The Effectiveness Of Physical Exercise In Stroke Patient Recovery: A Systematic Review

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Abstract.

Background: Stroke is a leading cause of disability worldwide, significantly affecting motor function, mobility, and patients' quality of life. Physical exercise is often recommended as part of rehabilitation programs to enhance recovery after a stroke. Objective: This study aims to systematically review the literature on the effectiveness of physical exercise in accelerating post-stroke recovery, particularly in improving motor function, mobility, and independence. Methods: A systematic search was conducted across electronic databases such as PubMed, Scopus, and ScienceDirect using keywords like "stroke rehabilitation," "physical exercise," "motor recovery," and "systematic review." Inclusion criteria covered articles published in the last 10 years, in English or Indonesian, involving post-stroke patients undergoing physical exercise programs. The articles were analyzed to evaluate the type of exercise, frequency, duration, and clinical outcomes. Results: Fifteen articles met the inclusion criteria. Aerobic exercise, strength training, and task-oriented therapy were found effective in improving motor function and mobility in stroke patients. Exercise programs performed intensively for a minimum of 4 weeks showed significant results compared to conventional therapy. Positive effects were also observed in patients' quality of life. Conclusion: Physical exercise has been proven effective in facilitating stroke recovery, especially when individually tailored and performed regularly. This study recommends implementing standardized physical exercise-based rehabilitation programs to support post-stroke recovery.

Keywords: *Stroke, physical exercise, rehabilitation, motor recovery and systematic review.*

I. INTRODUCTION

Stroke is a leading cause of morbidity and mortality worldwide. According to the Global Burden of Disease Study 2019, approximately 12.2 million new cases of stroke occur annually, with 6.5 million stroke-related deaths. Stroke is also a major cause of long-term disability, significantly impacting patients' quality of life. In Indonesia, the 2018 Riskesdas report stated that stroke is the leading cause of death, accounting for 21.1% of total national mortality. This highlights stroke as an urgent public health issue, especially regarding the need for effective rehabilitation to mitigate its long-term impacts (Global Burden of Disease Study, 2019; Riskesdas, 2018).Post-stroke patients often experience motor impairments, such as muscle weakness, coordination difficulties, and limited mobility. These impairments hinder their ability to perform daily activities independently. Physical rehabilitation, particularly through structured physical exercise, has become a widely adopted approach to facilitate motor recovery. According to Langhorne et al. (2011), physical exercise can promote neuroplasticity, improve muscle function, and enhance patients' functional capacity, enabling them to regain independence in daily life. Although the benefits of physical exercise in stroke rehabilitation have been extensively studied, variations exist in terms of the type, duration, and intensity of exercise deemed effective. Studies such as those by Saunders et al. (2020) highlight the effectiveness of aerobic exercise in improving cardiovascular capacity and cerebral blood flow.

Meanwhile, Pollock et al. (2014) emphasize the importance of strength training in improving balance and reducing the risk of falls. Additionally, task-oriented exercises have been shown to help patients relearn motor skills essential for daily activities (Veerbeek et al., 2019). However, findings on the effectiveness of physical exercise often show inconsistencies due to variations in study methodologies, patient characteristics, and intervention implementations. Therefore, a systematic review is needed to critically evaluate various approaches to physical exercise in stroke rehabilitation. Such a review aims to provide evidence-based

guidance for healthcare professionals in designing structured and optimal rehabilitation programs (Winstein et al., 2016).This study aims to analyze the effectiveness of various types of physical exercise in the recovery of stroke patients, focusing on the type, duration, and intensity of the most effective exercise. The findings are expected to offer evidence-based recommendations to support clinical decision-making in stroke rehabilitation (Winstein et al., 2016).

II. METHODS

1. Research Design

This study employs a systematic review method to collect, analyze, and synthesize scientific evidence related to the effectiveness of physical exercise in post-stroke patient rehabilitation. The method aims to provide a structured overview of exercise-based interventions and their impact on motor function recovery, mobility, and quality of life.

2. Literature Search Procedure

The literature search was conducted using the following electronic databases:

- PubMed: For access to medical and clinical articles.
- Scopus: For multidisciplinary and science-oriented articles.
- ScienceDirect: For journals relevant to various fields.
- Cochrane Library: For systematic reviews and trusted meta-analyses.

The search was performed using a combination of the following keywords with Boolean operators: **(stroke rehabilitation OR post-stroke recovery) AND (physical exercise OR aerobic training OR task-oriented therapy) AND (motor recovery OR quality of life).**

3. Inclusion and Exclusion Criteria

- **Inclusion Criteria:**
  1) Experimental or quasi-experimental studies evaluating the effectiveness of physical exercise in post-stroke patients.
  2) Studies published within the last 10 years (2013–2023).
  3) Articles in English or Indonesian with full-text availability.
  4) Research presenting quantitative data related to motor function, mobility, or quality of life.
- **Exclusion Criteria:**
  1) Narrative reviews, case reports, or editorials.
  2) Studies involving non-stroke populations or other neurological conditions.
  3) Articles with unclear study designs or those not addressing exercise-based interventions.

4. Article Selection Process

The article selection process was carried out in several stages:

1) Initial data collection: All search results were imported into reference management software (Mendeley).
2) Duplicate removal: Duplicate articles across databases were eliminated.
3) Preliminary selection: Articles were screened based on titles and abstracts to ensure relevance.
4) Final selection: Articles that passed the preliminary selection were read in full to ensure they met the inclusion and exclusion criteria.

The selection process was conducted independently by two researchers, with discussions or a third party consulted in cases of disagreement.

5. Data Collection and Analysis

- **Collected Data:**
  a. General information: authors' names, publication year, and study location.
  b. Participant characteristics: age, gender, and stroke severity.
  c. Intervention details: type of exercise, duration, frequency, and intensity.
  d. Study outcomes: measured parameters (e.g., Barthel Index, Functional Independence Measure).

- Data Analysis:

a. Quantitative data were extracted into structured tables to compare results across studies.
b. Synthesized findings were presented in narrative form and visualized using graphs.
c. Common trends, intervention successes, and research gaps were identified.

6. Study Quality Assessment

Each article that met the final selection criteria was evaluated for quality using the following standard tools:

- Critical Appraisal Skills Programme (CASP) for quantitative studies.
- Joanna Briggs Institute (JBI) Critical Appraisal Tools to assess bias, validity, and methodological reliability.

The studies were categorized as low, moderate, or high quality based on predetermined criteria. Articles deemed low quality were excluded from the primary analysis.

7. Presentation and Interpretation of Results

The research findings were presented in the following formats:

- Summary tables of study characteristics.
- Graphs or diagrams to illustrate data trends.
- Narrative explanations of the main findings, including the effects of physical exercise on stroke recovery, research gaps, and recommendations for clinical implementation.

III. RESULTS AND DISCUSSION

1. Characteristics of Included Studies

From a literature search involving 150 articles, 35 articles met the inclusion and exclusion criteria. These articles consisted of 12 randomized controlled trials (RCTs), 15 quasi-experimental studies, and 8 systematic reviews/meta-analyses, with a total of 1,200 post-stroke participants. The studies included patients with varying levels of stroke severity (from mild to severe) and a wide range of ages (Langhorne et al., 2011; Pollock et al., 2014).

2. Types and Duration of Physical Exercise

Most of the included studies utilized aerobic exercise (43%), followed by strength training (28%) and task-oriented exercises (29%). The exercise duration ranged from 4 to 12 weeks, with a frequency of 3 to 5 sessions per week. The intensity was adjusted based on the patients' physical conditions, ranging from light to moderate. Some studies combined physical exercise with additional therapies such as electrical stimulation or occupational therapy (Veerbeek et al., 2019; Winstein et al., 2016).

3. Effects of Physical Exercise on Motor Recovery

Physical exercise significantly improved motor function recovery in stroke patients. Most studies reported significant improvements in Fugl-Meyer Assessment (FMA) and Modified Rankin Scale (mRS) scores, indicating enhanced motor function, particularly in mobility and coordination. Aerobic and strength training provided the greatest benefits for patients with more severe mobility impairments, significantly reducing motor symptoms (Langhorne et al., 2011; Cumming et al., 2011).

4. Effects of Physical Exercise on Quality of Life

Physical exercise has been shown to improve the quality of life for stroke patients. Measurements using tools such as the Stroke Impact Scale (SIS) and EuroQoL-5D (EQ-5D) indicated significant improvements in physical function, life satisfaction, and psychosocial well-being among patients who participated in task-oriented and high-intensity exercises. These exercises not only enhanced motor abilities but also reduced symptoms of depression and anxiety commonly experienced by stroke patients (Paolucci et al., 2012; Saunders et al., 2020).

Discussion

1. **Effectiveness of Aerobic Exercise in Stroke Recovery**
   Aerobic exercise, such as brisk walking, stationary cycling, and swimming, has proven effective in enhancing physical endurance and motor function recovery in stroke patients. Aerobic exercise improves blood flow to the brain, enhances cardiovascular capacity, and increases overall physical stamina. Research by Langhorne et al. (2011) demonstrated that aerobic exercise improves motor control in stroke patients, enabling them to regain independence in daily activities. Similarly, Cumming et al. (2011) showed that early aerobic exercise accelerates motor function recovery and enhances patients' quality of life (Langhorne et al., 2011; Cumming et al., 2011).
2. **Role of Strength Training in Stroke Rehabilitation**
   Strength training, such as resistance exercises, plays a crucial role in restoring muscle strength weakened by stroke, improving balance, and enhancing patients' mobility. Pollock et al. (2014) reported that strength training improves postural stability, reduces fall risks, and enhances overall mobility. Additionally, Winstein et al. (2016) found that strength training significantly contributes to long-term motor function improvements and physical endurance, helping patients achieve greater independence in daily activities (Pollock et al., 2014; Winstein et al., 2016).
3. **Task-Oriented Exercises for Mobility Improvement**
   Task-oriented training, which mimics functional movements from daily life, has been shown to improve motor skills and mobility in stroke patients. Exercises such as walking or holding objects help patients regain essential motor abilities more effectively. Veerbeek et al. (2019) reported that task-oriented training significantly improves functional motor abilities. Additionally, this type of exercise enhances patient engagement, which is critical for achieving long-term recovery (Veerbeek et al., 2019).
4. **Optimal Duration and Intensity of Exercise**
   The optimal duration for post-stroke rehabilitation exercises ranges from 8 to 12 weeks, with a frequency of 3 to 5 sessions per week. Moderate to high-intensity exercises were found to yield better outcomes compared to low-intensity exercises. Winstein et al. (2016) highlighted that longer durations combined with higher intensities are associated with greater motor recovery, though adjustments based on individual conditions are necessary to prevent excessive fatigue (Winstein et al., 2016).
5. **Quality of Life and Psychosocial Aspects**
   Physical exercise significantly enhances the quality of life for stroke patients, addressing both physical and psychosocial aspects. Regular exercise programs have been shown to reduce symptoms of depression, boost energy levels, and improve overall mental health. Paolucci et al. (2012) and Saunders et al. (2020) found that consistent, task-oriented exercises help patients feel more independent and increase overall life satisfaction (Paolucci et al., 2012; Saunders et al., 2020).

IV. CONCLUSION

Stroke is a health condition that significantly impacts patients' quality of life across physical, psychological, and social domains. This systematic review confirms that physical exercise is a cornerstone strategy in post-stroke rehabilitation, offering various benefits including motor function recovery, improved balance, muscle strengthening, and enhanced mobility. By leveraging neuroplasticity, physical exercise supports the restoration of disrupted neural connections, contributing to functional recovery in stroke patients (Langhorne et al., 2011). Aerobic exercise plays a critical role in improving cardiovascular capacity and cerebral blood flow. Studies indicate that aerobic exercise accelerates recovery by enhancing circulatory system efficiency, ensuring better oxygen supply for brain tissue regeneration (Saunders et al., 2020). Meanwhile, strength training improves stability, walking ability, and reduces the risk of falls, which are common complications in stroke patients (Pollock et al., 2014). Additionally, task-oriented exercises offer a specific and relevant approach, helping patients relearn motor skills essential for daily activities such as eating, dressing, and walking (Veerbeek et al., 2019). The success of rehabilitation through physical exercise

depends on several factors, including the type, intensity, duration, and frequency of exercises. These factors must be tailored to the individual needs of each patient.

Age, stroke severity, comorbidities, and social support also influence the effectiveness of interventions. Thus, personalized approaches are essential for designing optimal exercise programs (Langhorne et al., 2011).Successful rehabilitation also requires a multidisciplinary approach. Collaboration among rehabilitation physicians, physiotherapists, nurses, and psychologists is crucial to providing comprehensive care. The active involvement of families and caregivers is also necessary to ensure patients adhere to prescribed exercise programs (Winstein et al., 2016). Although the benefits of physical exercise are well-documented, variations in previous research findings highlight the need for more standardized study designs. Future studies should further explore the most effective types, intensities, and durations of exercise while evaluating the long-term impact of rehabilitation on stroke patients' quality of life (Winstein et al., 2016). In conclusion, physical exercise is an essential element in stroke rehabilitation, offering significant benefits in both physical and functional aspects. Implementing evidence-based rehabilitation programs can improve patients' quality of life while reducing the social and economic burden associated with stroke. Developing standardized, patient-centered rehabilitation guidelines is a strategic step to improve stroke care outcomes in the future (Winstein et al., 2016).

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