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ORIGINAL ARTICLE

Benefits of Physical Activity on Stroke Recovering Patients: A Review of the Literature

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ABSTRACT

Background. Stroke is one of the world's most serious social and health problems. The incorporation of tailored physical activity and exercise into the rehabilitation process and post-rehabilitation phase could portray a successful action primarily directed at the cognitive and functional recovery of brain-injured individuals following a stroke. Exercise has been shown to provide both physical and psychological benefits for post-stroke patients. **Objectives.** To identify and discuss the physical activities that are beneficial to stroke-recovering patients. **Methods.** A keyword search was used with the following headings; "benefits of physical activity", "stroke", "physical activity", "recovering patients", "physical activity guidelines", "exercises", "health benefits", "stroke survivors", "epidemiology stroke", "prevention", "incidence of stroke", "statistical data on stroke", "type of strokes", "elderly", "case fatality", "mortality", "morbidity", and "risk factors" "physical fitness" which were combined and exploded. **Results.** Only 46 full-text English-language articles were found among 1,897 citations through electronic searches. The information was judged appropriate for use in this study. **Conclusion.** The use of different types of exercise training (e.g., aerobic, strength, flexibility, neuromuscular and traditional Chinese exercise) for stroke survivors is firmly supported by evidence. Exercise training enhances functional capacity, daily living ability, and quality of life while also lowering the risk of cardiovascular events. To maximize long-term adherence, stroke survivors' physical activity goals and exercise prescriptions should be tailored to them individually.

KEYWORDS: ***Physical Activity, Neuromuscular Conditions, Exercise Prescriptions, Recovery, Exercise Benefits.***

INTRODUCTION

Stroke is one of the top causes of death in the world, and in the United States, it is considered the fourth, most prevalent cause of death (1-3). According to the World Health Organization (4), 15 million people endure stroke complications globally, 5 million face mortality, and another 5 million face morbidity and became disabled. The major reason for this high rate is due to hypertension (5), other risk factors include diabetes mellitus, cigarette smoking, hyperlipidemia, obesity, poor diet/nutrition, and physical inactivity (6). According to the World Health Organization (4), transient ischemic attacks, or TIAs, had the greatest outcomes for demise, with symptoms resolving in less than 24 hours, followed by a stroke caused by carotid stenosis. A clogged artery is more hazardous, with a ruptured cerebral blood vessel being the deadliest. Nerve damage is caused by a blood vessel being blocked or a haemorrhage (7).

According to the National Institute of Neurological Disorders and Stroke, strokes can

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cause substantial impairment in language, motor, cognitive and sensory skills. An ischemic stroke is the most common type of stroke. When a blood vessel in the brain becomes blocked, it causes an ischemic stroke. Ischemic stroke is classified into two types, embolic stroke, and thrombotic stroke. A blood clot or a blockage in the arteries supplying blood to the brain causes an embolic stroke due to plaque fragments developing most commonly in the heart or the lungs (8), whereas thrombotic strokes are caused by a blood clot in the brain (9). As a result, stroke survivors are frequently deconditioned and predisposed to a sedentary lifestyle, which impairs daily living activities, raises the chances of falls, and may contribute to an increased risk of recurrent stroke and other CVDs (10). Surviving a stroke brings with it new and difficult situations that can have a significant impact on quality of life and engagement (11).

Physical activity and exercise have clear health benefits. Physical fitness is a physiologic condition of well-being that enables one to meet the demands of daily life or that serves as a foundation for athletic performance, or both. Physical fitness components relevant to health statuses, such as cardiovascular fitness, musculoskeletal fitness, and metabolism, are included in health-associated physical fitness. Physical activity and physical fitness are frequently employed interchangeably in large epidemiologic studies, with fitness being viewed as a more accurate (although indirect) indicator of physical activity than self-report (12). Exercise is a type of physical activity that is intentionally planned, structured, and repeated to improve physical fitness. Flexibility (range of motion about a specific joint), balance (ability to maintain stability and posture), and body composition (for example, relative amounts of fat and fat-free mass) are all factors that can affect one's ability to perform physical activities (12). Almost everyone can benefit from increasing their physical activity. The most worldwide report recommends 150 minutes per week of moderate-to-vigorous physical activity (13). Physical fitness training following a stroke is strongly advised in guidelines all over the world (14). Physical activity is encouraged as an element of stroke rehabilitation programs and that is because of rising evidence that encompasses the benefits of improving function after stroke (10).

Recovering from a stroke is a long lengthy procedure that demands patience, hard work, and commitment which can begin after health professionals have stabilized the condition (15). However, most research on this matter has focused on one benefit specifically of physical activity, and how it has a positive effect on stroke victims. This research novelty aims to create a comprehensive list of the benefits of physical activity on stroke victims, to create a starting point for future research to add to these benefits. Furthermore, this will allow health practitioners to have access to all the benefits under one umbrella, and use it to implement these different modes of physical activity to better the health of this population. Evidence supports the application of many types of training to survivors of strokes (e.g., neuromuscular, aerobics, flexibility, strength, and traditional Chinese practice) (16). Although the benefits of exercise and healthy lifestyles for the prevention and risk mitigation of coronary and stroke outcomes are well known, the comprehensive regimen and guidelines are less explicit. As recommended, physical exercise programs for post-stroke patients should include consideration of different activities, which should include a component of the type of activity, duration of the activity, intensity of activity, and frequency of activity (10). The primary purpose of this review is to evaluate the current literature and to provide further insight into the role that physical activity plays in the recovery of stroke patients.

MATERIALS AND METHODS

Inclusion Criteria. The studies that qualified for this review met the following criteria: A keyword search yielded MeSH headings; “benefits of physical activity”, “stroke”, “physical activity”, “recovering patients”, “physical activity guidelines”, “exercises”, “health benefits”, “stroke survivors”, “epidemiology stroke”, “prevention”, “incidence of stroke”, “statistical data on stroke”, “type of strokes”, “elderly”, “case fatality”, “mortality”, “morbidity”, and “risk factors” “physical fitness” which were combined and exploded. All the above headings were used to search for articles ranging from 1990-2021 as mentioned below in the data sources section. The reason for the wide search is due to find as many possible benefits of physical activity on stroke victims, to create a starting point for future studies to identify and implement these different methods to have a positive influence on the life of the above-

mentioned population. For this study, the PEDro scale was utilized as a checklist to evaluate the articles. The PEDro scale is used to evaluate the quality of clinical evaluations and ensure that the methodology of the articles matches that of the objective of the study. This matches what was needed for this study.

Exclusion Criteria. The clinimetric reviews and relevant systematic reviews were portrayed as dependent on the included distributions, gender preference was excluded as this review was set on recovering stroke patients. Duplicates were excluded, as well as articles that were published before 2005. Abstracts were also excluded as they do not contain enough information. The little benefit of physical activity (PA) on stroke victims and articles where there is a lack of substantiated evidence that PA benefits stroke victims were also excluded.

Data Sources. An electronic search was conducted on the following databases to review the scholarly literature on the benefits of physical activity on stroke recovery patients: (1990-2021, PubMed), Allied and Complimentary medicine database (1990-2021, (AMED), Current Contents (1990-2021), Google Scholar (GS) (1990-2021), Science Direct (SD) (1990-2021), Cochrane Database of Systematic Reviews (CDSR) (1990-2021), and International E-Catalogues (IEC) (1990-2021), EBM Reviews (1990-2021), Cumulative Index to Nursing and Allied Health Literature (CINAHL).

Data Extraction. For this study, N=266 studies were initially identified (PubMed n=53, AMED n=46, GS n=32, SD n=15, CDSR n=27, IEC n=38, EBM Reviews n=37, and CINAHL n=18). After duplicates, 84 were removed, and only 202 remained. A further 112 were excluded due to not being published between 2005-2020 and some articles being only abstracts. 18 more articles were excluded due to clinimetric reviews, after which 16 more articles were excluded due to there being little benefit of PA on stroke victims, and lack of substantial evidence that PA benefits stroke volume. This left only 46 articles to be used. Please see figure 1 below.

RESULTS

Only 46 full-text English-language articles were found among 266 citations found through electronic searches. The information was judged appropriate for use in this study.

Table 1 Representing rehabilitation goals, primary and secondary outcomes measures, and other relevant information that you can expect to find in this study.

DISCUSSION

To date, studies relating to the benefits of physical activity and stroke-recovering patients tend to focus on the level of physical fitness in isolation. This review has identified and summarized information about previously researched factors related to outcome measures on the effects of training. The factors covered in this review are not complete and focus on those commonly associated with different factors that affect one to perform different physical activities like cardiorespiratory, flexibility, balance, body composition, and muscular strength for rehabilitation. Factors included that are not commonly associated with the benefits of physical activity for stroke-recovering patients are pain and spasticity.

Sedentary behavior is garnering more attention because of its link to an elevated risk of cardiovascular disease and early mortality (32). The deleterious effects of not engaging in recommended levels of exercise, or moderate-vigorous physical activity, have traditionally been the focus of epidemiologic research (33). People who are moderately or extremely active have a lower risk of stroke and mortality. Strokes, both ischemic and hemorrhagic, were reduced among moderately and highly active people (18, 19). Case-control studies appeared to have slightly better results than cohort studies, but the difference was not significant (18, 19).

Post-stroke problems are broad and include the quality of using movement and its function freely, attention, aesthesis, balance, memory pain, the act of becoming aware via senses, emotional problems, mental issues, and emotional issues (34). While the physical and mental effects of stroke are complicated and long-term, early treatment and rehabilitation following a stroke can help people recover faster and restore many abilities (34-36). Following a stroke, the patient's physical activity expectations and exercise prescription must be tailored to their tolerance, level of rehabilitation, climate, accessible social assistance, physical activity needs, particular impairments, activity limits, and participation constraints (10, 20). The first aims of post-stroke therapy relate to physical activity and exercise are to avoid risks of chronic

inactivity, regain voluntary mobility, and restore basic tasks of everyday life (10).

The International Classification of Functioning, Disability, and Health, developed by the World Health Organization (4), divides the impact of illnesses like stroke into three categories: impairments in "body functions and structure," "activity," and "participation." Hemiparesis, stiffness, cognitive disability, and aphasia affect the majority of stroke survivors. Only a small percentage of stroke survivors will make a complete recovery. Reduced capacity to conduct daily tasks is a sign of activity limits, and 40% of stroke survivors struggle with basic self-care six months following their stroke (e.g, dressing, feeding) (37). Physical activity is only helpful if it is done regularly (38). Stroke therapy aims to reverse the deficits caused by the stroke and minimize their impact (39). Physical activity reduces the incidence of stroke and is linked to fewer severe symptoms and improved cognitive function in people who have had one (40). Despite this, compared to stroke-free adults of the same age, stroke survivors are less active and spend more time sedentary (41).

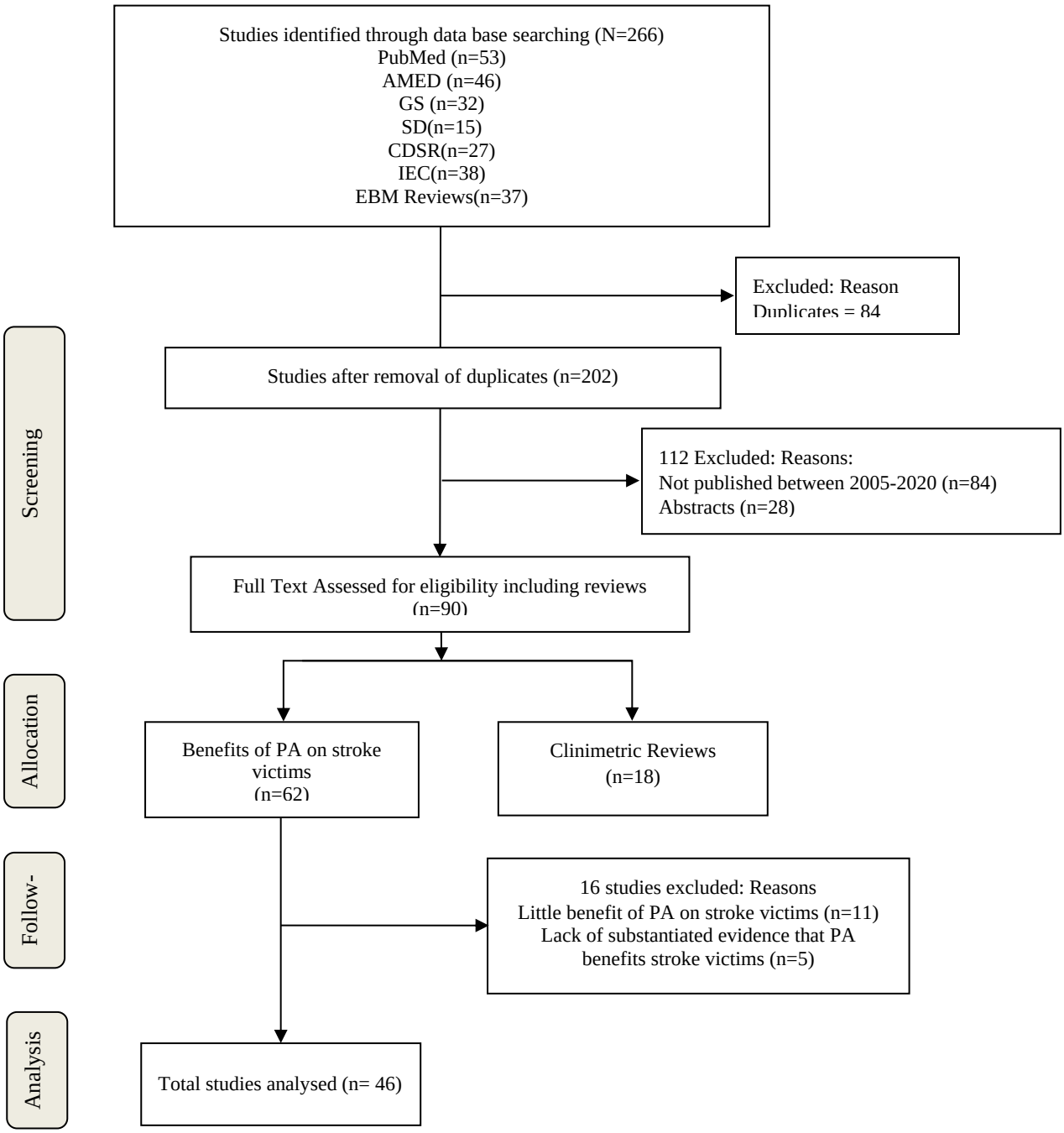

Figure 1. PRISMA Flow Chart of the study selection process

Table 1. Rehabilitation goals, primary and secondary outcomes measures.

Components	Description	Sources
Physical activity	Physical fitness is a physiologic condition of well-being that enables one to meet the demands of daily life or that serves as a foundation for athletic performance, or both.	(12, 14)
Benefits of physical activity	The effects that training has on an individual suffering from stroke.	(17)
Inactivity prior acute stroke	Being inactive before enduring stroke.	(18, 19)
Inactivity post stroke	Not participating in any physical activity after stroke.	(10, 20)
Goals of rehabilitation		
1st goal	The stroke patient must begin a physical conditioning program aimed at quickly returning to pre-stroke levels of activity.	(21)
2nd goal	Aim is to prevent recurrent stroke and cardiovascular events, which occur more often in stroke patients.	(1)
3rd goal	Aim for this population of patients should be to enhance aerobic fitness.	(22)
Measures of primary outcome		
Death or dependency	Mortality rate in stroke, and a higher VO2 peak has been linked to a lower risk of stroke and mortality.	(23)
Case fatality	Which refers to the total number of deaths from all causes.	(18)
Disability	Exercise reduced fatalities in adults with coronary heart disease.	(24)
Measures of secondary outcomes		
Vascular risk factors	Resting heart rate; total cholesterol; resting systolic and diastolic blood pressure.	(23, 25)
Physical fitness	BMI (body mass index), muscle strength, exercise heart rate and maximum or peak oxygen uptake (peak VO2) and power output. low VO2 peak is linked to functional limitations in the elderly, this improvement could be advantageous.	(26, 27)
Mobility	Gait speed, training to enhance walking economy and peak may be useful for post-stroke walking performance and exercise tolerance.	(28)
Adverse effects	Effects recurrent nonfatal cardiovascular or stroke changed muscle tone; training-induced injury; fall frequency; fracture frequency. In patients who took part in physical fitness training programs, there was no indication of any significant adverse events as a result of the training.	(17)
Mood	Physical function, quality of life, and mood outcomes have a scarcity of data.	(17)
Musculoskeletal fitness	The results of the few trials that looked at whether resistance training or mixed exercise increased muscular strength after stroke were mixed.	(27, 29, 30)
Health status and quality of life	There are few conclusive findings on whether training can enhance self-perceived health status and quality of life after a stroke.	(31)

American Heart Association recommends exercise as part of secondary stroke prevention. Physical activity was found to have a protective effect in two meta-analyses examining the link between physical activity and the risk of stroke (42). The research considered in the review, which date back to the late 1970s, were observational studies, the majority of which were cohort studies and some of which were case–control studies. Some studies identified a u-shaped relationship or no link between increased physical activity and reduced stroke risk, while others found a u-shaped relationship or no link. There has been no evidence that increased physical exercise increases the risk of stroke (17).

Individual comparison is challenging because physical activity was measured using a variety of questionnaires. Individuals' physical rehabilitation used to be completed within a few months of their stroke since it was assumed that

the majority, if not all, of their motor function would be restored during this time. Recent research investigations have demonstrated, however, that vigorous rehabilitation beyond this time frame, which includes treadmill activity with or without body weight support (42-44), boosts aerobic capacity and sensorimotor function (45).

Rehabilitation programs for stroke survivors that aim to restore functional motor performance have increasingly included aerobic exercise training, both with and without partial body weight–supported walking, to improve muscle strength and timing, as well as cardiorespiratory fitness (46). This is usually supplemented by specialized training to improve competence and efficiency in self-care, occupational, and recreational activities. Improvements in quality of life, daily functioning, and mobility are among them. To fulfil the first rehabilitation goal, the stroke patient must begin a physical conditioning program aimed at quickly returning to pre-stroke levels of activity (21). Simple exposure to orthostatic or gravitational stress (ie, intermittent sitting or standing) during hospital convalescence has been demonstrated to prevent much of the decline in exercise tolerance that occurs after a cardiovascular incident or intervention in inpatients. Shortly after release from the hospital, exercise treatment can range from hemiparetic stroke patients' corrective gait retraining to supervised or home-based walking or treadmill training programs (42, 43).

An aerobic conditioning program can help with glucose control as well as weight loss and fat storage. Exercise improves blood rheology, hemostatic factors, and coronary artery endothelial function as well as increasing high-density lipoprotein cholesterol. These findings support a growing body of research suggesting that treatments that enhance plaque stability or positive changes in arterial wall function have major implications for the medical care of stroke patients (47). The stroke survivor's second rehabilitation aim is to prevent recurrent stroke and cardiovascular events, which occur more often in stroke patients. Regardless of residual functional limitations, the third rehabilitation aim for this population of patients should be to enhance aerobic fitness. Stroke risk can be decreased with regular leisure-time physical exercise in multi-ethnic persons of all ages and both sexes, according to mounting evidence. Although extrapolating these findings to the prevention of subsequent strokes is untested, it seems sensible to make increased cardiorespiratory fitness a key rehabilitation aim (22).

Physical fitness training does not appear to reduce case fatality. Higher physical activity has been linked to a lower risk of stroke (18), and a higher VO2 peak has been linked to a lower risk of stroke and mortality (23). Exercise reduced fatalities in adults with coronary heart disease (23), however the training programs generally lasted several years. Because many stroke patients have coexisting heart disease, cardiorespiratory exercise performed over a long period of time may have an impact on post stroke mortality. There is insufficient evidence to draw judgments about the impact of training on the composite outcome of mortality or dependence following a stroke. The absence of an immediate effect does not rule out the possibility of long-term benefits. Increased fitness reserves may help to delay the decline of function that occurs as people get older, delaying the crossing of independence thresholds (26). For measuring results in trials of fitness training after stroke, long-term follow-up may be a more useful technique.

In physical fitness training trials, there is a clear need to improve the reporting of adverse outcomes. Cardiorespiratory training, and to a lesser extent mixed training, enhanced VO2 peak and exercise tolerance during continuous exercise significantly. Because a low VO2 peak is linked to functional limitations in the elderly, this improvement could be advantageous (26). However, the functional benefits in those who have had a stroke are less obvious (48, 49). Gait economy may improve as a result of training that includes walking. As a result, training to enhance walking economy may be useful for post-stroke walking performance and exercise tolerance. The results of the few trials that looked at whether resistance training or mixed exercise enhanced muscular strength after stroke were mixed. The majority of trials that demonstrated favourable training benefits were either methodologically skewed or confounded by extra training time (26).

One individual trial tested explosive lower limb extensor power, but mixed training had no immediate or long-term effect (29). The lack of explosive, quick movements during resistance training could be the cause of non-response. Explosive power output is linked to function and

disability after stroke in people who have had a stroke (27), and in elderly people, explosive power output may be more essential than strength for function and disability. Improvements in gait in stroke survivors following cardiorespiratory exercise could be related to a greater fitness reserve (arising from an increased VO2 peak or improved gait economy, or both). Cardiorespiratory walking training, on the other hand, is task and repetition based. Even if there is no visible change in physical fitness measurements, these aspects by themselves may aid motor learning and improve gait performance. The effects of resistance training cannot be accurately assessed due to a lack of evidence. Mixed training has been suggested to improve walking performance. There is evidence that when fitness training is particular or 'job related,' the training effect may be larger. Physical function, quality of life, and mood outcomes have a scarcity of data. There aren't enough data to run meaningful subgroup analyses to investigate the impacts of training kind, 'dosage,' and time on outcome measures (27, 29).

Physical activity promotion in stroke survivors should focus on low- to moderate-intensity aerobic activity, muscle-strengthening activity, sedentary behavior reduction, and risk management for secondary stroke prevention. Moore et al. (50), showed a notable effect on aerobic fitness. The 4-week duration of training employed may be too brief to generate a meaningful cardiovascular impact in individuals with chronic stroke, who may have an inactive lifestyle for longer periods of time. Other studies which demonstrated a favourable effect on peak VO2, the length of the exercise program was at least 8 weeks (44).

According to the ACSM (39), frequent physical activity decreases the risk of numerous negative health consequences. According to the recommendations, all adults should avoid inactivity, that some physical exercise is preferable than none, and that individuals who engage in any quantity of physical exercise obtain some health advantages (39). Exercise training enhances functional capacity, daily living ability, and quality of life while also lowering the risk of cardiovascular events. To maximize long-term adherence, stroke survivors' physical activity goals and exercise prescriptions should be tailored to them individually.

CONCLUSION

Previously searched benefits of physical activity have shown that aerobic exercise helps increase VO2 and peak working loads in medium to large-size stroke patients. However, there was a lack of research that brought all these different methods and benefits of physical activity on stroke victims under one umbrella. Activity after activity this study highlights the benefits of different modes of physical activity on stroke victims, which novely allows health practitioners to gain access to these modes of physical activity and the benefit thereof under one source. This study allows for a starting point for future research to add alternative modes of physical activity and gives health practitioners the information they need to effectively implement these modes of exercise to improve the well-being of this population. From primary to secondary objectives this review has highlighted areas for future research, pointing to opportunities to broaden the scope of the knowledge base. It's unknown how training affects death, dependency, and impairment following a stroke. There is enough data to recommend incorporating cardiorespiratory training, which includes walking, into post-stroke rehabilitation to increase walking speed, tolerance, and independence. More research is needed to find the best exercise prescription after a stroke and to see whether there are any long-term benefits. This offers new opportunities for researchers to investigate the effects of a combination of factors, and for researchers to explore best exercise prescriptions.

APPLICABLE REMARKS

- Previously searched benefits of physical activity have shown that aerobic exercise helps increase VO2 and peak working loads in medium to large-size stroke patients.
- From primary to secondary objectives this review has highlighted areas for future research, pointing to opportunities to broaden the scope of the knowledge base.
- It's unknown how training affects death, dependency, and impairment following a stroke.
- There is enough data to recommend incorporating cardiorespiratory training, which includes walking, into post-stroke rehabilitation to increase walking speed, tolerance, and independence.

- More research is needed to find the best exercise prescription after a stroke and to see whether there are any long-term benefits.

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AUTHORS' CONTRIBUTIONS

Study Concept and Design: LM, GJB. *Acquisition of data:* GJB, CJ and NTB. *Analysis and interpretation of data:* LM and CJ. *Drafting of manuscript:* LM, GJB, CJ and NTB. *Critical revision of the manuscript for important information*: LM, NTB. *Statistical analysis:* LM, GJB. *Administrative, technical, and material support:* LM, GJB. *Study supervision:* LM, GJB.

CONFLICT OF INTEREST

There is no conflict of interest declared by the authors.

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