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The effectiveness of adaptive physical activity on improving motor, cognitive and functional abilities in post-stroke patients: A literature review

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Abstract

Stroke is one of the non-communicable diseases that can cause long-term disorders for sufferers, increasing the economic burden for families and the state. Some of the risks that can be experienced by stroke sufferers include impaired body activity, almost most sufferers experience limited physical activity and need assistance when meeting daily needs so that it becomes a burden on the family. The method used in this study is a literature search from three electronic databases, namely Google Scholar, reputable journals, pub med. The inclusion criteria of the study discussed stroke, using adaptive physical activity, based on the review of clinical articles and research published between 2018 and 2024. Exclusion criteria are studies that are not primary research, articles that are not evidence-based, studies that do not use appropriate designs such as RCTs, cohorts or meta-analyses. Results The six articles used in this literature review all showed the effectiveness of adaptive physical exercise on improving the motor and functional abilities of stroke patients.

Keywords

Stroke, Adaptive physical activity, Motor skills, Functional abilities

Introduction

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Stroke remains a significant global health challenge. In 2019, the worldwide prevalence of stroke reached an alarming 101.5 million individuals. A breakdown of these figures reveals that ischemic stroke accounted for the majority at 77.2 million cases, followed by intracerebral hemorrhage at 20.7 million, and subarachnoid hemorrhage at 8.4 million. Geographically, the age-standardized prevalence rates for stroke in 2019 were notably higher in Oceania, Southeast Asia, North Africa and the Middle East, and East Asia. A crucial aspect of stroke management involves addressing modifiable risk factors. Patients are encouraged to engage in feasible daily activities to mitigate complications and prevent further adverse events. Physical rehabilitation and therapeutic exercise are recognized as primary interventions for reducing brain impairment and minimizing

infarct volume. Research indicates that treadmill exercise, specifically, can be beneficial in enhancing cerebral vasomotor activity, diminishing neuroinflammation, and regulating muscle function. Furthermore, evidence suggests that treadmill use contributes to improved motor function, underscoring the potential of exercise to facilitate neural functional recovery post-stroke [1].

A well-supervised physical exercise program can reduce the risk of severe pain and disability. Family being the best supervisor at home, walking for 6 minutes is a good and comfortable activity to do at home. Chronic stroke refers to the recovery period that occurs within six months after the initial stroke event. When a patient enters this stage of recovery, their progress may seem slower than in the acute stage. During the early stages of stroke rehabilitation, patients usually experience rapid improvement in function, after a few months, progress may slow down or stop which is called the recovery plateu phase.

Stroke recovery is a dynamic process, often characterized by distinct phases. A critical phase is the recovery plateau, where observable improvements in a stroke patient's condition significantly diminish or cease. This phenomenon is closely tied to the brain's natural healing mechanisms and the concept of neuroplasticity. Spontaneous recovery is an inherent aspect of the brain's post-stroke healing. During this initial phase, typically within the first three months, the brain exhibits heightened neuroplasticity, allowing for some natural restoration of lost cognitive and physical functions. This innate ability of the brain to repair and salvage damaged, but not destroyed, areas often occur during the acute stage of stroke rehabilitation, generally lasting up to six months. However, spontaneous recovery is neither the sole nor the most reliable pathway to regaining function. Crucially, spontaneous recovery tends to plateau after approximately six months, concurrent with a decline in neuroplasticity. This reduction in the brain's adaptability contributes to the recovery plateau, leading to a perceived lack of progress and potential demotivation for patients.

Activating and sustaining neuroplasticity through consistent intervention, particularly adaptive physical activity (APA), remains the most robust strategy for long-term recovery. Research into APA for stroke patients highlights its potential to bolster the restoration of motor, cognitive, and overall quality of life functions. APA encompasses the ability of individuals to perform functional activities and adapt to various exercises, including walking, strength training, and balance drills. These tailored exercises are specifically designed to stimulate neuroplasticity, thereby fostering improved physical and functional recovery, even during the recovery plateau. The benefits of physical activity for stroke patients are substantial and multifaceted. It significantly enhances neuroplasticity, improves cerebral blood flow, aids in hormone regulation, and contributes to the recovery of motor, cognitive, and functional abilities. Therefore, a rehabilitation program meticulously tailored to the patient's condition and incorporating regular, consistent adaptive physical activity is paramount for accelerating the recovery process and ultimately enhancing the patient's quality of life.

Methods

Literature searches were conducted through the google scholar database. The keywords used to obtain articles to be reviewed are Stroke, Adaptive physical activity. Searches are limited from 2017 to 2024. The results of searching articles from the google scholar database, reputable Scopus journals, PubMed are 50 articles. The next step is screening. The type of application used in searching for literature using WATASE UAKE. Scoping review used in this research was guided by Preferred Reporting Items for Systematic Reviews and Meta-Analyses Extension for Scoping Reviews (PRISMA-ScR) with ISSN number 15393704. Data were screened by the first author using the following inclusion criteria: 1) original articles, reviews, consensus statements, or guidelines that explain stroke and APA written in English or Indonesian. 2) The full articles can be accessed freely (no charge) (free full text) and 3) no duplication. Meanwhile, the exclusion criteria included research that did not match the inclusion criteria. Additional articles were identified by the first author through a snowballing search of the reference list in the full article that met both inclusion and exclusion criteria.

Data Charting Process: The author conducted an independent search of electronic databases from 2017 to 2024. Initially, each database was searched using keywords, followed by exploring titles and reading the abstract based on the search results obtained from writing keywords. Titles and abstracts that met the inclusion criteria were continued by reading the full articles. The re-filtering process was carried out by snowballing the references obtained from the full articles to conduct exploration starting from reading title, abstract, and complete article content.

Each group collected the form of a table and carried out the extraction of the data including author name and year of publication, title, location, objectives, type, method, design, and results. Table creation was carried out to determine which variables to extract and independently map the data from each eligible article and discuss the results. Subsequently, the results were analyzed to obtain conclusions.

Results and Discussion

A total of 50 articles were removed due to the inclusion of literature reviews or meta-analyses, correlations, and surveys. Subsequently, 8 articles became the topic of discussion after being trimmed according to the criteria and 6 were subjected to screening from reputable international publications shown in Table 1. The 6 articles synthesized showed that several APA methods affected motor movement and functional activity in post stroke patients.

Table 1. Search Results for stroke and APA articles

No	Title	Year	Author	Research Methods and Population	Research Results
1	Physical Activity Participation in Community-Dwelling Stroke	2017	Jacqui H Morris, Tracey Oliver, Thilo Kroll, Sara	Qualitative study using semi-structured in-depth interviews.	This research suggested the need for a shift from purely pragmatic methods to

No	Title	Year	Author	Research Methods and Population	Research Results
	Survivors: Synergy and Dissonance between Motivation and Capability. A Qualitative Study		Joice, Brian Williams		promoting PA towards conceptual solutions.
2.	Adapted Physical Activity and Stroke: A Systematic Review	2018	Patrizia Belfiore, Alessandra Miele, Francesca Gallè, Giorgio Liguori	Systematic literature review	Integrating physical activity and exercise into the rehabilitation process and post-rehabilitation period could be a successful intervention for functional and cognitive recovery in patients with brain damage post stroke.
3.	Adaptive Physical Activity for Stroke: An Early-Stage Randomized Controlled Trial in the United States	2019	Mary stuart, alexander W domerick, et al.	single-blind, randomized controlled trial, 76 stroke patients, mild to moderate hemiparesis >6 months were randomized to either APA-Stroke	The safety, feasibility, and effectiveness of APA-Stroke classified survivors in a variety of home and community settings across three separate trials conducted in two countries with varying levels of health systems. Research on APA-Stroke consistently showed that, with appropriate screening and exercise therapy, survivors of stroke could make improvements in their functional abilities.
4.	Effectiveness of Adaptive Physical Activity Combined with Therapeutic Patient Education in Stroke Survivors at 12 Months	2019	Simona Calugi, Mariangela Taricco, Paola Rucci, Stefania Fugazzaro, Mary Stuart, Laura Dallolio, Paolo Pillastrini, Maria P Fantini	This research is a non-randomized parallel group research comparing APA-TPE intervention with treatment as usual (TAU)	APA-TPE was found to be an effective intervention for maintaining and improving activities of daily living, reducing the risk of falls, and the need for rehabilitation care in 12 months.
5.	Physical Activity in Stroke Patients: A Scoping Review	2021	Ariyati Amin, Rosyidah Arafat, Rini Rachmawaty	scoping review using Arksey and O'Malley's five-stage framework	Physical activity among stroke survivors served as a basis for implementing the standard. Various physical activity

No	Title	Year	Author	Research Methods and Population	Research Results
					regimens were identified as appropriate for stroke survivors, each with different goals and benefits in improving physical function in stroke survivors.
6.	Adaptive Sports for Promoting Physical Activity in Community-Dwelling Adults with Stroke: A Feasibility Study	2021	Pradeepa Nayak, Amreen Mahmood, Senthil Kumaran D, Manikandan Natarajan, Bhaskaran Unnikrishnan, John M. Solomon	Two focus groups were conducted among the eight experts and a person with stroke to develop adaptive sports. To test the feasibility of these adaptive sports, in a multi-methods study eighteen community-dwelling adults with stroke were recruited.	Participants reported positive experiences with the program. There were no adverse events during or after participation. Health benefits, fitness, and enjoyment were reported as facilitators, while lack of access to exercise facilities and lack of caregiver support were reported as barriers to participation.

Discussion

In this research, five kinds of literature were explored discussing the types of massage or combinations to improve blood pressure conditions in stroke patients. The following is a discussion related to the literature obtained.

The first research conducted by Morris et al. showed that the beliefs, attitudes, as well as physical and social contexts of survivors, produced synergy or dissonance between motivation and cognitive ability to perform physical activity. Dissonance occurs when motivated survivors have limited ability, causing frustration. Belief in achieving goals and determination to overcome obstacles act as catalysts for activity when other influences are synergistic. This research shows that a transition is needed from a purely pragmatic method to one of the recommended exercises for stroke patients. The relationship between motivation and physical ability to influence the behavior of patients will support physiotherapists and other health professionals in helping with occurring problems. This research provides a model for developing individualized interventions to overcome the barriers faced by stroke survivors [2].

Belfiore et al. [3] conducted a systematic review to explore the integration of physical activity and exercise within both the rehabilitation and post-rehabilitation phases for individuals with brain injury following a stroke. Their synthesis of existing literature highlighted that tailored physical activity and exercise can significantly contribute to the functional and cognitive recovery of these patients. The findings underscore the valuable role of physical activity in supporting stroke survivors to sustain adequate

levels of motor autonomy, alongside fostering improvements in their physical and psychological well-being. Furthermore, engagement in physical activity and exercise has been shown to enhance overall health and quality of life, preserve functional independence, mitigate the risk of subsequent cerebrovascular events, and promote social engagement, particularly when undertaken in group settings.

Stuart et al. [4] executed a Phase II trial to evaluate the safety, effectiveness, and feasibility of the Italian Adaptive Physical Activity (APA-Stroke) community-based exercise program for stroke survivors in the United States. This research demonstrated that the APA-Stroke program is a safe, feasible, and effective intervention for stroke survivors across both home and community environments in the United States and Italy. The study's results suggest that stroke survivors can achieve notable functional gains through appropriately screened and trained participation in such programs. This emphasizes the critical importance of protocol-specific training and vigilant instructor supervision to ensure participant safety. Community-based exercise programs, like APA-Stroke, led by trained lay instructors, present a cost-effective and accessible intervention model, offering particular benefit to low-income and underserved populations. The authors recommend future trials to meticulously consider control interventions, recruit larger sample sizes, conduct long-term follow-up assessments, and broaden the scope of investigated outcome measures.

Calugi et al. [5] further investigated Adaptive Physical Activity (APA) as a community-based exercise program specifically designed for chronic stroke patients. Their research had previously established the short-term efficacy of this method in enhancing both physical function and psychological well-being. In their subsequent investigation, patients were enrolled between 3 and 18 months post-stroke, following their discharge from Physical Medicine and Rehabilitation Units. The APA-Therapeutic Patient Education (APA-TPE) intervention was delivered in local gymnasiums. The study's outcomes revealed that APA-TPE served as an effective intervention for maintaining and improving activities of daily living, reducing the incidence of falls, and minimizing the need for readmission to rehabilitation care over a 12-month period. The clinical implications of this rehabilitation approach include a structured physical activity program adaptable for home use. When augmented with therapeutic education focused on the benefits of physical activity, APA-TPE can significantly motivate stroke patients to sustain their exercise regimens. Consequently, this methodology fulfills essential criteria for sustaining long-term health benefits and preventing both physical and psychological deterioration in stroke survivors.

The fifth research was conducted by Ariyati Amin, Rosyidah Arafat, and Rini Rachmawaty, who independently screened published articles. Initially, the title and abstract were examined, followed by scanning of articles in the last 5 years of publications. The results showed physical activity in stroke patients that provided a basis for routine implementation. Several physical activity exercises were identified to be beneficial in the recovery process. Therefore, physical activity should be carried out

regularly, following the appropriate duration, intensity, and frequency of the exercise to patients' ability and stamina. This showed the important role of physical activity in the improvement of stroke patients [6].

The sixth research conducted by Nayak et al. [7] investigated the development and feasibility of adaptive sports for stroke survivors. Their research, employing a multi-method approach, began with qualitative data collection from eight experts and one stroke survivor to inform the design of the adaptive sport intervention. For the feasibility testing phase, eighteen community-dwelling adult stroke patients were recruited. These participants engaged in adaptive sports sessions twice weekly over a two-month period at a local community center. The study assessed physical activity levels and quality of life both before and after the intervention. Additionally, participants were interviewed at the conclusion of the program to gain insights into their experiences. The program demonstrated promising results. A high retention rate of 83.33% was observed, and participants showed a significant increase in physical activity training levels. However, the improvement in quality of life did not reach statistical significance. Qualitative feedback from participants was overwhelmingly positive, with no adverse effects reported during or after participation. Facilitators to participation included perceived health benefits, improved fitness, and enjoyment. Conversely, significant barriers identified were limited access to appropriate sports facilities and insufficient environmental support.

APA is exercise contributing to improved health and quality of life. Stroke survivors can benefit from physical activity and exercise in terms of improving health, quality of life, and maintaining functional autonomy. Practicing physical activity in a group setting also promotes socialization. This is because group physical activity offers a sense of competition and challenge, which can motivate and help stroke survivors in recovery process.

Cognitive impairments are a prevalent consequence following a stroke, significantly impacting patient outcomes. Data indicate that episodic memory deficits are experienced by 55% of stroke survivors, while executive function impairments affect 40%, and language deficits are observed in 23% of cases. These cognitive challenges – specifically in episodic memory, executive function, visual attention, and language – are strongly correlated with difficulties in performing both activities of daily living (ADL) and instrumental activities of daily living (IADL). This highlights the profound influence of stroke-induced cognitive deficits on an individual's capacity for independent daily functioning. The incidence of cognitive deficits dramatically increases threefold post-stroke, with approximately 25% of stroke patients subsequently developing dementia. Intriguingly, even patients who achieve full recovery from physical disabilities often find themselves unable to resume daily activities due to persistent cognitive impairments. The welcome decline in stroke mortality has, paradoxically, led to an increased burden of post-stroke cognitive impairment, consequently escalating healthcare costs.

The clinical manifestation of post-stroke cognitive impairment is highly variable, ranging from discrete focal neurological deficits to comprehensive cognitive dysfunction. However, the accurate testing and assessment of cognitive function in this population face considerable hurdles. These difficulties primarily stem from the absence of a universally accepted definition of cognitive impairment and the frequent lack of baseline information regarding a patient's cognitive status prior to their stroke event.

Conclusion

In conclusion, this research provided empirical results regarding physical activity in stroke patients that served as a basis for routine implementation. The results showed that several physical activity exercises could be performed by stroke patients with each having a purpose and benefit in the functional recovery process. The exercises should be carried out regularly, by adjusting the duration, intensity, and frequency according to the ability and stamina of patients. This research showed how physical activity played an important role in the improvement of stroke patients.

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