

# Beneficial Effects of Physical Activity on Stroke: A Narrative Review

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## ABSTRACT

Stroke is a major health issue in the category of non communicable diseases, placing a significant burden on developed and developing countries in terms of long-term and specialised care. In today's era, controlling the highly prevalent non communicable diseases is a primary focus, with preventive strategies taking precedence over treatment strategies. Physical inactivity is one of the contributing factors to stroke, highlighting the immense significance of physical activity for stroke survivors. Therefore, it is crucial to investigate and understand the positive effects of physical activity in preventing and managing stroke. This narrative review aims to explore and summarise the beneficial effects of physical activity in stroke prevention and management. By narrating these benefits, we hope to encourage stroke survivors to engage in sufficient physical activity to maximise their advantages.

**Keywords:** Active lifestyle, Active time, Activity level, Cerebrovascular accident, Positive effect, Sedentary time

## INTRODUCTION

Stroke is associated with a wide range of impairments and disabilities, and these stroke-related disabilities often persist for an extended period of time. The burden of stroke on a global scale is a significant and growing public health concern. According to the Global Burden of Disease 2019 report, stroke ranked as the third-leading cause of death and disability combined, accounting for over 5.5% of total disability-adjusted life-years worldwide. Additionally, stroke remained the second-leading cause of death, accounting for more than 11.5% of total deaths [1]. Low-income countries were disproportionately affected, with mortality rates 3.6 times higher and disability-adjusted life years 3.7 times higher compared to high-income countries. Without concerted efforts, the burden of stroke is expected to continue increasing. It is imperative to implement recommended guidelines for primary and secondary stroke prevention [1].

Physical inactivity is a prominent risk factor for stroke [2]. Conversely, physical activity has been reported to have a wide range of beneficial effects in mitigating stroke risks [3]. Emerging evidence from a large-scale study in America suggests that increasing daily physical activities effectively reduces stroke risk and warrants recommendation [4]. While several studies and reviews have examined the effects of physical activity on stroke patients in specific affected areas [5,6], there remains a scarcity of comprehensive research on the overall beneficial effects of physical activity among stroke participants.

This review aims to explore the beneficial effects of physical activity in preventing and rehabilitating stroke. Electronic databases such as PubMed, Cochrane Library, and EBSCOhost were searched for studies and reviews investigating the effects of physical activity on stroke, focusing on three areas:

1. What are the benefits of physical activity for stroke prevention?
2. What are the beneficial effects of physical activity in poststroke rehabilitation?
3. How much physical activity is required to achieve desired beneficial effects?

### Physical activity benefits in Stroke Prevention

The effect of physical activity on reducing stroke risk is significant. Stroke is a prevalent non communicable disease, with estimated

prevalence rates ranging from 84-262/100,000 to 334-424/100,000 in rural and urban areas of India, respectively [7]. Considering the high prevalence rate, the best approach to address this issue is to focus on preventive measures to lower the occurrence rate. There is a wealth of high-quality research evidence that has demonstrated a significant reduction in stroke risk with high-level physical activity. Highly active individuals have a 27% lower risk of stroke incidence or mortality compared to low-active individuals, while moderately active individuals have a 20% lower stroke risk compared to inactive individuals. Moderate to high levels of physical activity have been shown to reduce the incidence and mortality associated with both subtypes of stroke [8]. These findings are supported by a meta-analysis of the global burden of disease study in 2013, which revealed a dose-response relationship between levels of physical activity and stroke risk [9]. Compared to sedentary individuals, low, moderate, and highly active individuals experience a 16%, 19%, and 26% reduction in ischaemic stroke risk, respectively [9]. Thus, higher levels of physical activity have beneficial effects on stroke prevention. Additionally, domain-specific physical activity, such as occupational and leisure-time physical activity, has been found to have a protective effect on total stroke [10]. While there have been encouraging results from high-quality studies, most of them have focused on ischaemic stroke [8,9]. Further investigation is still needed to comment on the haemorrhagic subtype of stroke.

### Variations in Stroke Risk Reduction among Gender with Physical Activity

It has been documented that an increase in physical activity reduces stroke risk and its after-effects. The perceived level of physical activity, as well as physiological factors, may impact stroke risk differently in males and females. The evaluation of physical activity requirements for risk reduction in males and females has revealed that males experience stroke risk reduction when engaged in moderate and high physical activity, while females only experience risk reduction with high physical activity [11]. The study reports a 12% and 19% reduction in stroke risk for males with moderate and high physical activity levels, respectively. In females, a 24% risk reduction was observed with high physical activity, but no risk reduction was observed with moderate physical activity. The mentioned meta-analysis reported limitations, including the limited number of relevant studies found, heterogeneity of data, and variation in the definition

of physical activity levels. The findings of the meta-analysis suggest that females require a higher level of physical activity compared to males to achieve the desired reduction in stroke risk [11]. Therefore, management plans for stroke risk reduction should incorporate different levels of physical activity based on the gender of the patient.

### Physical Activity Benefits in Stroke Rehabilitation

#### Benefits of physical activity on poststroke functional recovery:

Various exercise interventions combined with physical activity have shown a beneficial role in improving cognition, arm function, balance, and gait after stroke [5]. Emerging evidence suggests that physical activity also has a positive impact on fatigue and confidence [5]. A review of different exercise modes to improve musculoskeletal function has indicated that aerobic exercise and resistance training are effective for enhancing strength, balance, and mobility. However, further exploration of technology-assisted exercises like biofeedback and treadmill training is needed. Overall, exercise and physical activity have been reported to positively affect functional recovery. It is important to note that improvement in motor function may not be equally reflected in day-to-day activities [6].

#### Benefits of physical activity on quality of life and socialisation:

Existing evidence supports the importance of physical activity in stroke rehabilitation, as it directly or indirectly improves the health and quality of life of stroke survivors. Physical activity also promotes independence and reduces the risk of recurrence [6]. It is recommended that physical activity be conducted in a group setting to facilitate better socialisation and positively influence individual interests [5,12].

#### Benefits of physical activity for poststroke bone health:

Bone health is adversely affected after stroke, primarily due to limited mobility. Immobility-related bone deterioration is more noticeable in the weakened limb during the acute stage. A systematic review has reported that physical activity is beneficial in maintaining or improving bone health in chronic stroke patients. However, the review acknowledged its limitation of relying on a few low-quality studies. It recommends further exploration of the type and duration of physical activity during the acute stage to optimise its benefits [13].

#### Physical activity benefits for poststroke cognitive functions:

A systematic review has reported that there is limited evidence regarding the impact of physical activity on poststroke cognitive functions, as cognitive recovery is often not the primary focus of stroke rehabilitation. However, the available evidence suggests that physical activity has a positive influence on poststroke cognitive functions. The review also noted the heterogeneity of interventions in the studies conducted in this area [14]. The review highlights the need for randomised controlled trials to further explore the effect of physical activity on cognitive functions. A meta-analysis reported that cognitive functions can benefit from physical activity even during the late recovery phase of stroke, with moderate positive effects found in attention/processing speed measures. However, no significant effects were found in executive function and working memory domains. Further research is needed to determine the optimal duration and strategies of physical activity to maximise cognitive gains, taking into consideration the safety and individual needs of patients with cognitive impairments [15].

### Recommended Level of Physical Activity for Stroke

Adopting an active physical lifestyle has been found to be beneficial for stroke prevention and recovery. Many studies have shown an

inverse relationship between physical activity and stroke risk [8,9]. There are currently no separate guidelines for physical activity prescription specifically for stroke prevention. Recommendations for stroke prevention align with the general preventive guidelines in the United States (US), which suggest engaging in moderate to vigorous-intensity aerobic physical activity for at least 40 minutes per day, 3-4 days per week [16]. For stroke rehabilitation, physical activity plays a crucial role in addressing limitations in activities of daily living. Given the prolonged inactivity associated with stroke, physical activity provides a conditioning effects and improves functional capacity and aerobic endurance.

The American Heart Association (AHA) has documented physical activity recommendations for stroke patients [17]. According to the AHA guidelines, stroke patients should engage in aerobic exercise for at least 3 days per week, for 20-60 minutes per day, at an intensity of 40-70% of their VO<sub>2</sub> max or heart rate reserve. The recommended exercise can be performed as continuous sessions or multiple sessions of at least 10 minutes each, depending on the individual's capacity. The AHA also recommends strength training to improve independence in daily activities and flexibility training to enhance balance, coordination, and prevent musculoskeletal complications.

In the initial period after a stroke, when a patient is more deconditioned, exercise can lead to a range of complications, including musculoskeletal injury and cardiac issues. Therefore, it is recommended that initial stroke rehabilitation incorporates exercise in an intermittent mode [18]. Recent guidelines from AHA in 2021 suggest that stroke patients should reduce their sedentary behaviour to prevent recurrent strokes. The guidelines recommend a minimum of 40 minutes of moderate physical activity for four days a week, or 20 minutes of vigorous physical activity twice a week [19]. The World Health Organisation (WHO) recommends a physical activity level of 600 metabolic equivalent (MET) minutes per week for overall health benefits [20]. To achieve this, incorporating 75 minutes of running per week or 150 minutes of brisk walking per week into one's lifestyle is recommended. The global burden of disease study in 2013 also reports that optimal health benefits are seen with a physical activity level of 3000-4000 MET [9].

### Factors to Consider to Optimise the Benefits of Physical Activity for Stroke Survivors

Despite the proven benefits of physical activity and exercise across a wide range of conditions, adoption into a lifestyle is still low. The physical activity level of stroke patients is also reported to be very low. Lack of motivation is commonly reported as a barrier, while family support and functional ability are common motivators for physical activity [21]. A systematic review from 2017 reported that physical activity levels after a stroke are low at all stages of recovery [22]. The review found that time spent walking by stroke patients ranged from 1.8-9% in the subacute and chronic stages, respectively. On the other hand, time spent being inactive and sedentary was high, ranging upto 78% or more at all stages after a stroke. Additionally, physical activity levels were much lower than the recommended requirements following a stroke. Therefore, designing physical activity interventions that incorporate individually perceived barriers and facilitators can increase participation.

The conclusive findings of the review are described in detail in [Table/Fig-1] [3,5,6,8,9,11-15,21,22].

S. No.	Author and study	Article type	Objective	Included studies	Finding
1	Howard VJ and McDonnell MN (2015) [3]	Topical review	To summarise the key points of physical activity and its effect on stroke risk	NA	Multiple health benefits and guidelines are there for physical activity but still, there is a need for further research about the detailed description of physical activity for optimal benefits.
2	Lee CD et al., (2003) [8]	Meta-analysis	To investigate the overall association between physical activity and stroke incidence or mortality	23 studies (18 cohort and 5 case-control)	Meta-analysis documents that moderately or highly active individuals have a reduced risk of stroke incidence or mortality.

3	Kyu HH et al., (2013) [9]	Systematic review and meta-analysis	To quantify the dose-response associations between total physical activity and risk of breast cancer, colon cancer, diabetes, ischaemic heart disease, and ischaemic stroke events	174 studies	Ischaemic stroke risk as compared to sedentary individual in low, moderate and high active individual is reduced 16%, 19%, and 26% respectively. However, more studies are needed for relative risk estimation.
4	Diep L et al., (2010) [11]	Meta-analysis	To quantify the association between physical activity level and risk of stroke outcomes and test the hypothesis that the association of physical activity level with stroke outcomes will be similar between men and women	13 cohort studies	Increased physical activity level appears beneficial in the reduction of the risk of stroke and related outcomes. However, higher levels of physical activity may be required in women to achieve as significant a risk reduction as in men.
5	Saunders DH et al., (2014) [5]	Topical review	To assess whether the multiple effects of exercise and physical activity correspond with the outcomes considered most important, by patients and carers, for life after stroke	NA	Physical activity with various exercise interventions has a beneficial role in addressing cognition, arm function, balance and gait. It also reports that physical activity has emerging evidence for positive results for fatigue and confidence.
6	Gallanagh S et al., (2011) [6]	Narrative review	To address the interface between physical activity and cerebrovascular disease with specific reference to prevention of stroke and poststroke rehabilitation	NA	Exercise and physical activity are useful tools in rehabilitation and provide protective benefits in the prevention of stroke.
7	Belfiore P et al., (2017) [12]	Systematic review	To evaluate the effect of physical activity in poststroke period	14 studies	Physical activity and exercise contribute to the improvement of health and quality of life in stroke survivors. It has extended benefits in risk reduction and socialisation.
8	Borschmann K et al., (2012) [13]	Systematic review	To investigate the skeletal effects of physical activity in adults affected by stroke	3 trials	Physical activity is beneficial in maintaining or enhancing bone health in chronic stroke.
9	Cumming TB et al., (2012) [14]	Systematic review	To evaluate the effect of physical activity or exercise on cognitive function in stroke	12 studies	There is some evidence from few studies with methodological limitations, that increased physical activity after stroke enhances cognitive performance.
10	Oberlin LE et al., (2017) [15]	Meta-analysis	To evaluate the effects of physical activity training on cognitive function poststroke and identify intervention and sample characteristics that may moderate treatment effects	14 RCTs	Significant positive effect of physical activity training on cognition poststroke which extends even in the chronic stroke phase.
11	Nicholson S et al., (2013) [21]	Systematic review	To report stroke survivors' perceived barriers and motivators to physical activity	6 studies	The most commonly reported barriers were lack of motivation, environmental factors (e.g., transport), health concerns, and stroke impairments. The most commonly reported motivators were social support and the need to be able to perform daily tasks.
12	Fini NA et al., (2017) [22]	Systematic review and meta-analysis	To describe physical activity across the various stages following stroke	103 studies	Physical activity levels do not meet guidelines following stroke. Time spent inactive and sedentary is high at all times. Increasing PA and developing standardised activity targets may be important across all stages of stroke recovery.

**[Table/Fig-1]:** Studies commenting on the beneficial effects of physical activity for stroke [3,5,6,8,9,11-15,21,22].

## CONCLUSION(S)

Moderate to high-level physical activity has been reported to provide protective benefits against stroke in the general population. The benefits of physical activity for stroke survivors are observed in functional areas such as arm function, balance, and gait at all stages of recovery. These benefits extend to cognitive function and bone health even in the long-term. To further enhance social participation, physical activity is recommended to be practiced in groups. Considering the advantageous effects beyond cardiovascular fitness in the stroke population, it should be recommended as a mode of prevention and rehabilitation for stroke patients. Exercise and physical activity have demonstrated proven benefits among stroke patients. However, there is a need to explore the dose-response relationship to target specific aims for optimal benefits among stroke patients.

## REFERENCES

- Feigin VL, Stark BA, Johnson CO, Roth GA, Bisignano C, Abady GG, et al. Global, regional, and national burden of stroke and its risk factors, 1990–2019: A systematic analysis for the global burden of disease study 2019. *The Lancet Neurology*. 2021;20(10):795-820.
- O'donnell MJ, Xavier D, Liu L, Zhang H, Chin SL, Rao-Melacini P, et al. Risk factors for ischaemic and intracerebral haemorrhagic stroke in 22 countries (the INTERSTROKE study): A case-control study. *The Lancet*. 2010;376(9735):112-23.
- Howard VJ, McDonnell MN. Physical activity in primary stroke prevention: Just do it! *Stroke*. 2015;46(6):1735-39.
- Ghozy S, Zayan AH, El-Qushayri AE, Parker KE, Varney J, Kallmes KM, et al. Physical activity level and stroke risk in US population: A matched case-control study of 102,578 individuals. *Ann Clin Transl Neurol*. 2022;9(3):264-75.
- Saunders DH, Greig CA, Mead GE. Physical activity and exercise after stroke: Review of multiple meaningful benefits. *Stroke*. 2014;45(12):3742-47.
- Gallanagh S, Quinn TJ, Alexander J, Walters MR. Physical activity in the prevention and treatment of stroke. *Int Scholarly Res Notices*. 2011;2011:953818.
- Pandian JD, Sudhan P. Stroke epidemiology and stroke care services in India. *J Stroke*. 2013;15(3):128.
- Borschmann K, Pang MY, Bernhardt J, Iuliano-Burns S. Stepping towards prevention of bone loss after stroke: A systematic review of the skeletal effects of physical activity after stroke. *Int J Stroke*. 2012;7(4):330-35.
- Kyu HH, Bachman VF, Alexander LT, Mumford JE, Afshin A, Estep K, et al. Physical activity and risk of breast cancer, colon cancer, diabetes, ischemic heart disease, and ischemic stroke events: Systematic review and dose-response meta-analysis for the global burden of disease study 2013. *BMJ*. 2016;354:i3857.
- Wendel-Vos GC, Schuit AJ, Feskens EJ, Boshuizen HC, Verschuren WM, Saris WH, et al. Physical activity and stroke. A meta-analysis of observational data. *Int J Epidemiol*. 2004;33(4):787-98.
- Diep L, Kwagyan J, Kurantsin-Mills J, Weir R, Jayam-Trouth A. Association of physical activity level and stroke outcomes in men and women: A meta-analysis. *J Womens Health*. 2010;19(10):1815-22.
- Belfiore P, Miele A, Gallè F, Liguori G. Adapted physical activity and stroke: A systematic review. *J Sports Med Phys Fitness*. 2017;58(12):1867-75.
- Borschmann K, Pang MY, Bernhardt J, Iuliano-Burns S. Stepping towards prevention of bone loss after stroke: A systematic review of the skeletal effects of physical activity after stroke. *Int J Stroke*. 2012;7(4):330-35.
- Cumming TB, Tyedin K, Churilov L, Morris ME, Bernhardt J. The effect of physical activity on cognitive function after stroke: A systematic review. *Int Psychogeriatr*. 2012;24(4):557-67.
- Oberlin LE, Waiwood AM, Cumming TB, Marsland AL, Bernhardt J, Erickson KL. Effects of physical activity on poststroke cognitive function: A meta-analysis of randomized controlled trials. *Stroke*. 2017;48(11):3093-100.
- Eckel RH, Jakicic JM, Ard JD, de Jesus JM, Miller NH, Hubbard VS, et al. 2013 AHA/ACC guideline on lifestyle management to reduce cardiovascular risk: A report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines. *J Am Coll Cardiol*. 2014;63(25 Part B):2960-84.
- Gordon NF, Gulanick M, Costa F, Fletcher G, Franklin BA, Roth EJ, et al. Physical activity and exercise recommendations for stroke survivors: An American Heart Association scientific statement from the Council on Clinical Cardiology, Subcommittee on Exercise, Cardiac Rehabilitation, and Prevention; the Council on Cardiovascular Nursing; the Council on Nutrition, Physical Activity, and Metabolism; and the Stroke Council. *Stroke*. 2004;35(5):1230-40.

- [18] Palmer-McLean K, Harbst KB. Stroke and brain injury. In: Durstine JL, Moore GE, eds. ACSM's Exercise Management for Persons With Chronic Diseases and Disabilities. 2<sup>nd</sup> ed. Champaign, Ill: Human Kinetics; 2003:238-46.
- [19] Kleindorfer DO, Towfighi A, Chaturvedi S, Cockcroft KM, Gutierrez J, Lombardi-Hill D, et al. 2021 guideline for the prevention of stroke in patients with stroke and transient ischemic attack: A guideline from the American Heart Association/American Stroke Association. *Stroke*. 2021;52(7):e364-467.
- [20] World Health Organization. Global Physical Activity Questionnaire (GPAQ) Analysis Guide. [http://www.who.int/chp/steps/resources/GPAQ\\_Analysis\\_Guide.pdf](http://www.who.int/chp/steps/resources/GPAQ_Analysis_Guide.pdf).
- [21] Nicholson S, Sniehotta FF, van Wijck F, Greig CA, Johnston M, McMurdo ME, et al. A systematic review of perceived barriers and motivators to physical activity after stroke. *Int J Stroke*. 2013;8:357-64.
- [22] Fini NA, Holland AE, Keating J, Simek J, Bernhardt J. How physically active are people following stroke? Systematic review and quantitative synthesis. *Phys Ther*. 2017;97(7):707-17.

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