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Effectiveness of rehabilitation programs in acute post-stroke: A systematic review

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ABSTRACT

Introduction: The effectiveness of rehabilitation programs during the acute phase of stroke remain unclear. This study aimed to identify and analyze the forms of exercise education available for post-stroke patients based on a review of existing literature.

Methods: This review was conducted in accordance with the preferred reporting items for systematic reviews and meta-analyses guidelines (PRISMA). This study included research articles related to rehabilitation programs for post-acute stroke patients that were published between 2019 and 2024. Literature searches were performed using PubMed, ScienceDirect, and Google Scholar.

Results: Among the 10 eligible studies, effective programs involved collaboration among medical teams, caregivers, and families. Hospital-based training with early mobilization was often combined with home-based programs supported by technologies such as telehealth for remote monitoring to enhance mobility. In addition, the iron level assessments and vitamin supplementation were important to support the rehabilitation process for patients with acute stroke.

Conclusion: Acute-phase rehabilitation has proven effective in enhancing physical recovery and function in stroke patients. However, methodological variations highlight the need for further research to develop region-specific protocols based on sociodemographic factors.

Keywords: acute post-stroke, early rehabilitation, rehabilitation effectiveness, stroke rehabilitation, systematic review.
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INTRODUCTION

Stroke is a neurological disorder affecting cerebral blood vessels and is a leading cause of disability worldwide.[1] It also poses a significant economic burden due to residual complications such as urinary tract infections[2], aspiration pneumonia[3], pressure ulcers[4], and constipation.[5] Long-term effects may include pain syndromes, depression, anxiety, cognitive impairment, dementia, epilepsy, gait instability[6], and major neurological deficits such as altered consciousness, behavioral changes, paralysis, dysphagia, and aphasia, all of which contribute to lasting disability.[7]

Significant disability can result from neglecting the critical onset period for stroke intervention and delays in rehabilitation. Early rehabilitation is associated with better recovery and fewer complications.[8] Rehabilitation protocols should consider the brain's neuroplasticity, which can begin soon after stroke onset.[9] This adaptive mechanism enhances the brain's ability to reorganize and supports effective recovery following an acute cerebrovascular event.[10]

Early rehabilitation after stroke is highly recommended due to its well-established benefits.[11] The inpatient care team typically includes neurologists, nurses, physiotherapists, occupational therapists, and speech therapists.[12] Rapid rehabilitation not only improves health outcomes but also enhances patients' confidence and self-care abilities. However, a common issue arises after hospital discharge: many patients wait up to two weeks for a follow-up appointment without participating in a rehabilitation program, particularly physiotherapy. This delay is concerning, as the critical recovery period spans the first three to six months post-stroke.[13,14] Physiotherapy plays a vital role during this phase by helping patients restore lost motor function and regain the strength needed for independent living.[15]

Given the challenges in accessing physiotherapy, especially among patients with financial constraints, there is a critical need for easily understandable educational interventions. These should address barriers to healthcare access and provide patients or their families with relevant exercise guidance tailored to post-stroke recovery.[14] Technology-based exercise education and stimulation for post-stroke patients offer significant benefits by enabling remote, detailed support, allowing continued practice at a distance. This study aimed to identify and analyze forms of exercise education for post-stroke patients through a review of existing literature.

METHODS

This study employed a literature review design and was conducted in accordance with the preferred reporting items for systematic reviews and meta-analyses (PRISMA) guidelines. Eligible studies included those involving acute stroke

patients (within three months post-stroke) that evaluated the effects of physiotherapy, occupational therapy, or combined rehabilitation interventions, employing experimental or quasi-experimental designs and reporting outcomes related to physical or cognitive recovery. Studies were excluded if they focused on chronic stroke patients (beyond six months post-stroke) or did not report relevant rehabilitation outcomes.

Literature searches were conducted in PubMed, ScienceDirect, and Google Scholar using keywords such as 'early rehabilitation,' 'education,' and 'stroke patient,' limited to publications from 2020 to 2024. Eligible studies were systematically analyzed, and their methodological quality was assessed using appropriate tools based on study design, considering variables such as sample size, control of confounding factors, and statistical methods. Study selection was conducted by the author with the assistance of Rayyan software.

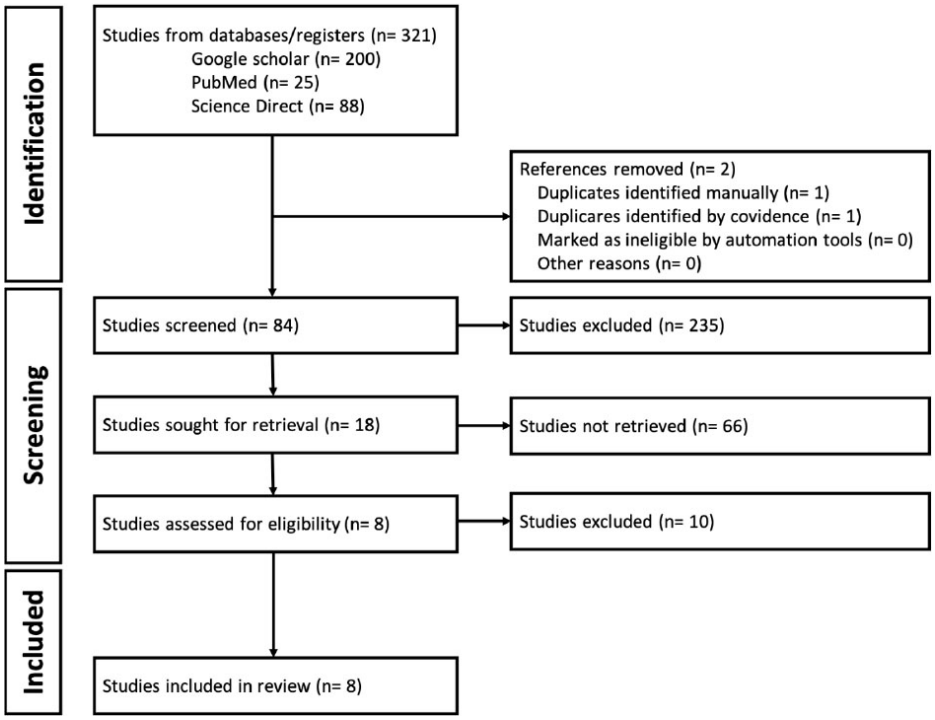

Figure 1. PRISMA flow diagram illustrating the study selection process.

RESULTS

This study employed a systematic literature review to investigate early rehabilitation education for stroke patients. A total of 321 articles were initially identified from PubMed (25 articles), ScienceDirect (88 articles), and Google Scholar (200 articles) using the keyword 'early rehabilitation,' 'education,' and 'stroke patient,' and limited to publications from 2020 to 2024. After removing 2 duplicates, 319 articles remained for screening based on predefined inclusion and exclusion criteria. In the end, 8 articles met the eligibility criteria for in-depth analysis (Figure 1).

The review of eight articles revealed key themes regarding post-stroke rehabilitation (Table 1). Most studies emphasized that early rehabilitation—within the first three months—significantly enhances physical and cognitive recovery. Patients who began therapy during this critical window demonstrated better functional outcomes than those who started later.[16] Some literature also notes that mobilization as early as the second day post-stroke can improve function and accelerate recovery.[17]

Several studies highlight the positive impact of technology-based interventions, such as telerehabilitation and mobile applications on patient engagement and adherence. These tools enable remote monitoring and support, offering particular benefits for patients in rural or underserved areas. The reviewed programs varied, including physiotherapy, occupational therapy, and combined approaches, with evidence favoring multidisciplinary strategies for optimal recovery outcomes.[18]

This review highlights the importance of integrating technology, initiating early intervention, and adopting a multidisciplinary approach to improve recovery outcomes in post-stroke patients. The use of assistive devices can significantly enhance quality of life and support rehabilitation.[19] Additionally, proper nutrition education, particularly on iron-rich foods is essential for optimizing physical performance and overall well-being during recovery.[20]

DISCUSSION

This systematic review confirms that rehabilitation during the acute phase post-stroke effectively enhances recovery outcomes.[21] Early intervention, particularly through physical and occupational therapy, significantly improves motor recovery and promotes independence in activities of daily living (ADLs). Improvements in ADLs are attributed not only to motor function but also to increased cardiovascular fitness.[22] Several studies have also shown that early rehabilitation improves cardiovascular health.[23] Additionally, cognitive rehabilitation plays a key role in addressing post-stroke cognitive deficits.[24]

Rehabilitation options may include telerehabilitation, home-based care with or without assistive devices.[25] The Rehabilitation Team should also develop a comprehensive guidebook tailored to the needs of acute stroke patients.[26] This guide should support both acute stroke rehabilitation and the transition from inpatient to outpatient care.[27]

The acute phase of a stroke may last from 24 hours up to six months.[28] Key considerations during recovery include rehabilitation methods, pharmacological treatments, and nutritional intake.[29] Studies show that low iron levels can impair physical activity in stroke patients, while endovascular thrombectomy (EVT) significantly influences recovery, especially in acute stroke cases.[30]

The success of acute stroke treatment can be evaluated using appropriate

Table 1. The results of these 8 articles were reviewed

Author (Year)	Country	Study Design	Sample Size	Intervention	Measurement/Instruments	Outcomes
Franceschini et al. (2018)[17]	Italy	1-year multicenter prospective project	352 patients	Early mobilization	Barthel Index and Modified Rankin Scale score.	Ability to mobilize from bed by the second day.
Ryu et al. (2022)[31]	Korea	Cohort	17,461 patients	Passive observation without intervention.	National Institutes of Health Stroke Scale (NIHSS) score at admission, early neurological deterioration (END), and 3-month functional outcome based on the modified Rankin Scale (mRS; scores 0–2 considered favorable, 3–6 unfavorable).	Night-onset strokes are associated with greater neurological severity at presentation, higher rates of early neurological deterioration (END), and poorer functional outcomes at three months compared to day-onset strokes.
Owolabi et al. (2021)[32]	World	Comprehensive questionnaire	Eighty-four countries across various WHO regions and income levels.	Acute Stroke Treatment	Questioner and survey	Countries with limited stroke services can adopt strategies from those with more advanced systems.
Doehner et al. (2022)[20]	Germany	Observational study	746 patients		The Barthel Index (Reha-BI), Motricity Index (MI), Trunk Control Test (TCT), and Functional Ambulatory Category (FAC) were used for assessment. Iron deficiency (ID) was defined as ferritin <100 µg/L, or TSAT <20% when ferritin ranged from 100–299 µg/L or C-reactive protein (CrP) >5 mg/L. Anaemia was defined as hemoglobin <12 g/dL in women and <13 g/dL in men.	Iron deficiency and anemia are independently linked to reduced functional capacity following acute stroke and poorer rehabilitation outcomes. Routine iron status assessment may help identify patients at risk of limited recovery.
Dhillon et al. (2022)[29]	United Kingdom	Cohort	Among 4,249 patients, 3,203 were treated in the early time window (593 with perfusion imaging, 2,610 without), and 1,046 in the late time window (378 with perfusion imaging, 668 without).	EVT perfusion	Modified Rankin Scale	In this real-world study, perfusion imaging for EVT was associated with improved functional outcomes in both early and late time windows compared to non-perfusion neuroimaging.

Author (Year)	Country	Study Design	Sample Size	Intervention	Measurement/Instruments	Outcomes
Heran et al. (2024)[33]	Canada	Guidelines	5,902 participants,	Acute Stroke Management Recommendations, 7th Edition, Update 2022	Appraisal of Guidelines for Research and Evaluation II (AGREE II) Instrument components.	By addressing these various program areas, a more holistic and effective rehabilitation strategy can be developed, leading to better outcomes for post-stroke patients.
Godecke et al. (2021)[30]	Australia	Randomized control trial	17 acute-care hospitals across Australia/New Zealand from 2014 to 2018	Early, intensive aphasia therapy	Western Aphasia Battery-Revised Aphasia Quotient (AQ)	Early, intensive aphasia therapy did not improve communication recovery within 12 weeks post-stroke compared to usual care.
Spits et al. (2024)[19]	The Netherlands	Qualitative Study	11 patients	Homecare arm rehabilitation (MERLIN)	Fugl-Meyer Assessment - Upper Extremity (FMA-UE)	Stroke patients show high acceptance of home-based, assistive device-aided upper limb rehabilitation.

assessment tools, which vary based on the affected functional domains. For instance, improvements in daily activities can be measured with the Barthel Index, Reha-BI, Motricity Index (MI), Trunk Control Test (TCT), and Functional Ambulatory Category (FAC).[17,20] Speech recovery can be assessed using the Western Aphasia Battery–Revised Aphasia Quotient (AQ), while upper limb function is commonly measured with the Fugl-Meyer Assessment – Upper Extremity.[31,19] Additional tools such as the NIH Stroke Scale (NIHSS) at admission, early neurological deterioration (END), and the 3-month modified Rankin Scale (mRS) score (0–2 vs. 3–6) help evaluate outcomes based on stroke onset.[32]

Stroke care requires a comprehensive review, as it impacts not only health but also social and economic aspects of life.[33] Effective post-stroke care demands a holistic, multidisciplinary approach involving various fields of expertise.[34] Research shows that successful recovery depends not only on medical treatment but also on strong family or caregiver support, which plays a key role in enhancing patient motivation.[35,36] This motivation significantly influences the recovery process and can improve ADLs in subacute stroke patients.[37]

This systematic review, despite adhering to PRISMA guidelines, is limited by its restricted database search (PubMed, Google Scholar only), a potential "gap" in its acute/chronic stroke patient definitions (3-6 months post-stroke), narrow keyword selection, and reliance on a single reviewer for study selection. Future research should address these by expanding database searches, refining stroke phase definitions, employing more comprehensive keywords, incorporating multiple independent reviewers, and considering a broader publication timeframe to enhance the robustness and generalizability of findings in early stroke rehabilitation.

CONCLUSION

Early-phase rehabilitation significantly enhances physical and cognitive recovery in stroke patients, particularly when initiated within the first three months. This systematic review of eight studies highlights the benefits of early mobilization, multidisciplinary care, and technology-based interventions like telerehabilitation. Approaches combining physiotherapy, occupational therapy, and assistive devices show strong potential for improving outcomes. Nutrition education, especially on iron-rich foods also supports recovery. Given methodological and regional variations, future research should focus on developing standardized, region-specific protocols that account for sociodemographic factors.

ETHICAL CONSIDERATION

This literature review relies exclusively on previously published studies, with no involvement of human or animal subjects. All sources are properly cited, and only peer-reviewed, reputable articles were included to uphold ethical research standards.

CONFLICT INTEREST

The authors declare no competing interests related to this publication.

AUTHORS' CONTRIBUTION

GLA contributed to the study's conception, design, data collection, and manuscript drafting; CM handled data analysis, interpretation, and critical revision for intellectual content; IZ and IB supported the literature review, data presentation, and provided administrative assistance throughout the research.

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