Implementation of Physical Activity Interventions for the Prevention of Recurrent Stroke: A Scoping Review

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Abstract

Background: Stroke patients face a high risk of recurrent attacks if secondary prevention is not optimized. Physical activity interventions, including structured exercise and movement-based programs, may improve functional outcomes and help prevent recurrent stroke.

Objective: This scoping review aimed to identify physical activity intervention programs for the prevention of recurrent stroke.

Methods: A literature search was conducted across four databases: PubMed, Scopus, ScienceDirect, and SAGE Journal. Manual searches were also performed for studies published between 2015 and 2025. Eligibility criteria included a focus on recurrent stroke and physical activity interventions, with all studies published in English. Thematic synthesis was used to synthesize the findings. This process was conducted from August to September 2025.

Results: Out of 622 identified articles, 10 met the inclusion criteria, involving 6,348 participants. Most participants were aged over 55 years with ischemic stroke. Three key themes emerged from the thematic synthesis: (1) Reported outcome of physical interventions on recurrent stroke, including both positive effects and the absence of effects; (2) Intervention characteristics of recurrent stroke prevention, comprising modifiable and non-modifiable factors; and (3) Variation in duration of physical therapy, which should be performed intensively but not excessively long.

Conclusion: Current evidence suggests that physical activity interventions may play a supportive role in secondary stroke prevention by improving functional outcomes and controlling modifiable and non-modifiable risk factors. Future research should further explore which specific types of physical interventions provide the greatest preventive benefits and under what conditions they are most effective.

Keywords: *Stroke, physical therapy modalities, exercise therapy, stroke rehabilitation, recurrent stroke.*

INTRODUCTION

Stroke is a cerebrovascular disease that ranks as the second leading cause of mortality and the third leading cause of morbidity worldwide [1]. The World Stroke Organization reported in 2022 the urgent need for proper stroke management, given that the global prevalence of stroke is currently high, with 12.2 million cases and 1.5 million deaths annually [2]. One year after a stroke, 25% of stroke patients may succumb to the condition, and 50% may live with lifelong morbidity [3, 4].

Stroke patients face a high risk of recurrent stroke, and data from several countries indicate a high incidence of recurrent stroke. In Nigeria, 32% of stroke patients experience a recurrent [5]; in Germany, the three-year recurrence rate is 23.3% [6]; and in Sweden, the ten-year recurrence rate is 18% [7]. The risk of recurrent stroke can be mitigated if optimal preventive strategies are implemented. Stroke in small blood vessels usually presents with minimal symptoms as it only causes small cerebral lesions; however, it can still lead to recurrent strokes [8]. Recurrent stroke most frequently occurs in large artery atherosclerosis, and patients with a history of ischemic stroke exhibit a higher incidence of recurrent stroke compared to those with hemorrhagic stroke [9, 10].

Recurrent stroke can be prevented through several management strategies, including physical activity, dietary modification, surgery, and the use of antithrombotic therapy to treat dyslipidemia [11]. Several studies have shown that controlling all modifiable risk factors can reduce the incidence of recurrent stroke by up to 75% [12]. Another study reported that utilizing various techniques within the categories of physical fitness, education, and adherence to treatment plans can reduce the risk of recurrence [13].

Recurrent stroke attacks may occur if modifiable lifestyle factors are not taken into consideration, one of which is physical activity [14]. Insufficient physical activity is a serious issue; for instance, it was reported that in Indonesia, 572 adults (52.48%) experienced recurrent stroke attacks due to sedentary behavior [15]. Physical activity guidelines are recommended to prevent recurrent stroke and to maintain physical function. Patient participation in physical activity not only reduces recurrence but also improves quality of life [16].

Regular physical activity strengthens the heart muscle and helps prevent an increase in blood pressure by dilating blood vessels and reducing fatty deposits in the

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Received: January 07, 2026; Revised: March 28, 2026; Accepted: April 21, 2026
DOI: https://doi.org/10.37184/lnjpc.2707-3521.8.54

coronary arteries, thereby promoting smooth blood flow. Physical activity also affects neurohormonal function by reducing parasympathetic nerve activity and increasing arterial diameter by lowering norepinephrine, renin, and systemic vascular resistance [17]. Furthermore, physical activity can also improve blood circulation and reduce the risk of blood clot formation, thereby lowering the likelihood of subsequent ischemic attacks [18].

Previous studies have examined the relationship between physical activity and recurrent stroke, indicating that 84% of patients with ischemic stroke experienced a recurrent event, with the first recurrence occurring in 92% of those cases. These results indicate a significant relationship between physical activity and recurrent stroke [19]. However, there is currently a lack of comprehensive reviews synthesizing multiple articles on this topic, and the various types of stroke also need to be identified in relation to the incidence of recurrent stroke. Therefore, the objective of this review is to identify how physical activity interventions contribute to the prevention of recurrent stroke attacks.

METHODS

This study is a scoping review developed in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses Extension for Scoping Reviews (PRISMA-ScR) 2020 guidelines [20]. The study provides a broad overview of the implementation of physical activity interventions to prevent recurrent stroke. Furthermore, this scoping review follows the five-stage framework proposed by Arksey and O'Malley (2005), which includes: (1) identifying the research question; (2) identifying relevant studies; (3) selecting studies; (4) mapping the data; and (5) compiling, summarizing, and reporting the results [21].

Identifying the Research Question

The PCC (Population, Concept, and Context) framework was used to define the focus and boundaries of this review. Population refers to individuals who have experienced a stroke. The concept focuses on physical activity interventions, both professionally guided physical rehabilitation/physical therapy and structured exercise. Lastly, the context encompasses the implementation environment for interventions aimed at preventing recurrent stroke, both in the community and in hospitals. The application of PCC to this review is shown in Table **1**.

Based on this framework, the primary research question was: "How have physical activity intervention programs been implemented and evaluated for the prevention of recurrent stroke?" This question explores implementation strategies, assesses outcomes, and examines the contribution of such programs to reducing the risk of stroke recurrence. Additionally, this inquiry serves to map existing evidence, identify gaps in the literature, and inform future research directions and clinical practice.

Table 1: PCC.

Components PCC	Descriptions
Population	Stroke patients
Concept	Physical intervention (structured exercise and professionally guided physical rehabilitation/ physical therapy)
Context	Prevention of recurrent stroke in various settings (outpatients, community, hospital, home care)

Identifying Relevant Studies

The article search process was conducted across four databases: PubMed, Scopus, ScienceDirect, and SAGE Journals. Boolean operators (AND and OR) were used to combine keywords effectively. The keywords were related to "physical activity", "exercise", "training", "aerobic exercise", "physical rehabilitation", "physiotherapy", "recurrent stroke", "prevention", and "stroke". We started in August and ended in September 2025. The keywords used in each database are presented in Table **2**. In addition to database searches, a manual search of reference lists from included articles was conducted to identify potentially relevant studies. No unrestricted web searches were performed. This scoping review is not registered in PROSPERO because it only accepts systematic reviews that focus on the effectiveness of interventions, and this study identifies, not analyzes, effects from the previous literature.

The inclusion criteria for this study were as follow: (1) research subjects consisted of stroke patients, (2) the study evaluated the application of physical intervention in patient care, (3) the article was published in English, (4) the publications date fell between 2015 and 2025, (5) the study addressed on the risk of recurrent stroke, and (6) the study was available as a peer-reviewed full-text article. Conversely, studies were excluded if the patients had already experienced a recurrent stroke, and if the study was a review article (*e.g.*, systematic review, meta-analysis, or literature review).

Table 2: Keywords.

Databases	Keywords
PubMed	((((Stroke) OR (hemorrhagic stroke)) OR (Ischemic Stroke)) AND (Physical Activity) OR (Exercise) OR (Training) OR (Aerobic Exercise) OR (Physical Rehabilitation) OR (Physiotherapy)) AND (recurrent stroke)) AND (Prevention)
Scopus	"stroke" OR "hemorrhagic stroke" OR "ischemic stroke" AND "physical activity" OR "exercise" OR "training" OR "aerobic exercise" OR "physical rehabilitation" OR "physiotherapy" AND "recurrent stroke" AND "prevention"
Science Direct	(((((Stroke) OR (hemorrhagic stroke)) OR (Ischemic Stroke)) AND (Physical Activity) OR (Exercise) OR (Training) OR (Aerobic Exercise) OR (Physical Rehabilitation)) OR (Physiotherapy)) AND (recurrent stroke)) AND (Prevention)
Sage Journal	Stroke OR Hemorrhagic stroke OR Ischemic stroke AND Physical activity OR Exercise OR Training OR Aerobic exercise OR Physical rehabilitation OR Physiotherapy AND Recurrent stroke AND Prevention

Study Selection

The selection of articles according to the review criteria was conducted by two reviewers, RBS and N, from July 8, 2025, to July 12, 2025. The article selection process was carried out using Rayyan AI [22]. The selection process continued by reviewing duplicate articles, assessing the relevance of titles and abstracts, evaluating the suitability of articles against the predetermined criteria, and reviewing the full-text content of the selected articles. Article selection was also conducted from other sources, namely through references to articles relevant to this topic. Any disagreements between the two reviewers were resolved through discussion until a consensus was reached.

Mapping the Data

The authors conducted multiple iterations of full-text reading to ensure a comprehensive understanding

Table 3: Data extraction.

Authors' (Years)	Objectives	Type of Physical Activity	Time/Duration	Results
Fini *et al.*, (2020) [23]	To investigate the 2-year post-discharge relationship between physical activity and stroke outcomes, including cardiovascular risk, mobility, mood, fatigue, and cognition.	Physical rehabilitation (inpatient or outpatient)	N/A	No significant relationships were found between physical activity variables and cardiovascular risk factors, including blood pressure, plasma glucose, or total cholesterol, over 2 years.
Ademuwiya *et al.*, (2021) [24]	To evaluate a nurse-led secondary prevention program's impact on medication adherence, lifestyle/dietary changes, and clinic/physical therapy attendance over a 9-month post-stroke period.	Counseling regarding lifestyle modification (diet, alcohol reduction, aerobic exercise, medication compliance)	3, 6, and 9 months after the post-discharge.	The intervention significantly improved adherence at 9 months, particularly in clinic/physical therapy attendance (80% difference) and medication compliance (76.6% difference), compared with the control group.
Deijle *et al.* (2024) [25]	To investigate the effects of a 1-year exercise intervention on cognitive function up to 2 years post-intervention.	MoveIT exercise	12 weeks, followed by counseling sessions every 3 months for 9 months.	After adjusting for age, gender, and education, the intervention group demonstrated significantly greater improvement in executive function over 2 years than the control group (β = 0.13; 95% CI [0.02 to 0.25]; p = 0.03).
Hou *et al.*, (2021) [26]	To test the relationship between exercise and ischemic recurrent stroke in first-time ischemic stroke survivors	Walking, dancing, running, gymnastics, equipment training, and tai chi.	1 time in 1 week	154 subjects (20.26%) experienced recurrent. Cumulative recurrent rates at 3 and 6 months, and 1, 2, 3, 4, 5, and 6 years,
Krawcyk et al., (2023) [27]	To evaluate long-term physical activity levels after discontinuing the intervention, and to assess changes in cardiorespiratory fitness, stroke risk profile, and recurrence 12 months post-stroke.	Home-based high-intensity interval training (HIIT)	15 minutes a day, 5 days a week for 12 weeks, with weekly phone calls to ensure compliance.	Seven patients (10%) were readmitted to the hospital for stroke or TIA during the study. Two patients in the intervention group were readmitted, one for TIA within six months and one for recurrent stroke within twelve months of the initial stroke.
Towfighi *et al.* (2020) [28]	To develop and pilot a nurse-led occupational therapy lifestyle intervention (HEALS) aimed at improving self-management of diet and physical activity among stroke survivors in a diverse safety-net population.	HEALS intervention (Healthy eating and lifestyle after stroke)	6 weeks, every 2 hours	The synthesis focused on physical activity interventions, with dietary and pharmacological factors as modifiers. At six months, no significant changes were observed in primary outcomes (BMI, diet, and physical activity) or in secondary outcomes, including blood pressure, lipid profiles (HDL, LDL, triglycerides), HbA1c, and perceptions of quality of care.
Cheng et al., (2017) [29]	To explain the dose-response relationship between rehabilitation frequency and adverse events in post-stroke patients.	Rehabilitation	N/A	Aggressive rehabilitation in the first year post-stroke is significantly associated with a lower incidence of recurrent stroke and all-cause mortality, regardless of the severity of patient comorbidities.
Ofori *et al.* (2017) [30]	To assess the effect of ergometer cycling on ambulation function and cardiovascular fitness of stroke patients in the sub-acute phase.	Cycling ergometer and conventional physiotherapy	60 minutes per session, 3 times per week for 8 weeks	Mean heart rate (75 to 72.3), systolic (133.9 to 123) and diastolic (82 to 73.2) blood pressure decreased significantly in the ergometer cycling group compared to the control group at the end of the 8-week intervention.
Li *et al.*, (2016) [31]	To compare the clinical profiles of young and middle-aged/older stroke patients treated within a neurological rehabilitation setting.	Physical therapy, balance training, sports training	Once or twice a day, for 45 minutes, five times a week. Follow-up: 6 months	Key risk factors in young stroke patients include hypertension, lifestyle habits (alcohol and smoking), and metabolic disorders (diabetes, hyperlipidemia, and hyperhomocysteinemia). While professional rehabilitation significantly enhances functional recovery, the rate of return to activity within six months remains low.

Authors' (Years)	Objectives	Type of Physical Activity	Time/Duration	Results
Fini *et al.*, (2020) [23]	To investigate the 2-year post-discharge relationship between physical activity and stroke outcomes, including cardiovascular risk, mobility, mood, fatigue, and cognition.	Physical rehabilitation (inpatient or outpatient)	N/A	No significant relationships were found between physical activity variables and cardiovascular risk factors, including blood pressure, plasma glucose, or total cholesterol, over 2 years.
Sandberg *et al.*, (2020) [32]	To evaluate the impact of the intervention on blood pressure (systolic and diastolic) and heart rate, both at rest and in response to exercise.	Bed cycle exercise	20 minutes, 5 days a week, done for 3 weeks	Both groups showed significant reductions in resting SBP post-intervention. However, the bedside exercise intervention resulted in a significantly greater change compared to the control group, demonstrating its effectiveness in blood pressure management.

of each article. Data were charted by extracting key information from the reviewed studies, which included the author(s), year of publication, study objectives, type of physical activity, intervention duration, and key research findings. The synthesized results of this data extraction process are presented in Table **3**.

Compiling, Summarizing, and Reporting the Result

The findings were synthesized using thematic analysis (Braun and Clarke, 2006), in which data were classified according to identified themes. The analytical process followed a rigorous six-phase approach: (1) data familiarization, (2) initial coding, (3) searching for themes, (4) reviewing themes, (5) defining and naming themes, and (6) producing the final report [33]. All authors discussed the synthesized findings until a consensus was reached regarding the results.

RESULTS

Study Selection Results

A total of 612 articles were initially identified across the four databases using the predetermined keywords. After removing 47 duplicate records using Rayyan, 565 articles remained for screening. Of these, 537 were excluded based on their titles and abstracts as they were deemed irrelevant or did not address physical activity and recurrent stroke.

The remaining 28 articles underwent a comprehensive full-text analysis, resulting in the exclusion of 23 studies. Reasons for exclusion included a lack of full-text access, inappropriate thematic focus, ineligible study designs, irrelevant interventions, or non-stroke patient populations. Ultimately, 5 articles met the criteria from the systematic search, supplemented by an additional 5 articles identified through manual searches of reference lists and relevant websites. The detailed article selection process is illustrated in the PRISMA flow diagram in Fig. **(1)**.

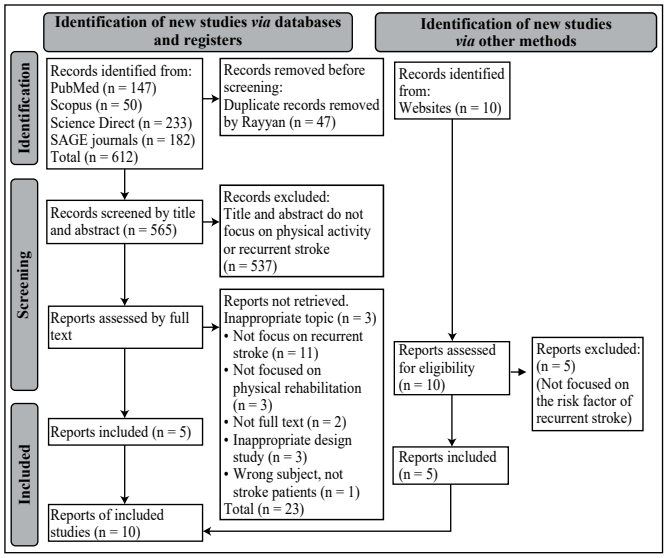

Fig. (1): PRISMA flowchart.

Study Characteristics

10 studies were included in this scoping review. These 10 studies originated from a diverse range of countries, including: China (n = 2), Australia (n = 1), Nigeria (n = 1), the Netherlands (n = 1), Denmark (n = 1), the US (n = 1), Taiwan (n = 1), Ghana (n = 1), and Sweden (n = 1). The total number of participants analyzed in these studies was 6,348; however, the vast majority of the sample was derived from a single large cohort study conducted by Cheng *et al.* (2017) (n = 4,899) [29]. The types of stroke experienced by participants included ischemic stroke, hemorrhagic stroke, transient ischemic attack (TIA), and lacunar stroke. Ischemic stroke was the most prevalent type (n = 7). Most participants were elderly (n = 9), and one study compared stroke in young adults with middle-aged/elderly individuals. The included study designs comprised randomized controlled trials (n = 5), cohort studies (n = 3), an observational study (n = 1), and a quasi-experimental study (n = 1). The characteristics of the comprehensive study are presented in Table **4**.

Table 4: Study characteristics.

Authors' (Years)	Country	Mean ± SD Age	Type Stroke	Subject (Participant)	Study Design
Fini *et al.*, (2020) [23]	Australia	65 ± 14	Ischemic stroke	79	Cohort
Ademuwiya *et al.*, (2021) [24]	Nigeria	55 ± 14.5	Stroke	60 (30 I, 30 C)	Case Control Quasi Experiment
Deijle *et al.*, (2024) [25]	Netherlands	64.2 ± 9.0	TIA or mild stroke	119 (60 I, 59 C)	Randomized Controlled Trial

Authors' (Years)	Country	Mean ± SD Age	Type Stroke	Subject (Participant)	Study Design
Hou *et al.*, (2021) [26]	China	61.97	Ischemic stroke	760	Cohort
Krawcyk *et al.*, (2023) [27]	Denmark	63.9	Lacunar stroke	59 (28 I, 31 C)	Randomized Controlled Trial
Towfighi *et al.*, (2020) [28]	United States	60 ± 7.0	TIA/Ischemic stroke	100 (49 I, 51 C)	Randomized Controlled Trial
Cheng *et al.*, (2017) [29]	Taiwan	67.24 ± 1.21	Ischemic stroke	4899	Cohort
Ofori *et al.*, (2017) [30]	Ghana	58.8 ± 8.3	Stroke in the subacute phase (ischemic or hemorrhagic)	20 (10 I, 10 C)	Randomized Controlled Trial
Li *et al.*, (2016) [31]	China	36.42 ± 7.24	Stroke (ischemic or hemorrhagic)	200 (100 young old, 100 middle-aged/older)	Observational
Sandberg *et al.*, (2020) [32]	Sweden	72.7 ± 12.0	Stroke (ischemic or hemorrhagic)	52 (23 I, 29 C)	Randomized Controlled Trial

I (Intervention), C (Control)

The thematic synthesis revealed three primary themes: (1) reported outcomes of physical interventions on recurrent stroke, (2) intervention characteristics for recurrent stroke prevention, and (3) variations in the duration of physical therapy. A detailed breakdown of the coding process, sub-themes, and final themes is presented in Table **5**.

Reported Outcome of Physical Interventions on Recurrent Stroke

Positive Outcomes: The review indicates that the majority of studies reported that physical intervention reduced the risk of recurrent stroke. Positive effects were attributed to nurse-led secondary stroke prevention programs that integrated multimodal interventions such as aerobic and strength training, ergometer cycling, professional rehabilitation, and bed-cycle exercises. [24, 25, 29-32]. These positive outcomes were demonstrated by adherence to physical therapy, regular medication intake, and adherence to an appropriate diet [24]. Other favorable outcomes were observed in improvements in ambulation, fitness, and cardiovascular function among patients [30]. As high blood pressure is a significant predictor of recurrent stroke, this review identified a study reporting a marked decrease in blood pressure following physical rehabilitation [32].

Table 5: The result of thematic analysis.

Theme	Sub-Theme	Codes
Reported outcome of physical interventions on recurrent stroke	Positive results	• Physical therapy compliance • Regular medication intake • Regular diet • Improved executive function • Aggressive rehabilitation • Increased ambulation • Improved fitness • Improved cardiovascular function • Overall life satisfaction • Improved physical health • Improved mental health • Decreased blood pressure
	There is no effect of physical intervention	• No change in blood pressure • No change in plasma glucose • No change in total cholesterol • Elderly • History of heart disease • Non-adherence to physical exercise • Exercise duration > 4 hours
Intervention characteristics of recurrent stroke prevention	Modifiable factors	• Blood pressure • Plasma glucose • Total cholesterol • Exercise adherence • Exercise duration • Smoking habits • Physical therapy adherence • Medication use • Diet
	Non-modifiable factors	• Elderly • History of heart disease
Variation in the duration of physical therapy	Intense implementation	• 5 days a week • Follow-up program • Additional counseling sessions
	Therapy is not effective if it takes too long	• Longer training time • Relapse due to high intensity

No Effect: Conversely, some results showed no significant effect, a decline in patient condition, or even recurrent strokes [23, 26, 28]. The parameters examined included no changes in blood pressure, glucose, and cholesterol levels [23, 28]. One study explained the lack of effect due to multiple factors, such as advanced age, a history of heart disease, and non-compliance with physical rehabilitation [26].

Characteristics of Recurrent Stroke Prevention

Modifiable Factors: Factors that patients can modify include maintaining blood pressure within a normal range [23, 28, 32] and improving glucose and cholesterol levels [26]. Additional modifiable factors include increasing physical activity with specific attention to exercise duration [26], taking medication regularly, and maintaining a healthy diet [24].

Non-Modifiable Factors: Factors that stroke patients cannot change. Analysis reveals that advanced age and a history of heart disease significantly increase the risk of recurrent stroke [26].

Variation in Duration of Physical Therapy

Intensive Implementation: Analysis of several articles indicates that physical activity therapy is effective when performed intensively and regularly. Effective regimens identified include five sessions per week for 45 minutes [31], five sessions per week for 20 minutes [32], and three sessions per week for 60 minutes [30]. Follow-

up assessments can be conducted 3, 6, or 9 months after the start of the intervention [24]. Furthermore, studies suggest that integrating counseling into rehabilitation programs enhances the effectiveness of the intervention [25].

Reduced Effectiveness of Physical Exercise Due to Prolonged Duration: Duration is a crucial factor in the implementation of physical activity interventions. Evidence shows that excessive duration can lead to adverse conditions. For instance, sessions exceeding four hours may increase the risk of recurrent stroke [26], and high-intensity interventions have also been linked to an increased risk of recurrence [27].

DISCUSSION

A total of 10 studies were included in this review. Out of 622 identified records, only 10 met the predefined inclusion criteria. This limited selection is primarily attributed to the fact that the majority of studies investigated physical activity in general patient populations, rather than specifically addressing the risk of recurrent stroke. Furthermore, numerous studies were excluded because they did not focus on physical activity within the context of stroke survivors. Prior research suggests a scarcity of evidence examining the sustained impact of physical activity interventions on the prevention of recurrent stroke [34]. Therefore, the intensity and volume of physical activity must be tailored to individual comorbidities and the residual neurological deficits persisting after a stroke [35].

The main findings of this review indicate that physical activity interventions can effectively prevent recurrent stroke, particularly when combined with other secondary interventions. Patients with a history of ischemic stroke face a higher risk of recurrence than those with hemorrhagic stroke. This is consistent with previous studies which found that 63.3% of ischemic stroke patients were at higher risk of recurrent stroke than those with hemorrhagic stroke [36]. This condition is caused by atherosclerosis in the large arteries [37]. Following an initial stroke, the risk of recurrence is exacerbated by atherosclerosis, vascular inflammation, and cardiac arrhythmias, while uncontrolled hypertension and diabetes further augment this risk [38].

Physical activity interventions yield have positive effects when integrated with other lifestyle interventions such as a proper diet and regular medication. This combination can improve blood pressure and enhance cardiovascular function in stroke patients. This is consistent with the American Heart Association's statement, which explains that physical exercise is more effective in preventing recurrent stroke when combined with strict blood pressure and cholesterol control, alongside antithrombotic therapy. This activity can reduce the risk of recurrent stroke by as much as 80% [16]. Other studies have also shown that the combination of physical therapy and diet can improve diet quality, physical activity, and lower blood pressure in the intervention group with a 3-6 month follow-up [39].

In contrast, other analyses have shown that physical activity interventions do not benefit Stroke patients with a history of cardiovascular disease (CVD). Previous studies support this, suggesting that CVD, hypercholesterolemia, and physical inactivity synergistically increase the risk of recurrent stroke [40]. Stroke patients with a history of cardiovascular disease are at high risk of complications such as heart failure and acute coronary syndrome, which increases the risk of recurrent stroke [41]. Cardiovascular disease increases the risk of recurrent stroke because it increases the risk of plaque formation, which can block blood vessels in the brain [42].

The success of rehabilitation can be observed from several modifiable factors such as blood pressure, plasma glucose, and cholesterol levels. This is consistent with studies explaining that there are several modifiable factors, including hypertension, cardiovascular disease, hypercholesterolemia, obesity, diabetes mellitus, smoking, alcohol consumption, and the use of contraceptive pills. Study results show that hypertension is the leading factor contributing to recurrent stroke [36]. Consequently, hypertension management through pharmacological treatments (*e.g.*, diuretics, beta-blockers, ACE inhibitors), sodium reduction, and the use of digital health technologies like telemonitoring is paramount for prevention [43].

Age was identified as a critical non-modifiable factor associated with recurrent stroke risk, with most studies indicating a higher recurrence among individuals aged over 55 years. This demographic factor may influence the effectiveness of physical therapy interventions. The older a person is, the higher the risk of stroke in patients associated with decreased vascular elasticity [40]. Notably, the risk of stroke doubles with each decade after the age of 55 [44].

Overall, physical therapy is most successful when implemented intensively and regularly, ideally with a daily frequency and a maximum session duration of 60 minutes. Follow-up and counseling are also important to monitor the ongoing therapy. Previous studies have suggested that intensive exercise can lower blood pressure and increase metabolism. Physical exercise can optimize functional capacity, improve the ability to complete daily activities, and reduce the risk of cardiovascular disease [16]. Physiotherapy-based exercise offers further benefits by enhancing sensory and motor rehabilitation [45].

The ideal timing of physical intervention in stroke patients depends on several factors, such as the severity of the stroke, the timing of rehabilitation initiation, and the intensity of therapy. While starting therapy within the first week is beneficial, overly high-intensity exercise too early can be detrimental [46, 47]. Rehabilitation can be

performed for a short period of 3 weeks [48], and long-term rehabilitation, lasting 3-6 months, is recommended to enhance functional recovery [49]. Therefore, it is highly recommended that rehabilitation be initiated as early as possible [50]. It is important to note that most included studies did not directly measure recurrent stroke events. Instead, they primarily assessed surrogate outcomes such as cardiovascular risk factors, functional capacity, and behavioral adherence, which are indirectly associated with recurrent stroke risk.

This scoping review identified gaps in the implementation of physical activity interventions for recurrent stroke prevention. The majority of studies were conducted in developed countries, which already have the infrastructure to support intervention implementation. Another gap is the lack of detailed reporting of the implementation process, with little information provided on activity details, duration, and practical considerations, making it difficult to generalize to other settings. This gap emphasizes the importance of further research to establish clear standards that can be implemented across all settings.

STRENGTHS AND LIMITATIONS

A systematic search was conducted to examine the relationship between physical interventions and the risk of recurrent stroke across four databases and additional sources identified from relevant articles. The data were analyzed using thematic analysis, yielding comprehensive findings across three identified themes. The findings of this review indicate that physical interventions have a positive effect; however, several factors may reduce the effectiveness of the therapy. We also found that the success of the therapy depends on several factors, including the appropriate duration of physical therapy.

This study has several limitations that should be acknowledged. First, the authors did not critically appraise the studies that met the inclusion criteria. Furthermore, this review was limited by the relatively small number of articles initially identified in the four prespecified databases, prompting the authors to seek additional studies from external sources, specifically the reference lists of included articles. Furthermore, while the study protocol was not registered with PROSPERO, the review was conducted in strict adherence to the PRISMA-ScR reporting guidelines. Lastly, the reliance on surrogate outcomes in many studies suggests a need for more direct longitudinal research on recurrent stroke incidence.

CONCLUSION

This study suggests that physical activity interventions play a crucial role in secondary stroke prevention, primarily by mitigating modifiable risk factors and enhancing functional outcomes, rather than by providing direct evidence of reduced stroke recurrence. This review yielded significant findings, with intervention success suggesting the importance of individualized, well-monitored programs that account for appropriate intensity, duration, and patient characteristics. Future research should further explore which specific types of physical interventions and conditions provide preventative benefits and are most effective. Furthermore, longitudinal studies are needed to clarify the complex interactions among modifiable and non-modifiable factors that influence recurrent stroke risk.

RECOMMENDATION FOR PRACTICE

- Physical activity interventions for stroke patients should be integrated with medication adherence, dietary management, and mental health maintenance to prevent recurrent episodes effectively.
- The intervention protocol is recommended to be implemented at an intensive frequency of five days per week.
- It is advised to avoid excessively long training sessions; a session length of approximately 15 minutes to 1 hour is considered sufficient.
- Early initiation of physical activity interventions is paramount to optimize the prevention of recurrent stroke.

LIST OF ABBREVIATIONS

TIA : Transient Ischemic Attack
SBP : Systolic Blood Pressure
N/A : Not Applicable

FUNDING

None.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

ACKNOWLEDGEMENTS

The author(s) would like to express sincere gratitude to Jenderal Soedirman University for the support in providing access to literature, which greatly contributed to the completion of this research.

AUTHORS' CONTRIBUTION

RBS contributed to the conception and design, the analysis and interpretation of the data, and the drafting of the paper. RBS and N contributed to conducting the literature search and to performing title, abstract, and full-text screening. All authors agree to be accountable for all aspects of the work.

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