregivers' diverse needs, such as stress management, patient care organization, and rehabilitation. The reviewed studies demonstrated the significant impact of mHealth apps in improving caregiver support. Some apps reduced caregiver burden and promoted mental well-being (9,16). These apps, offering stress-reducing activities and positive reinforcement tools, underscore the potential of technology to alleviate the emotional and physical toll on caregivers. Some apps facilitate real-time communication between caregivers and healthcare professionals, allowing caregivers to seek advice or report patient health updates. This feature supports collaborative care (8). Apps such as ARMStrokes allow caregivers to communicate with therapists or physicians, enhancing coordination and patient care (18,19). Many apps include guided rehabilitation exercises for stroke patients, helping caregivers facilitate these exercises at home. Interactive features, gamification, and reminders often accompany these functionalities to increase adherence (9,16). The app "RecoverNow," for instance, provides cognitive and speech therapy exercises tailored for stroke recovery (14). Apps often include tools for monitoring patient health metrics such as blood pressure, glucose levels, or cognitive abilities. Alerts for abnormal readings help caregivers respond promptly to potential health issues (24).

mHealth apps frequently provide directories of local resources, support groups, or rehabilitation centers. These features are particularly beneficial in underserved areas or for caregivers unfamiliar with available support systems (13). Park et al (29) found that resource access features, such as links to medical information and support groups, were highly valued by caregivers. To enhance usability, apps often include customizable features such as adjustable font sizes, language options, or interfaces tailored to caregivers' technical abilities (11). The app-based intervention analyzed by Ferré-Grau et al (9) demonstrated improvements in caregivers' positive mental health and overall satisfaction. Moreover, apps incorporating communication features with healthcare providers showed notable success in ensuring better care coordination. For instance, Gerber et al (13) highlighted the benefits of therapist-guided rehabilitation apps in empowering caregivers to assist with patient recovery. Similarly, apps with health monitoring capabilities, such as those assessed by Sarfo et al (14), demonstrated enhanced medication adherence and reduced hospital readmissions. However, evidence-based validation of these apps' effectiveness remains a challenge. Some studies stressed the need for rigorous clinical trials to establish their efficacy conclusively (i.e., 6, 28). Additionally, user engagement and app adherence varied significantly across the studies, with technical usability being a key factor in app adoption. Several apps lack adaptability for individual caregiver needs, particularly for older caregivers who may struggle with technology. Studies like Szeto et al (15) and Cao et al (11) emphasized the importance of user-friendly interfaces and culturally appropriate content. Fewer than 50% of reviewed apps incorporated input from healthcare providers during Development (8). This lack of involvement risks reducing the clinical relevance and applicability of these tools. The absence of robust validation processes limits the credibility of many mHealth apps.

Research Limitations

The research relied on a systematic evaluation of existing literature, with its conclusion's contingent upon the quality and thoroughness of the studies included. Certain pertinent studies may have been omitted due to publication biases or linguistic limitations. The review predominantly concentrated on applications referenced in academic literature, possibly neglecting other efficacious mHealth applications accessible in commercial app stores that are not addressed in scientific research.

The research utilized various approaches, including usability surveys, feasibility assessments, and randomized controlled trials. This variability complicates the ability to reach conclusive determinations or to directly compare results across

investigations. The criteria employed to assess app efficacy exhibit variation, complicating the establishment of common benchmarks for success.

Conclusion

This study's findings have significant implications for research, practice, and policy regarding the development and use of mHealth applications for family caregivers of stroke patients. The research underscores the necessity for additional exploration into the design and assessment of mHealth applications, especially those that incorporate multi-functionality and thoroughly address caregiver well-being. The study highlights the necessity of performing randomized controlled trials to evaluate their therapeutic efficacy. Applications featuring communication capabilities enhance collaboration among caregivers and healthcare professionals, mitigating caregiving ambiguities and elevating the quality of patient care.
Investment in mHealth app development to solve recognized deficiencies, such as limited functionality and inadequate caregiver emphasis, can result in more effective and broadly embraced solutions. Given that mHealth applications manage sensitive health information, it is necessary to ensure adherence to privacy standards and foster user trust. Mitigation of Caregiver Burden: Assisting caregivers using mHealth applications can diminish the physical and mental strain linked to caregiving, hence improving their well-being and ability to deliver care.

Journalism Ethics considerations

Ethical issues (Including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, redundancy, etc.) have been completely observed by the authors.

Funding Statement

This research received no funds.

Conflict of Interest

The authors declare no conflict of interest related to this study. All opinions and interpretations expressed are solely those of the authors.

Ethics Statement

This study did not involve human or animal participants, and ethical approval was therefore not required.

References

1. Benjamin EJ, Muntner P, Alonso A, et al (2019). Heart disease and stroke statistics—2019 update: A report from the American Heart Association. *Circulation*, 139(10):e56–e528.
2. Zhiyan H, Li NIN, Chen B, et al (2017). Rehabilitation nursing for cerebral stroke patients within a suitable recovery empty period. *Iran J Public Health*, 46(2):180-185.
3. Djurovic O, Mihaljevic O, Radovanovic S, et al (2021). Risk factors related to falling in patients after stroke. *Iran J Public Health*, 50(9):1832-1841.
4. Lin WU, Zhang, L (2017). Effect of high-quality nursing on improvement of anxiety and depression of patients with acute stroke in MRI examination. *Iran J Public Health*, 46(12): 1646-1651.
5. Camak DJ (2015). Addressing the burden of stroke caregivers: A literature review. *J Clin Nurs*, 24(17–18):2376–2383.
6. Choukou MA, Zhu X, Malwade S, et al (2022). Digital health solutions transforming long-term care and rehabilitation. In *Healthcare Information Management Systems* (pp. 301–316). Cham: Springer International Publishing.

7. Yunitawati D, Latifah L, Suryaputri IY, Laksono AD (2024). A higher maternal education level could be a critical factor in the exceeded cesarean section delivery in Indonesia. *Iran J Public Health*, 53(1):219-227.
8. Burns SP, Terblanche M, Perea J, et al (2020). mHealth intervention applications for adults living with the effects of stroke: A scoping review. *Arch Rehabil Res Clin Transl*, 3(1):100095.
9. Ferré-Grau C, Raigal-Aran L, Lorca-Cabrera J, et al (2021). A mobile app–based intervention program for non-professional caregivers to promote positive mental health: Randomized controlled trial. *JMIR Mhealth Uhealth*, 9(1): e21708.
10. Kumar A, Khurana D, Pattanaik S, et al (2024). A mobile application-based post-stroke care strategy for survivors and their caregivers for prevention and management of post-stroke complications—"Stroke Home Care:" Development and feasibility. *J Neurosci Rural Pract*, 15(2):217-226.
11. Cao W, Kadir AA, Wang Y, et al (2023). Description of apps targeting stroke patients: A review of app stores. *Digit Health*, 9:20552076231181473.
12. Li L, Huang J, Wu J, et al (2020). A mobile health app for the collection of functional outcomes after inpatient stroke rehabilitation: Pilot randomized controlled trial. *JMIR Mhealth Uhealth*, 8(5):e17219.
13. Gerber SM, Schütz N, Uslu AS, et al (2019). Therapist-guided tablet-based telerehabilitation for patients with aphasia: Proof-of-concept and usability study. *JMIR Rehabil Assist Technol*, 6:e13163.
14. Sarfo F, Treiber F, Gebregziabher, M, et al (2019). Phone-based intervention for blood pressure control among Ghanaian stroke survivors: A pilot randomized controlled trial. *Int J Stroke*, 14(6):630–638.
15. Szeto SG, Wan H, Alavinia M, et al (2023). Effect of mobile application types on stroke rehabilitation: A systematic review. *J Neuroeng Rehabil*, 20(1):12.
16. Garnett A, Northwood M, Ting J, Sangrar R (2022). mHealth interventions to support caregivers of older adults: Equity-focused systematic review. *JMIR Aging*, 5(3):e33085.
17. Sidek NN, Tengku Ismail TA, Kamalakannan S, et al (2023). A mixed-methods study on the implementation of a mobile health application (mHealth app) for stroke caregivers in Malaysia: Healthcare providers' perspective. *Front Neurol*, 14:1222260.
18. Pugliese M, Ramsay T, Shamloul R, et al (2019). RecoverNow: A mobile tablet-based therapy platform for early stroke rehabilitation. *PLoS One*, 14:e0210725.
19. Lawson S, Tang Z, Feng J (2017). Supporting stroke motor recovery through a mobile application: A pilot study. *Am J Occup Ther*, 71: 7103350010p1-7103350010p5.
20. Kringle EA, Setiawan IM, Golias K, et al (2020). Feasibility of an iterative rehabilitation intervention for stroke delivered remotely using mobile health technology. *Disabil Rehabil Assist Technol*, 15(8):908–916.
21. Singer J, Weingast S, Gilles N, et al (2018). Developing a user-centered mobile application for stroke caregivers: A pilot national survey. *J Mob Technol Med*, 7(2):35–45.

22. Guo J, Smith T, Messing D, et al (2015, October 26). ARMStrokes: A mobile app for everyday stroke rehabilitation. In *Proceedings of the 17th International ACM SIGACCESS Conference on Computers & Accessibility* (pp. 429–430). Lisbon, Portugal.
23. Lawson S, Guo J, Smith T, et al (2016, February 12). Preliminary evaluation of a mobile app for everyday stroke rehabilitation. In *RESNA's Annual Conference*. Arlington, VA.
24. Zhou X, Du M, & Zhou L. (2018). Use of mobile applications in post-stroke rehabilitation: A systematic review. *Top Stroke Rehabil*, 1-11.
25. Marwaa MN, Guidetti S, Ytterberg C, Kristensen, HK (2023). Using experience-based co-design to develop mobile/tablet applications to support a person-centred and empowering stroke rehabilitation. *Res Involv Engagem*, 9(1):69.
26. Firmawati E, Setyopanoto I, Pangastuti HS (2022). Mobile health application to support family caregivers in recurrent stroke prevention: Scoping review. *Open Access Maced J Med Sci*, 9(T5):142–151.
27. Rehman S, Ghazali SR, Elklit A (2025). COVID-19 and psychopathologies in children—A single session intervention plan to promote mental health during crises management: A systematic review. *Iran J Public Health*, 54(4):688–700.
28. Niyomyart A, Ruksakulpiwat S, Benjasirisan C, et al (2024). Current status of barriers to mHealth access among patients with stroke and steps toward the digital health era: Systematic review. *JMIR Mhealth Uhealth*, 12: e54511.
29. Park JYE, Tracy CS, Gray CS (2022). Mobile phone apps for family caregivers: A scoping review and qualitative content analysis. *Digit Health*, 8:20552076221076672.
30. Cao W, Wang J, Wang Y, et al (2024). mHealth app to improve medication adherence among older adult stroke survivors: Development and usability study. *Digit Health*, 10:20552076241236291.
31. Lobo EH, Abdelrazek M, Frølich A, et al (2022). Detecting usability and user experience issues in stroke caregiving apps: An analysis of user reviews.
32. Mohammadzadeh N, Khenarinezhad S, Ghazanfarisavadkoohi E, et al (2021). Evaluation of m-health applications use in epilepsy: A systematic review. *Iran J Public Health*, 50(3):459-469.
33. Bonura A, Motolese F, Capone F, et al (2022). Smartphone app in stroke management: A narrative updated review. *J Stroke*, 24(3):323–334.