Scientific Research Publishing

Open Journal of Therapy and Rehabilitation, 2024, 12, 356-391
https://www.scirp.org/journal/ojtr
ISSN Online: 2332-1830
ISSN Print: 2332-1822

Aerobic vs. Anaerobic Training in Post-Stroke Rehabilitation: Effects on Functionality, Strength, and Balance

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How to cite this paper: Quadrado, I., Britto, A., Morelati, T., Gutierres, P., Ramos, B. and Carmo, J. (2024) Aerobic vs. Anaerobic Training in Post-Stroke Rehabilitation: Effects on Functionality, Strength, and Balance. *Open Journal of Therapy and Rehabilitation*, **12**, 356-391.
https://doi.org/10.4236/ojtr.2024.124026

Received: October 15, 2024
Accepted: November 18, 2024
Published: November 21, 2024

Abstract

Research Background: Stroke rehabilitation is essential for improving patient outcomes, with a focus on restoring functionality, strength, and mobility. Aerobic (TAE) and anaerobic (TAN) training have demonstrated varying impacts on post-stroke recovery. Objective: This systematic review and meta-analysis aimed to compare the effects of TAE and TAN on post-stroke rehabilitation outcomes, including functionality, walking improvement, strength, balance, and cardiorespiratory capacity. Methods: A comprehensive literature search was conducted in the PubMed and PEDro databases, covering studies from January 2014 to May 2024. Randomized controlled trials (RCTs) evaluating the impact of TAE and TAN on the specified outcomes were included. The review adhered to PRISMA guidelines, and independent reviewers extracted relevant data on participant characteristics, interventions, and outcomes. The methodological quality of the included studies was assessed using the PEDro scale, and the risk of bias was analyzed. Results: Data synthesis revealed that TAN was more effective in improving performance in the 10-Meter Walk Test (10MWT) and the Berg Balance Scale (BBS), while TAE demonstrated superior results in the Timed Up and Go (TUG) test and the Barthel Activities of Daily Living Index (Barthel ADL). Both training modalities showed significant improvements in the 6-Minute Walk Test (6MWT) for cardiorespiratory capacity, with TAN exhibiting a slightly higher mean difference. Surprisingly, strength gains, assessed by Maximal Isometric Strength (MaxIS), were higher in the TAE group. Conclusions: Both TAE and TAN contribute to post-stroke recovery, with TAN excelling in walking and balance improvements, and TAE showing advantages in functional mobility and strength. The findings support personalized rehabilitation strategies that incorporate both aerobic and anaerobic training to optimize patient outcomes.

Keywords

Stroke Recovery, Aerobic Training, Anaerobic Training, Rehabilitation, Systematic Review, Meta-Analysis

1. Introduction

Stroke remains a leading cause of long-term disability worldwide, significantly affecting functional independence in daily activities. Given the growing number of stroke survivors, effective rehabilitation strategies have become a key area of research to improve recovery outcomes [1] [2]. Optimizing the management of training and interventions should be a priority for stroke victims.

One of the key areas of research in post-stroke recovery focuses on the impact of exercise and training on an individual's quality of life and independence. Over the past decade, studies have demonstrated that both aerobic training (TAE) and anaerobic training (TAN) are crucial for stroke rehabilitation. TAE is well known for improving cardiorespiratory fitness and endurance, while TAN is recognized for enhancing muscle strength and motor control. However, the relative benefits of these two training modalities remain debated, especially concerning their differing impacts on balance, walking ability, and overall functional recovery [3] [4].

With so many post-strokes side effects, one of the most important is the extensive loss of strength. On the affected side, strength is reduced by approximately 50% compared to individuals who have not experienced a stroke [5] [6]. As muscle strength is an important variable for walking, and walking performance is related to post-stroke independence, one of the goals of stroke rehabilitation is to increase muscle strength and thereby improve walking ability and facilitate participation in activities of daily living [7] [8].

TAE and TAN are two types of physical activity that differ primarily in the way the body produces energy during exercise.

Activities such as walking, running, cycling, and swimming are prime examples of TAE. These activities are particularly effective in the context of stroke rehabilitation because they enhance cardiorespiratory fitness and endurance [9] [10], which are crucial for improving the mobility and independence of stroke survivors [11]-[13]. The increased oxygen flow during TAE also aids in muscle recovery and brain health [14] [15], contributing to better overall outcomes in stroke rehabilitation.

TAE also facilitates the living of the post-stroke population. Individuals with stroke have twice the energy cost for locomotion and half the cardiorespiratory fitness, when compared to healthy individuals, contributing to considerable inactivity and loss of aerobic conditioning [16]. Thus, this loss after the stroke is an important barrier to adherence to rehabilitation programs, which hinders and attenuates potential motor recovery.

TAN, on the other hand, includes exercises such as strength training and

weightlifting. These types of exercises are particularly beneficial for stroke survivors because they focus on increasing muscle strength [17] [18], an essential factor for improving walking ability and functional independence [12] [19]. By specifically targeting the improvement of muscle strength on the affected side, TAN can help mitigate the extensive loss of strength observed in stroke survivors [15] [20] [21], thereby facilitating their participation in daily activities and enhancing their quality of life.

Previous reviews and meta-analyses have shown varying results. For example, a meta-analysis conducted by Veldema and Jansen (2020) [4] demonstrated that TAN supports muscle strength and gait recovery after stroke. However, other reviews have found that strength exercises benefit muscle strength but do not improve walking ability in this cohort [6] [22].

Different reviews [3] [23] demonstrate that TAE with early intervention reduces lesion volume and protects injured tissue against oxidation and/or inflammation. This is associated with better locomotor evolution [23]. TAE has been linked to improved motor recovery and balance in stroke survivors, with studies showing that TAE positively affects motor recovery, balance, and coordination, regardless of the intervention method or parameter. However, while TAE enhances these outcomes, it has been found to be ineffective for upper limb recovery [3] [24].

The major objective of this study is to systematically compare the effects of TAE and TAN on key rehabilitation outcomes for individuals post-stroke, including functionality, walking ability, strength, balance, and cardiorespiratory capacity. By evaluating the impact of these training modalities on these specific outcomes, the study seeks to fill existing gaps in the research and provide insights that will inform more personalized rehabilitation strategies to optimize patient outcomes in post-stroke recovery.

2. Methods

2.1. Criteria of Selection

This systematic review was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 guidelines and the PRISMA-S extension for reporting literature searches in systematic reviews. This was aimed at ensuring transparency and reproducibility throughout our review process.

The search strategy was designed to capture all relevant studies on the effects of aerobic and anaerobic training in post-stroke recovery. Two independent reviewers conducted searches across several electronic databases, namely PubMed, Scopus, Web of Science, and PEDro, spanning from January 2014 to May 2024.

These searches aimed to identify trials evaluating the effects of aerobic and anaerobic training interventions on post-stroke rehabilitation and were performed in accordance with the PRISMA guidelines. Boolean operators and MeSH terms related to “aerobic training”, “anaerobic training”, and “stroke” were employed.

The search terms were developed in consultation with a medical librarian and included a combination of MeSH terms and free text words related to "stroke", "cerebrovascular accident", "aerobic exercise", and "anaerobic exercise". The search strategy for PubMed was: ("aerobic exercise" [MeSH Terms] OR "aerobic training" [All Fields]) OR ("anaerobic exercise" [MeSH Terms] OR "anaerobic training" [All Fields]) AND "stroke" [MeSH Terms]. Initial screening focused on titles and abstracts for eligibility, followed by a full-text review of potential studies. Reference lists of relevant reviews and meta-analyses were also examined. Disagreements were resolved by consensus, with a third party available if needed. The complete search strategy, including all search terms and combinations used, is provided in **Appendix A**.

The risk of bias in each study was evaluated using the Cochrane Risk of Bias Tool. Our findings indicated a low risk of selection bias in 100% of the studies. Performance bias was high in 6% of the studies, and detection bias was high in 6% of the studies. Attrition bias was low in 97% of the studies, with only 3% showing a high risk. Detailed results of this assessment are provided in **Appendix A**.

Were included randomized controlled trials (RCTs) and quasi-experimental studies that compared the effects of aerobic training (TAE) or anaerobic training (TAN) on post-stroke recovery outcomes.

The study selection process is detailed in the PRISMA flow diagram (Figure 1), which illustrates the number of records identified, included, and excluded at each stage of the review, along with reasons for exclusions at the full-text review stage.

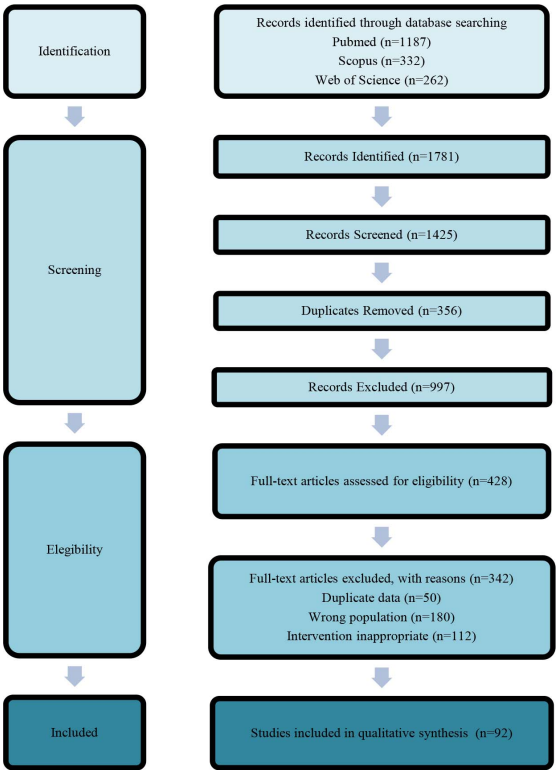

Figure 1. PRISMA flow diagram.

This systematic review protocol was registered in the International Prospective Register of Systematic Reviews (PROSPERO) under the registration number CRD42024528759, ensuring transparency and reducing the risk of bias publication.

2.2. Selection of Studies

Studies meeting the following criteria were included: 1) human studies, 2) prospective design, 3) written in English, 4) confirmed stroke diagnosis, 5) inclusion of aerobic or anaerobic training, 6) pre- and post-intervention evaluation, 7) at least two experimental groups, and 8) a minimum of five randomized patients.

Following the evaluation of all the articles, the tests were compiled and categorized into the most used tests in the same scope. Five categories were selected based on the frequency of appearance of tests: Functionality, Walking Improvement, Strength, Balance and Cardiorespiratory Capacity. Subsequently, the most utilized tests for both TAE and TAN training were selected from each category.

To assess the different variables and their impact, various tests were employed, each specifically chosen for its relevance to the corresponding analysis. For the Functionality analysis, three tests were utilized: the 10-Meter Walk Test, the Timed Up and Go test, and the Barthel Activities of Daily Living Index (BarthelADL). These tests were selected because they provide valuable insights into an individual's mobility, functional capacity, and ability to perform daily activities [25] [26].

To evaluate Walking Improvement, the test employed was the 10-Meter Walk Test. This test was chosen due to its widely recognized and established measures of an individual's walking ability and overall gait performance, providing valuable information on improvements in walking speed and quality [27] [28].

For the variable of Strength, the Maximal Isometric Strength (MaxIS) test was employed. This test specifically focuses on measuring an individual's maximal force production during static muscle contractions. By assessing strength levels, this test provides insights into an individual's muscular capabilities, helping to evaluate changes and improvements in strength over time [29].

The evaluation of Balance utilized the Berg Balance Scale, a well-known and widely used assessment tool [30]. This test evaluates an individual's balance abilities, including both static and dynamic balance, by assessing their ability to perform various tasks while maintaining stability. It provides valuable information on balance control and the potential for improvement [31].

To assess Cardiorespiratory Capacity, the 6-Minute Walk Test was employed. This test measures an individual's endurance and cardiovascular fitness by assessing their ability to walk as far as possible within a six-minute timeframe. It is a reliable and commonly used test to evaluate an individual's aerobic capacity and to monitor changes in their functional status over time [32].

By utilizing these specific tests for each analysis, a comprehensive evaluation of

different variables, such as functionality, waking improvement, strength, balance, and cardiorespiratory capacity, can be conducted. These tests were carefully selected based on their proven validity and reliability in assessing the respective variables, enabling researchers to gather meaningful data and insights for their analysis. To provide clarity on the purpose of each test, the following chart (Table 1) was created:

Table 1. Tests and categories studied related.

Categories	Tests		
Functionality	10MWT	TUG	BarthelADL
Walking Improvement	10MWT		
Strength	MaxIS		
Balance	BBS		
Cardiorespiratory capacity	6MWT		

2.3. Data Extraction and Risk of Bias

The following information from selected publications was extracted: 1) characteristics of included subjects (amount, age, sex, time since stroke, stroke etiology, stroke location), 2) study design used, methodological quality (parallel groups/crossed, PEDro scale), 3) description of the intervention applied (amount and duration of intervention sessions applied, type and intensity of intervention) 4) outcomes (evaluations used, differences detected between groups). The methodological quality of included trials (such as random allocation, baseline comparability, blinding etc.) was assessed using the PEDro scale.

2.4. Data Synthesis and Statistical Analysis

To synthesize the data and perform the meta-analysis, we employed comprehensive statistical methods. The effect sizes for the outcomes within each study were calculated using standardized mean differences (SMDs) for continuous outcomes and risk ratios (RRs) for dichotomous outcomes, along with their 95% confidence intervals (CIs). A random-effects model was applied to account for the expected heterogeneity among the included studies.

We assessed the heterogeneity of the included studies using the I^2 statistic, where values over 50% were considered indicative of high heterogeneity. To explore the potential sources of this heterogeneity, subgroup analyses were planned based on predefined study characteristics, such as study design, population, and type of intervention.

Sensitivity analyses were conducted to assess the robustness of the findings by excluding studies with a high risk of bias. This allowed us to determine the impact of individual studies on the overall meta-analysis results.

To address potential reporting biases, we employed funnel plots and Egger's regression test, particularly when the meta-analysis included enough studies.

These methods helped to assess the presence of publication bias and other types of reporting biases in the included studies [33] [34].

2.5. GRADE Approach

The certainty of evidence for each outcome was evaluated using the Grading of Recommendations Assessment, Development and Evaluation (GRADE) approach. This systematic and transparent methodology considers several factors, including the risk of bias, inconsistency, indirectness, imprecision, and publication bias.

Each outcome was assessed and assigned a GRADE rating ranging from "very low" to "high", reflecting confidence in the effect estimates. The criteria for downgrading or upgrading the evidence were clearly defined, with the risk of bias assessed for each included study, inconsistency evaluated through the analysis of heterogeneity, and imprecision considered based on the width of confidence intervals and the effect sizes.

By incorporating these detailed methods into our meta-analysis and applying the GRADE approach, we aimed to provide a thorough and reliable synthesis of the evidence, facilitating informed conclusions about the effectiveness of aerobic and anaerobic training interventions in post-stroke rehabilitation [33] [34].

2.6. Ethical Considerations

Given that this study was based on published studies and did not involve collecting primary data, ethical approval was not required.

3. Results

A total of 1187 articles between 2014 and 2024 were selected, 92 of which fit the selection criteria. Among the 92, those who performed TAE and/or TAN had their tests used in research selected. Within the filtering process, 824 articles were subsequently excluded due to their focus on training modalities not pertinent to the scope of this research, such as respiratory exercises, virtual reality, vascular occlusion, speech, and music training.

Furthermore, an additional 210 articles were omitted from consideration as they presented a single intervention approach without a controlled environment, or they were limited to purely cognitive stimuli or to conventional physiotherapy, lacking the comprehensive multidisciplinary approach required for this review.

Additionally, 120 studies were discarded because the physiotherapy training was not sufficiently elaborated upon, which is vital to ensure the exclusion of solely aerobic or anaerobic stimuli from the analysis. This rigorous selection process was essential to ensure that the remaining studies accurately reflected the effects of the targeted physiotherapy interventions within the research parameters.

The results were categorized into five main areas: Functionality, Walking Improvement, Strength, Balance, and Cardiorespiratory Capacity. Each outcome was assessed using standardized tests, and the differences between TAE and TAN were analyzed. Thus, it was possible to analyze which intervention, TAE or TAN, most

modified the performance of individuals in each of these categories.

3.1. Functionality

The analysis of 29 articles, encompassing a total of 1682 individuals, allowed for an examination of the effectiveness of different training interventions in relation to the 10 Meter Walk Test, the Timed Up and Go test, and the BarthelADL scale. The findings demonstrated varying outcomes across these assessments for both TAE and TAN training interventions.

The results from the 10MWT (Figure 2) show that TAN was significantly more effective at improving walking speed than TAE ($p < 0.0001$). The Chi^2 value of 5.06 with a degree of freedom of 1 ($p = 0.02$) suggested a significant association, while the I^2 value of 80.2% indicated a moderate-to-high degree of heterogeneity among the studies. This suggests that anaerobic training is particularly beneficial for enhancing short-duration functional movements, which are crucial for stroke recovery.

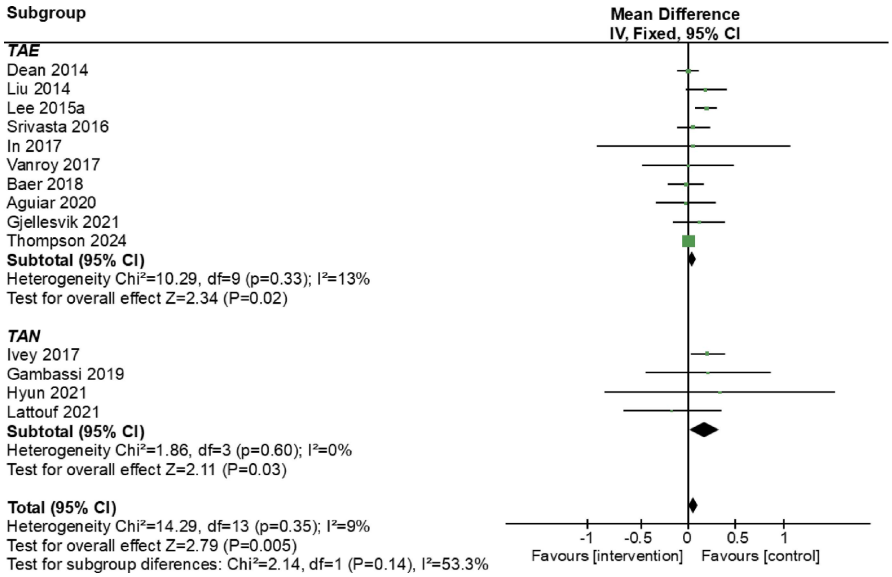

Figure 2. Forest plot of comparison: 10MWT TAE X TAN.

These results highlight the potential of TAN for improving walking efficiency, a critical aspect of functional recovery, while TAE may be better suited for enhancing overall mobility, as reflected in the TUG test results (Figure 3).

When considering the BarthelADL index (Figure 4), neither the TAE nor the TAN groups showed any significant improvements. This lack of significant changes suggests that both training modalities were equally ineffective in impacting the BarthelADL scores.

To provide a comprehensive analysis of the impact of TAE and TAN on various functional outcomes in post-stroke rehabilitation, the following tables offer an overview of the studies investigated. These tables summarize the findings from multiple research articles, highlighting the efficacy of TAE and TAN in improving

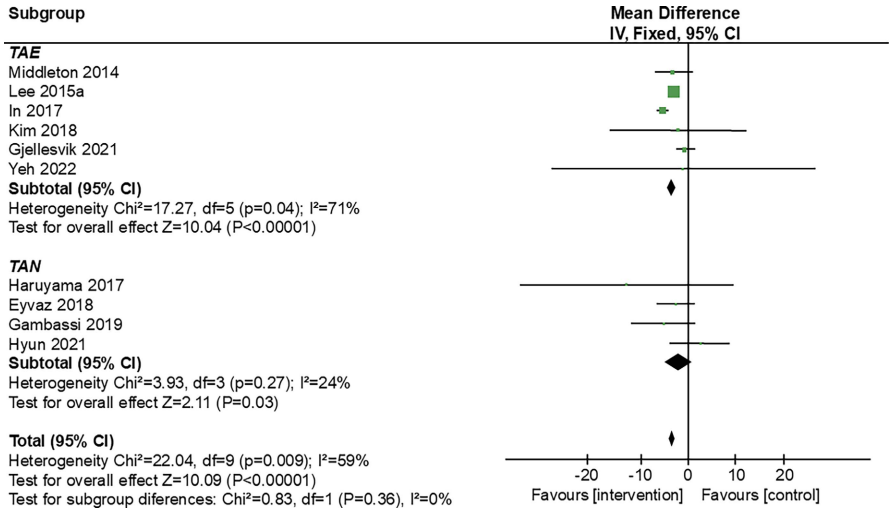

Figure 3. Forest plot of comparison: TUG TAE X TAN.

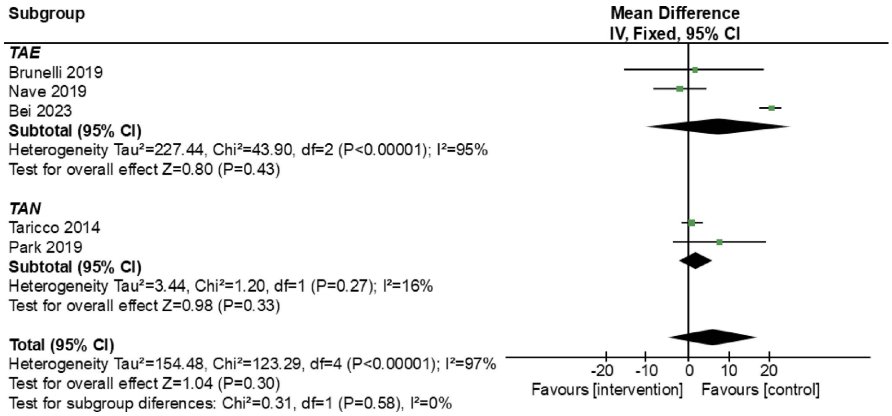

Figure 4. Forest plot of comparison: BarthelADL TAE X TAN.

specific functional measures. Table 2 presents an overview of the studies investigating TAE and TAN in the 10MWT. Table 3 summarizes the studies investigating TAE and TAN in the TUG test. Table 4 provides an overview of the studies investigating TAE and TAN in the BarthelADL. These tables provide detailed insights into the methodologies, sample sizes, and key outcomes of the studies, allowing for a clearer understanding of the comparative effectiveness of TAE and TAN in post-stroke rehabilitation.

3.2. Walking Improvement

A total of 654 individuals were selected in a total of 14 articles. Figure 2 shows a significant improvement in the 10MWT for TAN participants, with a p-value of < 0.00001. This improvement reflects the ability of TAN to enhance walking speed and quality, which is vital for stroke survivors regaining mobility.

The heterogeneity ($I^2 = 80.2\%$) indicates variability across studies, suggesting that TAN interventions may have different effects depending on the intensity and frequency of training.

Table 2. Overview of the studies investigating TAE and TAN in the 10MWT (na: not available, not applicable; SS-QOL: Stroke Specific Quality Of Life scale; HRrest: Resting Heart Rate; SIS: Stroke Impact Scale; SSS: Scandinavian Stroke Scale; RMI: Rivermead Mobility Index; 5XST:Five Times Sit to Stand Test; BP: Blood Pressure; HR: Heart Rate; DP: Double-Product; SF-12: Short Form Health Survey; FAC: Functional Ambulation Categories; VAS: Visual Analogue Scale; MAssS: Motor Assessment Scale, MAshS: Modified Ashworth Scale; FIM: Functional Independence Scale; FMA: Fugl-Meyer Scale; POMA: Performance-Oriented Mobility Assessment).

Reference (10MWT)	Subjects number/ gender/age (years)	Time since stroke (months)	Stroke etiology/ affected hemisphere	Study design/ sessions number/follow up/ PEDro scale (score)	Intervention	Results/Used assessments
Aguiar *et al.* [35]	16/8 male 8 female/50	47	ischemic 19 hemorrhagic 2 unknown 1/13 right 9 left	parallel/36 sessions/4 weeks after/7	A: walking on the treadmill at 60% - 80% HRrest B: walking on the ground below 40%HRrest	Improvement in 6MWT, 10MWT, SS-QOL, the others without improvement, and without difference between groups/10MWT, 6MWT, VO2peak, VO2threshold, SIS, SS-QOL
Baer *et al.* [36]	77/40 male 37 female/72	1	na/43 right 30 left 4 bilateral	parallel/24 sessions/na/7	A: to treadmill training (minimum twice weekly) plus normal gait retraining B: normal gait retraining only (control)	Treadmill training in patients with subacute stroke was feasible, but showed no significant difference in results when compared to normal gait re-education./10MWT, 6MWT, BarthelADL, MAssS, SSS, RMI
Dean *et al.*, [37]	68/43 male 25 female/66	20	na/31 right 37 left	parallel/48 sessions/na/7	A: 30 minutes of treadmill and floor walking B: received no intervention	Improved distance and speed in walking test/10MWT, 6MWT
Gambassi *et al.*, [38]	22/9 male 13 female/62	60	na/16 right 6 left	parallel/16 sessions/na/6	A: physical therapy B: resistance training with elastic	resistance training with elastic bands improves TUG, 5XST/isometric handgrip, 10MWT, 5XSTS, TUG, BP, HR, DP
Gjellesvik *et al.* [39]	70/41 male 29 female/58	25	ischemic 57 hemorrhagic 13/25 right 34 left 11 both	Parallel/24 sessions/12 months/8	A: HIIT with 4 × 4 minutes at 85% - 95% of maximum heart rate plus standard care B: control group	Group A improved 6MWT, BBS, TMT-B, FIM/6MWT, BBS, TMT-B, FIM
Hyun *et al.* [40]	30/13 male 17 female/60	4	21 ischemic 9 hemorrhagic/16 right 14 left	parallel/30 sessions/na/5	A: real-time visual feedback + sit to stand training B: sit-to-stand training	Sit-to-stand training combined with real-time visual feedback was effective at improving the muscle strength of the lower extremities, balance, gait, and quality of life in patients with stroke./MaxIS, 10MWT, TUG, SS-QOL
In *et al.* [41]	30/17 male 13 female/53	6	21 ischemic 9 hemorrhagic/15 right 15 left	parallel/20 sessions/na/7	A: treadmill training with TheraBand B: treadmill training	In FMA, TUG, 10MWT and Gait POMA, there were significant improvements in both groups after intervention. And more significant changes were shown in the group A than the group B/FMA, TUG, 10MWT, POMA
Ivey *et al.* [42]	30/21 male 9 female/56	66	na/na	parallel/36 sessions/na/4	A: Strength training B: Attention-matched stretch control group	The group A showed improvement in relation to the control group in terms of strength and better functional capacity/gait speed, 1Max repetition, 10MWT, 6MWT, Vo2peak,
Lattouf *et al.* [43]	37/20 male 17 female/70	11	28 ischemic 9 hemorrhagic/34 right 3 left	parallel/12 sessions/na/4	A: group receiving eccentric muscle strengthening B: control group	Eccentric bodybuilding training with improvements in 1RM and 10MWT, 6MWT/1RM, 10MWT, 6MWT, MAshS
Lee *et al.* [44]	61/36 male 25 female/64	1	40 ischemic 21 hemorrhagic/32 right 29 left	parallel/20 sessions/na/6	A: progressive training group B: high-speed training group	Progressive and fast walking training, improvements in all parameters (10MWT, 6MWT, TUG, Step length) except stride width with better results in high-speed training/10MWT, 6MWT, TUG

Continued

Srivasta *et al.* [45]	45/36 male 9 female/45	16	36 ischemic 9 hemorrhagic/24 right 21 left	parallel/20 sessions/3 months after/6	A: Overground gait training B: Treadmill training without bodyweight support C: Body-weight-supported treadmill training	BWSTT offers improvement in gait but has no significant advantage over conventional gait-training strategies for chronic stroke survivors./10MWT, FAC, SSS
Thompson *et al.* [46]	250/134 male 116 female/63	6	Na/na	Parallel/36 sessions/na/na/8	A: Walking 40 min 70% - 80% da HRres B: Daily step activity monitoring with feedback and goal setting C: Combination of the two interventions above	Improvements in Group A compared to Group B/6MWT, VO2 threshold
Vanroy *et al.* [47]	59/38 male 21 female/65	0	51 ischemic 7 hemorrhagic/29 right 29 left 1 bilateral	parallel/36 sessions/3 months and 6 months after/6	A: Cycling group (after divided into A1: coaching croup and A2: non-coaching group) B: Control group	No significant differences between training groups were found over time./MaxIS, 10MWT, FAC, BP, VO2peak

Table 3. Overview of the studies investigating TAE and TAN in the **TUG** (na: not available, not applicable; SS-QOL: Stroke Specific Quality Of Life scale; HRrest: Resting Heart Rate; SIS: Stroke Impact Scale; SSS: Scandinavian Stroke Scale; RMI: Rivermead Mobility Index; 5XST:Five Times Sit to Stand Test; BP: Blood Pressure; HR: Heart Rate; DP: Double-Product; SF-12: Short Form Health Survey; FAC: Functional Ambulation Categories; VAS: Visual Analogue Scale; MAssS: Motor Assessment Scale, MAshS: Modified Ashworth Scale; FIM: Functional Independence Scale; FMA: Fugl-Meyer Scale; POMA: Performance-Oriented Mobility Assessment).

Reference (TUG)	Subjects number/ gender/age (years)	Time since stroke (months)	Stroke etiology/ affected hemisphere	Study design/sessions number/follow up/PEDro scale (score)	Intervention	Results/Used assessments
Eyvaz *et al.* [48]	60/ 29 male 31 female/ 58	23	50 ischemic 10 hemorrhagic/ 28 right 32 left	parallel/30 sessions/na/5	A: water exercises and land exercises B: only land exercises	The application of water exercise together with land exercise (except the SF-36 vitality subparameter) in patients with hemiplegia did not bring any additional contribution to the application of LBE alone./TUG, BBS, SF-36
Gambassi *et al.* [38]	22/9 male 13 female/62	60	na/16 right 6 left	parallel/16 sessions/na/6	A: physical therapy B: resistance training with elastic	resistance training with elastic bands improves tug, 5xst/isometric handgrip, 10MWT, 5XSTS, TUG, BP, HR, DP
Gjellesvik *et al.* [49]	73/44 male 29 female/57	26	29 ischemic 28 hemorrhagic/25 right 34 left 11 bilateral	parallel/24 sessions/na/7	A: HIIT training at treadmill B: standard care only	HIIT combined with standard care improved walking distance, balance, and executive function immediately after the intervention compared to standard care only. However, only TMT-B remained significant at the 12-month follow-up. /10MWT, 6MWT, TUG, BBS, SIS
Haruyama *et al.* [50]	32/25 male 7 female/66	69	14 ischemic 18 hemorrhagic/15 right 17 left	parallel/20 sessions/na/6	A: strength training for trunk B: physiotherapy	Trunk strengthening training improved tug and fac/TUG, FAC
Hyun *et al.* [40]	30/13 male 17 female/60	4	21 ischemic 9 hemorrhagic/16 right 14 left	parallel/30 sessions/na/5	A: real-time visual feedback + sit to stand training B: sit-to-stand training	Sit-to-stand training combined with real-time visual feedback was effective at improving the muscle strength of the lower extremities, balance, gait, and quality of life in patients with stroke./MaxIS, 10MWT, TUG, SS-QOL

Continued

In *et al.* [41]	30/17 male 13 female/53	6	21 ischemic 9 hemorrhagic/15 right 15 left	parallel/20 sessions/na/7	A: treadmill training with Thera-band B: treadmill training	In FMA, TUG, 10MWT and Gait POMA, there were significant improvements in both groups after intervention. And more significant changes were shown in the group A than the group B/FMA, TUG, 10MWT, POMA
Kim *et al.* [51]	12/10 male 2 female/58	na	6 ischemic 6 hemorrhagic/9 right 3 left	parallel/36 sessions/na/5	A: Land-scape imagery observation physical training group B: Action observation physical training group	Action observation training and physical training are effective in improving sit-to-walk and balance ability of chronic stroke patients/TUG
Lee *et al.* [44]	61/36 male 25 female/64	1	40 ischemic 21 hemorrhagic/32 right 29 left	parallel/20 sessions/na/6	A: progressive training group B: high-speed training group	Progressive and fast walking training, improvements in all parameters (10MWT, 6MWT, TUG, Step length) except stride width with better results in high-speed training/10MWT, 6MWT, TUG
Middleton *et al.* [52]	40/30 male 13 female/61	40	na/27 right 16 left	parallel/10 sessions/na/6	A: Body weight-supported treadmill training B: Overground gait training	No differences between groups/6MWT, 3MeterBackWT, TUG, BBS, FMA
Yeh *et al.* [53]	56/38 male 18 female/57	45	28 ischemic 27 hemorrhagic 1 unknown/23 right 33 left	parallel/36 sessions/ na/6	A: Aerobic exercise training B: Computerized cognitive training C: Aerobic exercise and computerized cognitive training	No between-group differences were observed for physical functions, daily function, quality of life, and social participation measures./6MWT, TUG, SIS, FIM

Table 4. Overview of the studies investigating TAE and TAN in the **BarthelADL** (na: not available, not applicable; SS-QOL: Stroke Specific Quality Of Life scale; HRrest: Resting Heart Rate; SIS: Stroke Impact Scale; SSS: Scandinavian Stroke Scale; RMI: Rivermead Mobility Index; 5XST:Five Times Sit to Stand Test; BP: Blood Pressure; HR: Heart Rate; DP: Double-Product; SF-12: Short Form Health Survey; FAC: Functional Ambulation Categories; VAS: Visual Analogue Scale; MAssS: Motor Assessment Scale, MAshS: Modified Ashworth Scale; FIM: Functional Independence Scale; FMA: Fugl-Meyer Scale; POMA: Performance-Oriented Mobility Assessment).

Reference (Barthel ADL)	Subjects number/gender/ age (years)	Time since stroke (months)	Stroke etiology/affected hemisphere	Study design/sessions number/follow up/PEDro scale (score)	Intervention	Results/Used assessments
Bei *et al.* [54]	160/112 male 48 female/62	1	80 ischemic 80 hemorrhagic/78 right 82 left	Parallel/48 sessions/na/4	A: Hydrotherapy group B: Control group	there was a significant difference in FMA, FAC, BBS, and MBI scores between the two groups/NIHSS, MRS, FMA, FAC, BBS, MBI
Brunelli *et al.* [55]	34/16 male 18 female/70	0	22 ischemic 12 hemorrhagic/17 right 17 left	parallel/40 sessions/na/6	A: conventional physiotherapy B: ground walking with weight relief	ground walking better improvement in FAC/6MWT, BarthelADL, FAC, RMI
Nave *et al.* [56]	200/118 male 82 female/69	1	181 ischemic 19 hemorrhagic/na	parallel/20 sessions/na/6	A: Aerobic physical fitness training B: Relaxation sessions	No differences between groups/10MWT, BarthelADL

Continued

Park *et al.* [57]	29/22 male 7 female/56	11	15 ischemic 14 hemorrhagic/12 right 17 left	parallel/20 sessions/na/7	A: Land-based and aquatic trunk exercise B: Control group (only land-based exercises)	The group that performed land exercise and hydrotherapy showed improvements in some BarthelADL, PASS and BBS compared to the control group./BarthelADL, BBS, PASS
Taricco *et al.* [58]	229/147 male 82 female/71	na	na/126 right 103 left	parallel/16 sessions/na/na	A: Adapted Physical Activity + Therapeutic Patient Education B: Usual care	Gait endurance, physical performance, balance, and the physical component of the quality of life score increased significantly at 4 months in the APA group and remained stable in the control group./ 6MWT, BarthelADL, VAS, SF-12

3.3. Strength (MaxIS)

Surprisingly, TAE showed better results than TAN in the MaxIS test, with a p-value of <0.00001. This may be due to TAE's focus on sustained aerobic activity, which indirectly supports strength development by improving cardiovascular efficiency.

Although TAN is typically associated with strength improvements, this result suggests that TAE can also play a role in enhancing muscular capacity, especially in post-stroke individuals who may benefit from improved oxygen delivery to muscles (Figure 5).

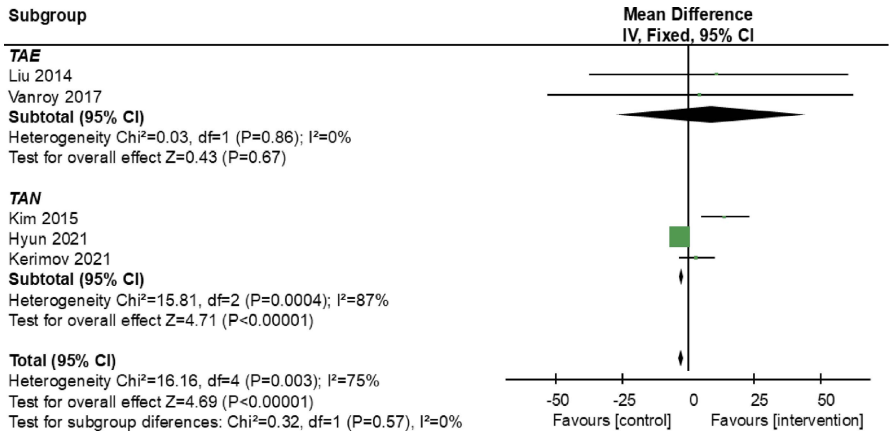

Figure 5. Forest plot of comparison: Max Isom. Strength TAE X TAN.

To thoroughly assess the impact of TAE and TAN on various outcomes in post-stroke rehabilitation, a compiled table was made that summarize the studies reviewed. This table consolidates findings from multiple research articles, showcasing the effectiveness of TAE and TAN in enhancing specific functional measures.

Table 5 presents an overview of the studies investigating TAE and TAN in MaxIS. This table provides detailed insights into the methodologies, sample sizes, and key outcomes of the studies, allowing for a clearer understanding of the comparative effectiveness of TAE and TAN in post-stroke rehabilitation.

Table 5. Overview of the studies investigating TAE and TAN in the **MaxIS** (na: not available, not applicable; SS-QOL: Stroke Specific Quality Of Life scale; HRrest: Resting Heart Rate; SIS: Stroke Impact Scale; SSS: Scandinavian Stroke Scale; RMI: Rivermead Mobility Index; 5XST: Five Times Sit to Stand Test; BP: Blood Pressure; HR: Heart Rate; DP: Double-Product; SF-12: Short Form Health Survey; FAC: Functional Ambulation Categories; VAS: Visual Analogue Scale; MAssS: Motor Assessment Scale, MAshS: Modified Ashworth Scale; FIM: Functional Independence Scale; FMA: Fugl-Meyer Scale; POMA: Performance-Oriented Mobility Assessment).

Reference (MaxIS)	Subjects number/gender/age (years)	Time since stroke (months)	Stroke etiology/affected hemisphere	Study design/sessions number/follow up/PEDro scale (score)	Intervention	Results/Used assessments
Hyun *et al.* [40]	30/13 male 17 female/60	4	21 ischemic 9 hemorrhagic /16 right 14 left	parallel/30 sessions/na/5	A: real-time visual feedback + sit to stand training B: sit-to-stand training	Sit-to-stand training combined with real-time visual feedback was effective at improving the muscle strength of the lower extremities, balance, gait, and quality of life in patients with stroke./MaxIS, 10MWT, TUG, SS-QOL
Kerimov *et al.* [59]	24/17 male 7 female/54	15	na/na	parallel/12 sessions/na/5	A: Isokinetic training group B: Control group (was tailored strengthening exercises with exercise bands)	Isokinetic strengthening can provide motor and functional improvement of the paretic upper limb in patients with post-stroke hemiplegia/MaxIS
Kim *et al.* [60]	30/15 male 15 female/59	7	16 ischemic 14 hemorrhagic/14 right 16 left	parallel/15 sessions/na/5	A: Control group (both knee belts of the tilt table were fastened) B: Experimental group 1 (only the affected side knee belt of the tilt table was fastened and one-leg standing training was performed using the less-affected leg) B: Experimental group 2 (only the affected side knee belt of the tilt table was fastened and progressive task-oriented training was performed using the less-affected leg)	Results suggest that progressive task-oriented training on a supplementary tilt table may have a favorable effect on improving paretic side muscle strength and gait function at an early stage of rehabilitation of stroke patients./Speed gait, MaxIS
Liu *et al.* [61]	15/9 male 6 female/60	1	4 ischemic 11 hemorrhagic/6 right 9 left	parallel/15 sessions/na/na	A: Body weight support treadmill training (BWSTT) B:over-ground walking	The results showed larger pennation angle and muscle thickness of tibialis anterior and longer fascicle length of medial gastrocnemius after the training. The findings of this study suggest that the early rehabilitation training of BWSTT in subacute stage of stroke provides positive changes of the muscle architecture, leading to the potential improvement of the force generation of the muscle./MaxIS, 10MWT, MAS, FMA,
Vanroy *et al.* [47]	59/38 male 21 female/65	0	51 ischemic 7 hemorrhagic/29 right 29 left 1 bilateral	parallel/36 sessions/3 months and 6 months after/6	A: Cycling group (after divided into A1: coaching croup and A2: non-coaching group) B: Control group	No significant differences between training groups were found over time./MaxIS, 10MWT, FAC, BP, VO2peak

3.4. Balance

As demonstrated in Figure 6, TAN resulted in a significant improvement in BBS scores ($p = 0.05$), with a Chi^2 value of 4.75. This highlights the efficacy of anaerobic training in enhancing balance, likely due to its emphasis on strength and coordination.

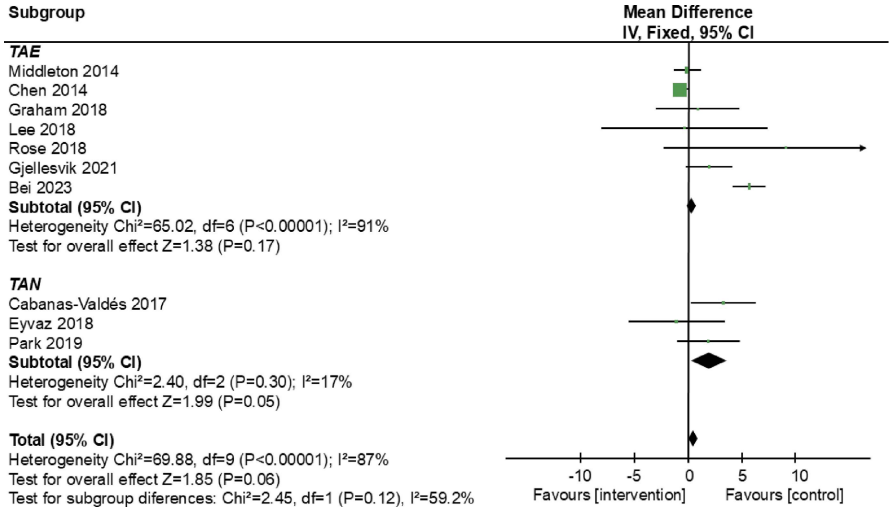

Figure 6. Forest plot of comparison: BBS TAE X TAN.

These findings suggest that TAN interventions may be more effective in addressing balance deficiencies, which are common among stroke survivors and critical for preventing falls.

Table 6. Overview of the studies investigating TAE and TAN in the BBS (na: not available, not applicable; SS-QOL: Stroke Specific Quality Of Life scale; HRrest: Resting Heart Rate; SIS: Stroke Impact Scale; SSS: Scandinavian Stroke Scale; RMI: Rivermead Mobility Index; 5XST: Five Times Sit to Stand Test; BP: Blood Pressure; HR: Heart Rate; DP: Double-Product; SF-12: Short Form Health Survey; FAC: Functional Ambulation Categories; VAS: Visual Analogue Scale; MAssS: Motor Assessment Scale, MAshS: Modified Ashworth Scale; FIM: Functional Independence Scale; FMA: Fugl-Meyer Scale; POMA: Performance-Oriented Mobility Assessment).

Reference (BBS)	Subjects number/gender/age (years)	Time since stroke (months)	Stroke etiology/affected hemisphere	Study design/sessions number/follow up/PEDro scale (score)	Intervention	Results/Used assessments
Bei *et al.* [54]	160/112 male 48 female/62	1	80 ischemic 80 hemorrhagic/78 right 82 left	Parallel/48 sessions/na/4	A: Hydrotherapy group B: Control Group	There was a significant difference in FMA, FAC, BBS, and MBI scores between the two groups/NIHSS, MRS, FMA, FAC, BBS, MBI
Cabanas-Valdés *et al.* [62]	68 / 34 male 34 female / 75	60	53 ischemic 15 hemorrhagic/33 right 35 left	parallel/25 sessions/na/6	A: conventional physiotherapy B: in addition to physiotherapy, performed CORE training for 15 minutes	Core stability exercises plus conventional physical therapy have a positive long-term effect on improving dynamic sitting and standing balance and gait in post-stroke patients/BBS, Postural Assessment Scale for Stroke Patients
Chen *et al.* [63]	30/27 male 3 female/53	36	16 ischemic 14 hemorrhagic/12 right 18 left	parallel/12 sessions/na/7	A: training on a rotating treadmill and B: training on a standard treadmill, both received a series of exercises	Spin-based treadmill training may be a viable and effective strategy to improve balance control for individuals with chronic stroke/BBS
Eyvaz *et al.* [48]	60 / 29 male 31 female / 58	23	50 ischemic 10 hemorrhagic/28 right 32 left	parallel/30 sessions/na/5	A: water exercises and land exercises B: only land exercises	The application of water exercise together with land exercise (except the SF-36 vitality subparameter) in patients with hemiplegia did not bring any additional contribution to the application of LBE alone./TUG, BBS, SF-36

Continued

Gjellesvik *et al.* [49]	73/44 male 29 female/57	26	29 ischemic 28 hemorrhagic/2 5 right 34 left 11 bilateral	parallel/24 sessions/na/7	A: HIIT training at treadmill B: standard care only	HIIT combined with standard care improved walking distance, balance, and executive function immediately after the intervention compared to standard care only. However, only TMT-B remained significant at the 12-month follow-up. /10MWT, 6MWT, TUG, BBS, SIS
Graham *et al.* [64]	29/15 male 14 female/54	49	na/9 right 20 left	parallel/18 sessions/na/7	A: treadmill and performed motor skills activities in free hands B: only the treadmill	Secondary outcomes showed similar pre-post improvements with no differences between groups. Adding challenging mobility skills to a hands-free BWSTT protocol did not lead to greater improvements in CWS after 6 weeks of training./BBS, 6MWT
Lee *et al.* [65]	37/19 male 18 female/60	1	20 ischemic 17 hemorrhagic/2 1 subcortical 16 cortical/19 right 19 left	parallel/20 sessions/na/7	A: Aquatic therapy (motorized aquatic treadmill) B: Land-based aerobic exercise (upper- and lower-body ergometers).	Both groups improved in isometric strength, BBS, FMA and only water walking improved Vo2 peak./MaxIS, BBS, FMA, BP, HR, Vo2peak,
Middleton *et al.* [52]	40/30 male 13 female/61	40	na/27 right 16 left	parallel/10 sessions/na/6	A: Body weight-supported treadmill training B: Overground gait training	No differences between groups/6MWT, 3MeterBackWT, TUG, BBS, FMA
Park *et al.* [57]	29/22 male 7 female/56	11	15 ischemic 14 hemorrhagic/1 2 right 17 left	parallel/20 sessions/na/7	A: Land-based and aquatic trunk exercise B: Control group (only land-based exercises)	The group that performed land exercise and hydrotherapy showed improvements in some BarthelADL, PASS and BBS compared to the control group./BarthelADL, BBS, PASS
Rose *et al.*	16/6 male 10 female/60	0	na/6 right 10 left	parallel/8 sessions/3 months after /5	A: Backward Walking Training B: Standing Balance Training	BWT resulted in greater improvements in both forward and backward walking speed than SBT/5MeterWT, 3MeterBackWT, BBS, FIM

Table 6 provides an overview of the studies investigating TAE and TAN in the Berg Balance Scale (BBS). This table offers detailed insights into the methodologies, sample sizes, and key outcomes of the studies, enabling a clearer understanding of the comparative effectiveness of TAE and TAN in post-stroke rehabilitation.

3.5. Cardiorespiratory Capacity

Both TAE and TAN demonstrated significant improvements in the 6MWT ($p < 0.00001$), as seen in Figure 7. This result suggests that both types of training are effective in enhancing cardiorespiratory fitness, which is essential for long-term recovery.

Given the equivalent benefits of TAE and TAN on cardiorespiratory capacity, rehabilitation programs can integrate both modalities to optimize endurance and overall fitness in stroke survivors.

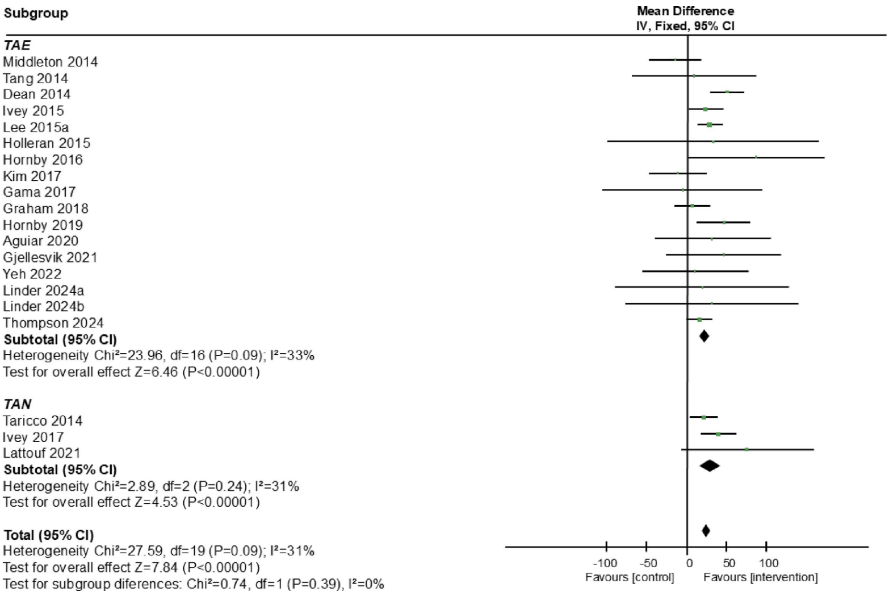

Figure 7. Forest plot of comparison: 6MWT TAE X TAN.

To assess the impact of TAE and TAN on post-stroke rehabilitation, Table 7 summarizes studies on the 6MWT. It details methodologies, sample sizes, and key outcomes, providing insights into the comparative effectiveness of TAE and TAN.

Table 7. Overview of the studies investigating TAE and TAN in the 6MWT (na: not available, not applicable; SS-QOL: Stroke Specific Quality Of Life scale; HRrest: Resting Heart Rate; SIS: Stroke Impact Scale; SSS: Scandinavian Stroke Scale; RMI: Rivermead Mobility Index; 5XST: Five Times Sit to Stand Test; BP: Blood Pressure; HR: Heart Rate; DP: Double-Product; SF-12: Short Form Health Survey; FAC: Functional Ambulation Categories; VAS: Visual Analogue Scale; MAssS: Motor Assessment Scale, MAshS: Modified Ashworth Scale; FIM: Functional Independence Scale; FMA: Fugl-Meyer Scale; POMA: Performance-Oriented Mobility Assessment).

Reference (BBS)	Subjects number/gender/age (years)	Time since stroke (months)	Stroke etiology/affected hemisphere	Study design/sessions number/follow up/PEDro scale (score)	Intervention	Results/Used assessments
Aguiar *et al.* [35]	16/8 male 8 female/50	47	ischemic 19 hemorrhagic 2 unknown 1/13 right 9 left	parallel/36 sessions/4 weeks after/7	A: Walking on the treadmill at 60% - 80% HRrest B: Walking on the ground below 40% HRrest	Improvement in 6MWT, 10MWT, SS-QOL, the others without improvement, and without difference between groups/10MWT, 6MWT, VO2peak, VO2threshold, SIS, SS-QOL
Dean *et al.*, [37]	68/43 male 25 female/66	20	na/31 right 37 left	parallel/ 48 sessions/ na/7	A: 30 minutes of treadmill and floor walking B: received no intervention	Improved distance and speed in walking test/10MWT, 6MWT
Gama *et al.* [66]	28/14 male 14 female/58	60	14 ischemic 14 hemorrhagic/na	Parallel/14 sessions/na/8	A: Treadmill group (n = 14) with body weight support B: Overground group (n = 14)	Improvements in 10-m walk test and 6-minute walk test; Treadmill group showed more significant improvement.
Gjellesvik *et al.* [49]	73/44 male 29 female/57	26	29 ischemic 28 hemorrhagic/25 right 34 left 11 bilateral	parallel/24 sessions/na/7	A: HIIT training at treadmill B: standard care only	HIIT combined with standard care improved walking distance, balance, and executive function immediately after the intervention compared to standard care only. However, only TMT-B remained significant at the 12-month follow-up. /10MWT, 6MWT, TUG, BBS, SIS

Continued

Graham *et al.* [64]	29/15 male 14 female/54	49	na/9 right 20 left	parallel/18 sessions/na/7	A: Treadmill and performed motor skills activities in free hands B: only the treadmill	Secondary outcomes showed similar pre-post improvements with no differences between groups. Adding challenging mobility skills to a hands-free BWSTT protocol did not lead to greater improvements in CWS after 6 weeks of training./BBS, 6MWT
Hornby *et al.* [67]	32/24 male 8 female/57	3	Na/ na	Parallel/40+ sessions/2 months after/8	A: High-intensity, variable stepping training B: Conventional intervention	Significant improvements in walking speed, distance, temporal gait symmetry, and self-reported participation scores in the experimental group.
Hornby *et al.* [68]	97/60 male 37 female/59	1 to 6	Na/na	Parallel/+40 sessions/3 months after/8	A: High-variable B: Low-variable stepping training C: high-forward	Significant improvements in walking outcomes for high-intensity groups compared to low-intensity group.
Holleran *et al.* [69]	12/na/na	+6	Na/na	Crossover/-12 sessions/4 weeks after/7	A: High-intensity B: Low-intensity locomotor training	Greater increases in 6-minute walk test performance following high-intensity training compared with low-intensity training.
Ivey *et al.* [42]	30/21 male 9 female/56	66	na/na	parallel/36 sessions/na/4	A: Strength training B: Attention-matched stretch control group	The group A showed improvement in relation to the control group in terms of strength and better functional capacity/gait speed, 1Max repetition, 10MWT, 6MWT, Vo2peak,
Kim *et al.* [70]	30/18 male 12 female/49	7	10 ischemic 20 hemorrhagic/na	Parallel/na/8 weeks after/8	A: Progressive backward BWSTT B: Forward treadmill training	Improved gait ability in both groups, with greater improvements in the backward BWSTT group.
Lattouf *et al.* [43]	37/20 male 17 female/70	11	28 ischemic 9 hemorrhagic/34 right 3 left	parallel/12 sessions/na/4	A: Group receiving eccentric muscle strengthening B: control group	Eccentric bodybuilding training with improvements in 1RM and 10MWT, 6MWT/1RM, 10MWT, 6MWT, MAshS
Lee *et al.* [44]	61/36 male 25 female/64	1	40 ischemic 21 hemorrhagic/32 right 29 left	parallel/20 sessions/na/6	A: Progressive training group B: High-speed training group	Progressive and fast walking training, improvements in all parameters (10MWT, 6MWT, TUG, Step length) except stride width with better results in high-speed training/10MWT, 6MWT, TUG
Linder *et al.* [71]	60/35 male 25 female/60	20	46 ischemic 14 hemorrhagic/na	Parallel/24 sessions/na/8	A: Forced-rate aerobic exercise combined with upper extremity repetitive task practice B: upper extremity repetitive task practice alone	Greater improvements in peak VO2 and anaerobic threshold in the combined intervention group.
Middleton *et al.* [52]	40/30 male 13 female/61	40	na/27 right 16 left	parallel/10 sessions/na/6	A: Body weight-supported treadmill training B: Overground gait training	No differences between groups/6MWT, 3MeterBackWT, TUG, BBS, FMA
Tang *et al.* [72]	50/29 male 21 female/50 - 80	+12	19 ischemic 16 hemorrhagic 15 others/na	Parallel/18 sessions/na/8	A: High-intensity aerobic exercise B: Low-intensity balance and flexibility	No changes in VO2peak; improvements in cardiovascular function and lipid profiles.

Continued

Taricco *et al.* [58]	229/147 male 82 female/71	na	na/126 right 103 left	parallel/16 sessions/na/na	A: Adapted Physical Activity + Therapeutic Patient Education B: Usual care	Gait endurance, physical performance, balance, and the physical component of the quality of life score increased significantly at 4 months in the APA group and remained stable in the control group./6MWT, BarthelADL, VAS, SF-12
Thompson *et al.* [46]	250/134 male 116 female/63	6	Na /na	Parallel/36 sessions/na/na/8	A: Walking 40 min 70% - 80% da HRres B: Daily step activity monitoring with feedback and goal setting C: Combination of the two interventions above	Improvements in Group A compared to Group B/6MWT, VO2 threshold
Yeh *et al.* [53]	56/38 male 18 female/57	45	28 ischemic 27 hemorrhagic 1 unknown/23 right 33 left	parallel/36 sessions/ na/6	A: Aerobic exercise training B: Computerized cognitive training C: Aerobic exercise and computerized cognitive training	No between-group differences were observed for physical functions, daily function, quality of life, and social participation measures./6MWT, TUG, SIS, FIM

4. Discussion

4.1. Functionality

The superiority of TAN over TAE training in improving performance on the 10MWT can be attributed to the specific physiological adaptations induced by TAN. Anaerobic exercise focuses on high-intensity, short-duration activities, targeting muscular strength, power, and anaerobic capacity [73]. These adaptations are particularly relevant for enhancing walking speed and efficiency, which are key components measured by the 10MWT [74].

On the other hand, the effectiveness of TAE training in improving TUG test performance can be attributed to its emphasis on aerobic capacity, cardiovascular fitness, and functional mobility [75]. The TUG test primarily assesses the time taken to complete a series of functional tasks, such as standing up, walking, and turning [76].

However, in the case of the Barthel ADL, both TAE and TAN did not display noteworthy enhancements. This lack of significance suggests that neither training intervention resulted in substantial changes in activities of daily living. The Barthel ADL assesses a broader range of functional abilities beyond walking, and it is possible that different types of interventions or longer training durations may be required to elicit notable improvements in this area.

The varying effectiveness of TAE and TAN training interventions across different outcome measures can be attributed to the specific physiological adaptations targeted by each intervention. The superior performance of TAN in the 10MWT likely stems from its focus on enhancing muscular strength, power, and anaerobic capacity, which are directly related to walking speed and efficiency. On the other hand, the lack of significant results in the Barthel ADL suggests a potential need for alternative interventions or longer training durations to achieve meaningful

improvements. The positive effects of TAE training in the TUG test highlight the importance of aerobic fitness and functional mobility for tasks involving standing, walking, and turning. This highlights the fact that functionality is an open capacity, encompassing both aerobic and anaerobic activities.

Integrating both aerobic and anaerobic elements into a training program could potentially enhance the range of physiological adaptations and improve outcomes across various functional measures. This approach may be particularly beneficial for individuals looking to improve both walking speed and efficiency as well as overall functional mobility.

In conclusion, while TAN training demonstrates superior efficacy in the 10MWT due to its focus on anaerobic adaptations, and TAE training excels in the TUG test through its emphasis on aerobic fitness and functional mobility, a combined approach incorporating both training modalities may offer the most comprehensive benefits. This holistic strategy could address the limitations observed in the Barthel ADL and provide a more effective means of improving overall functional capacity. Functionality, therefore, is an open capacity, encompassing both aerobic and anaerobic activities, and optimizing training programs to include both elements may yield the best results for enhancing various aspects of physical performance and daily living activities.

4.2. Walking Improvement

The observed significance of TAN in improving walking performance, as measured by 10MWT, can be attributed to several factors. Firstly, TAN protocols typically emphasize high-intensity exercises, targeting the development of muscular strength and power [77]. These exercises primarily focus on the lower extremities, which are crucial for walking and gait mechanics. By engaging in TAN, individuals can enhance their muscular strength and power, leading to improvements in walking ability and performance as reflected in the 10MWT results [74].

Secondly, TAN often involves exercises that promote neuromuscular coordination and motor control [78]. The precise and coordinated movements required during TAN can enhance the communication and synchronization between the muscles, nerves, and central nervous system [79]. As a result, individuals who undergo TAN may experience improved motor control and movement efficiency, leading to better performance in the 10MWT.

Furthermore, the anaerobic nature of the training stimulates adaptations in the anaerobic energy system, enabling individuals to sustain higher levels of effort during walking. The improved anaerobic capacity contributes to enhanced walking speed, endurance, and overall performance, all of which are assessed in the 10MWT. For this population, displacements occur over short distances, not requiring too much aerobic capacity. This means that the anaerobic adaptations induced by the training are particularly beneficial, as they are more relevant to the short bursts of effort typically required in their daily activities. Consequently, the emphasis on anaerobic training aligns well with the functional demands of their

environment, leading to significant improvements in their walking performance and overall mobility.

The observed heterogeneity among the studies included in the analysis could be attributed to variations in the duration, intensity, and specific protocols of the TAN interventions. Differences in participant characteristics, such as age, fitness level, and baseline walking abilities, may also contribute to the heterogeneity. Additionally, variations in study design, measurement tools, and statistical approaches used across the included articles could influence the degree of heterogeneity observed.

In summary, the significant association between TAN and Walking Improvement, specifically demonstrated by the 10MWT results, can be attributed to the development of muscular strength and power, enhanced neuromuscular coordination, and improved anaerobic capacity.

4.3. Strength (MaxIS)

The unexpected superiority of TAE in promoting strength increase, as measured by the MaxIS, can be attributed to several factors, especially in individuals recovering from a stroke. TAE interventions typically involve sustained aerobic activities that target cardiovascular fitness, endurance, and whole-body muscle engagement. These exercises, such as walking, cycling, or swimming, stimulate the cardiovascular system, leading to improved oxygen delivery and enhanced energy production within the muscles, especially in the lower limbs [80].

Additionally, for strength-related activities, the body primarily uses ATP reserves rather than glycogen or fat. This is particularly relevant for stroke survivors, whose muscles may have reduced efficiency and strength. Aerobic exercises help improve the overall metabolic efficiency of the body, ensuring that ATP is produced and utilized more effectively during muscle contractions. This increased efficiency in ATP utilization can lead to significant strength gains, even though the primary focus of TAE is on aerobic conditioning.

In the context of stroke rehabilitation, enhanced oxygen delivery and improved energy production within the muscles due to TAE can help rebuild muscle strength and endurance. The emphasis on sustained aerobic activities also aids in overall cardiovascular health, which is crucial for stroke survivors. By improving the efficiency of the anaerobic energy system and ensuring that ATP reserves are readily available, TAE helps stroke survivors increase their muscle strength and perform daily activities with greater ease.

Therefore, while TAE primarily targets aerobic capacity, it also indirectly supports strength gains by optimizing the body's energy systems. This dual benefit makes TAE a valuable component of stroke rehabilitation, contributing to improved functional outcomes and quality of life for stroke survivors.

It is important to consider the heterogeneity observed among the studies included, which may contribute to the variations in the strength increase outcomes between TAE and TAN interventions. Variations in the duration, intensity, and

specific protocols of the exercise interventions, as well as differences in participant characteristics (e.g., age, time since stroke, initial strength levels), can influence the heterogeneity observed.

Furthermore, the dissimilarities in control group characteristics between TAE and TAN studies may have influenced the outcomes and contributed to the apparent inferiority of TAN. In TAE studies, comparisons with well-established rehabilitation methods, such as massage and physiotherapy, provided a robust baseline for evaluating the aerobic training's efficacy. Additionally, the incorporation of passive mobilization in the control group allowed for a comprehensive assessment of the TAE's unique benefits.

On the other hand, TAN studies utilized control groups with combined interventions, potentially leading to confounding factors in the evaluation of anaerobic training alone, such as task-related activities. Moreover, the comparison of TAN on lower limbs and upper limbs plus oriented tasks in the control group may have introduced biased results, as upper limb tasks differ significantly from lower limb-focused training in stroke rehabilitation [81]. Furthermore, the contrast between TAN in isokinetic settings and TAN performed at home introduced variations in training environment and supervision, possibly affecting the intervention's effectiveness.

Hence, the diverse and less conventional control groups used in TAN studies might have contributed to the observed disparities in outcomes compared to TAE interventions. As such, careful consideration of control group selection and standardization is crucial for future research investigating the efficacy of TAN in stroke rehabilitation.

Another potential explanation for the superior strength increase observed in the TAE group could be the focus on functional movements and activities that closely mimic daily tasks. TAE interventions often involve exercises that simulate real-life movements, which are directly relevant to the functional needs of individuals who have had a stroke. By specifically targeting these functional movements, TAE training may result in more significant improvements in overall strength. and functional capacity.

In conclusion, the unexpected finding of TAE demonstrates a significant response and superior strength increase compared to TAN in individuals who had a stroke, as measured by the MaxIS test, may be attributed to one or more factors cited previously.

The lack of significant improvement in strength observed in the TAN can be attributed to several potential factors. Firstly, TAN typically emphasizes high-intensity, short-duration activities that target muscular strength and power [74]. However, in the context of individuals who have had a stroke, it is possible that the intensity of the TAN prescribed in the interventions was not sufficient to elicit substantial strength gains. Stroke survivors may have unique physiological considerations and limitations that could affect their ability to tolerate and benefit from high-intensity TAN [82]. Additionally, factors such as muscle weakness,

reduced motor control, and altered muscle activation patterns resulting from the stroke may impact the response to TAN [83].

4.4. Balance

The observed significant response for TAN in improving balance, as measured by the BBS, can be attributed to several factors. First, TAN interventions generally involve exercises that focus on enhancing muscular strength, power, and explosive movements [84]. These exercises often include resistance training or plyometric exercises. Such activities can directly target the muscles involved in maintaining balance and stability, leading to improved muscular control and coordination [85].

Furthermore, TAN commonly incorporates movements that challenge balance and proprioception [86]. By engaging in exercises that require dynamic stability, individuals can improve their ability to maintain equilibrium and control body movements [87]. The focus on rapid changes in direction, quick transitions, and sudden stops during TAN exercises can enhance proprioceptive feedback, body awareness, and postural control, which are critical elements for maintaining balance [88].

Another possible explanation for the significant response favoring TAN is the principle of specificity in exercise training [89]. TAN interventions often involve movements and exercises that closely resemble activities performed in daily life or specific sports. This specificity of training may lead to better transfer of skills to balance-related tasks assessed by the Berg Balance Scale.

However, it is important to consider the heterogeneity observed among the included studies, which may influence the overall response and the interpretation of the results [90]. Variations in the types and intensity of exercises, duration of interventions, participant characteristics, and outcome measures used across the studies could contribute to the observed heterogeneity.

In conclusion, the significant response favoring TAN over TAE in the comparison of their effects on balance improvement, as measured by the BBS, can be attributed to the focus on muscular strength, power, explosive movements, dynamic stability, and the principle of specificity in training. The incorporation of exercises that challenge balance, proprioception, and postural control likely contributes to the observed improvements.

4.5. Cardiorespiratory Capacity

The absence of significant differences between TAN and TAE interventions in improving Cardiorespiratory Capacity, as measured by the 6MWT, can be attributed to several factors. Firstly, both TAN and TAE interventions typically involve exercises that target the cardiovascular and respiratory systems [90]. Aerobic exercise, regardless of the specific modality, increases heart and respiratory rate, also oxygen consumption, thereby improving Cardiorespiratory Capacity [90].

Secondly, the 6MWT primarily assesses an individual's endurance and functional capacity to perform activities involving walking. Both TAN and TAE interventions can enhance aerobic fitness, muscular endurance, and overall physical conditioning, which positively influence an individual's performance in endurance-based tasks such as the 6MWT [91]. Therefore, the significant results observed in both TAN and TAE groups can be attributed to the benefits of aerobic exercise on Cardiorespiratory Capacity.

It is important to consider that the lack of significant differences between the two interventions may also be influenced by the low degree of heterogeneity observed among the studies included. The consistency in exercise protocols, intervention durations, participant characteristics, and outcome measures across the studies might contribute to the absence of significant variation between TAN and TAE groups.

In conclusion, the significant results observed in both TAN and TAE interventions without significant differences between the groups in improving Cardiorespiratory Capacity, as measured by the 6MWT, can be attributed to the shared focus on aerobic exercise targeting the cardiovascular and respiratory systems. The 6MWT serves as a suitable measure for assessing an individual's endurance and functional capacity related to walking activities.

4.6. General Outcomes

In conclusion, this study has provided valuable insights into the effectiveness of different training modalities across various functional categories. Five key points emerge from our findings:

Regarding the category of Functionality, it is easy to determine that none of the training modality is more efficient than the other. Our results demonstrated that for the 10MWT, TAN appeared to be more efficient, while for the TUG test, TAE exhibited greater efficacy. Interestingly, no significant differences were observed for either training modality in the BarthelADL. This highlights the importance of tailoring the choice of training to individual patient needs and therapeutic objectives [92].

In the category of Walking Improvement, our findings suggest that the 10MWT was more effective when coupled with TAN. This underscores the potential benefits of anaerobic training in enhancing gait performance for individuals with the conditions in this investigation.

For the Strength category, our results indicated that MaxIS testing favored TAE. However, this outcome is accompanied by several justifications, contravening initial expectations that TAN would be more efficient for strength improvement. Thus, it is imperative not to definitively conclude that TAE is superior for enhancing strength, as the influence of training methodology and individual participant characteristics necessitates further investigation [93].

Within the Balance category, the BBS emerged as the more effective tool when combined with TAN. This suggests that TAN may hold promise for improving

balance in individuals with the studied conditions [94].

Finally, in the category of Cardiorespiratory Capacity, both TAE and TAN modalities demonstrated efficacy. This indicates that both approaches can be considered viable options for enhancing Cardiorespiratory Capacity in patients with the conditions under examination [95].

In summary, this research has shed light on the nuanced effects of different training modalities across various functional domains. It is imperative to acknowledge the complexity of these relationships and to consider individual patient characteristics when selecting the most appropriate training approach. Further research is warranted to deepen our understanding of these findings and to identify the most effective therapeutic strategies for specific clinical contexts.

Given the overall findings, it is noteworthy that TAN consistently showed significant advantages in key performance metrics such as the 10MWT for walking improvement and the BBS for balance. These outcomes suggest that, while both TAE and TAN have their merits, TAN may offer superior benefits in enhancing functional performance, particularly in areas critical to daily living and mobility. This indirect indication of TAN's superiority underscores the potential for anaerobic training to play a pivotal role in the rehabilitation and improvement of functional capacities in individuals with the conditions studied.

5. Limitations

The studies incorporated into our meta-analysis demonstrate inconsistency in the demographic characteristics of the included study population, such as time elapsed since stroke occurrence, stroke etiology, stroke location, and degree of motor impairment. Likewise, the applied intervention also varied significantly, including differences in intensity, duration, number of sessions and equipment used. These variations in the parameters used in the studies make it difficult to compare effect sizes, as they create significant inconsistencies between studies.

6. Conclusions

In summary, this study offers a comprehensive evaluation of the efficacy of TAE and TAN interventions tailored for individuals post-stroke. The findings present a multifaceted picture, where no single training modality stands out as universally superior in terms of overall effectiveness.

While TAN demonstrates greater efficacy in enhancing Walking Improvement and Balance, TAE exhibits an unexpected advantage in the context of Strength assessment. These results underscore the imperative for personalized therapeutic strategies that consider the unique needs and goals of each post-stroke patient. Additionally, both TAE and TAN modalities demonstrate their effectiveness in augmenting Cardiorespiratory Capacity, underscoring their versatility as potential therapeutic avenues.

Further investigation remains essential to delve deeper into the intricacies of these outcomes and to inform evidence-based decision-making in clinical practice.

Future research should explore the optimal balance of these training modalities and their long-term effects on personalized stroke rehabilitation.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

References

[1] Mozaffarian, D., Benjamin, E., Go, A., *et al.* (2015) Heart Disease and Stroke Statistics—2015 Update: A Report from the American Heart Association. *Circulation*, **131**, e29-e322.

[2] Vos, T., Lim, S.S., Abbafati, C., Abbas, K.M., Abbasi, M., Abbasifard, M., *et al.* (2020) Global Burden of 369 Diseases and Injuries in 204 Countries and Territories, 1990-2019: A Systematic Analysis for the Global Burden of Disease Study 2019. *The Lancet*, **396**, 1204-1222. https://doi.org/10.1016/s0140-6736(20)30925-9

[3] Veldema, J. and Jansen, P. (2020) Ergometer Training in Stroke Rehabilitation: Systematic Review and Meta-Analysis. *Archives of Physical Medicine and Rehabilitation*, **101**, 674-689. https://doi.org/10.1016/j.apmr.2019.09.017

[4] Veldema, J. and Jansen, P. (2020) Resistance Training in Stroke Rehabilitation: Systematic Review and Meta-Analysis. *Clinical Rehabilitation*, **34**, 1173-1197. https://doi.org/10.1177/0269215520932964

[5] Moriello, C., Finch, L. and Mayo, N.E. (2011) Relationship between Muscle Strength and Functional Walking Capacity among People with Stroke. *The Journal of Rehabilitation Research and Development*, **48**, 267-275. https://doi.org/10.1682/jrrd.2010.04.0066

[6] Dorsch, S., Ada, L. and Alloggia, D. (2018) Progressive Resistance Training Increases Strength after Stroke but This May Not Carry over to Activity: A Systematic Review. *Journal of Physiotherapy*, **64**, 84-90. https://doi.org/10.1016/j.jphys.2018.02.012

[7] Dobkin, B.H. (2004) Strategies for Stroke Rehabilitation. *The Lancet Neurology*, **3**, 528-536. https://doi.org/10.1016/s1474-4422(04)00851-8

[8] Tankisheva, E., Bogaerts, A., Boonen, S., Feys, H. and Verschueren, S. (2014) Effects of Intensive Whole-Body Vibration Training on Muscle Strength and Balance in Adults with Chronic Stroke: A Randomized Controlled Pilot Study. *Archives of Physical Medicine and Rehabilitation*, **95**, 439-446. https://doi.org/10.1016/j.apmr.2013.09.009

[9] Kelly, J.O., Kilbreath, S.L., Davis, G.M., Zeman, B. and Raymond, J. (2003) Cardiorespiratory Fitness and Walking Ability in Subacute Stroke Patients. *Archives of Physical Medicine and Rehabilitation*, **84**, 1780-1785. https://doi.org/10.1016/s0003-9993(03)00376-9

[10] Gordon, N.F., Gulanick, M., Costa, F., Fletcher, G., Franklin, B.A., Roth, E.J., *et al.* (2004) Physical Activity and Exercise Recommendations for Stroke Survivors. *Circulation*, **109**, 2031-2041. https://doi.org/10.1161/01.cir.0000126280.65777.a4

[11] Winstein, C.J., Stein, J., Arena, R., Bates, B., Cherney, L.R., Cramer, S.C., *et al.* (2016) Guidelines for Adult Stroke Rehabilitation and Recovery: A Guideline for Healthcare Professionals from the American Heart Association/American Stroke Association. *Stroke*, **47**, e98-e169. https://doi.org/10.1161/str.0000000000000098

[12] Billinger, S.A., Arena, R., Bernhardt, J., Eng, J.J., Franklin, B.A., Johnson, C.M., *et al.* (2014) Physical Activity and Exercise Recommendations for Stroke Survivors: A

Statement for Healthcare Professionals from the American Heart Association/American Stroke Association. *Stroke*, **45**, 2532-2553. https://doi.org/10.1161/str.0000000000000022

[13] Moore, S.A., Boyne, P., Fulk, G., Verheyden, G. and Fini, N.A. (2022) Walk the Talk: Current Evidence for Walking Recovery after Stroke, Future Pathways and a Mission for Research and Clinical Practice. *Stroke*, **53**, 3494-3505. https://doi.org/10.1161/strokeaha.122.038956

[14] Gaitán, J.M., Moon, H.Y., Stremlau, M., Dubal, D.B., Cook, D.B., Okonkwo, O.C., *et al.* (2021) Effects of Aerobic Exercise Training on Systemic Biomarkers and Cognition in Late Middle-Aged Adults at Risk for Alzheimer's Disease. *Frontiers in Endocrinology*, **12**, Article 660181. https://doi.org/10.3389/fendo.2021.660181

[15] Penna, L.G., Pinheiro, J.P., Ramalho, S.H.R. and Ribeiro, C.F. (2021) Effects of Aerobic Physical Exercise on Neuroplasticity after Stroke: Systematic Review. *Arquivos de Neuro-Psiquiatria*, **79**, 832-843. https://doi.org/10.1590/0004-282x-anp-2020-0551

[16] Aguiar, L.T., Nadeau, S., Britto, R.R., Teixeira-Salmela, L.F., Martins, J.C. and Faria, C.D.C.D.M. (2018) Effects of Aerobic Training on Physical Activity in People with Stroke: Protocol for a Randomized Controlled Trial. *Trials*, **19**, Article No. 446. https://doi.org/10.1186/s13063-018-2823-0

[17] Chacon-Barba, J.C., Moral-Munoz, J.A., De Miguel-Rubio, A. and Lucena-Anton, D. (2024) Effects of Resistance Training on Spasticity in People with Stroke: A Systematic Review. *Brain Sciences*, **14**, Article 57. https://doi.org/10.3390/brainsci14010057

[18] Eng, J.J. (2004) Strength Training in Individuals with Stroke. *Physiotherapy Canada*, **56**, 189-201.

[19] Tole, G., Raymond, M.J., Williams, G., Clark, R.A. and Holland, A.E. (2020) Strength Training to Improve Walking after Stroke: How Physiotherapist, Patient and Workplace Factors Influence Exercise Prescription. *Physiotherapy Theory and Practice*, **38**, 1198-1206. https://doi.org/10.1080/09593985.2020.1839986

[20] Maeneja, R., Silva, C.R., Ferreira, I.S. and Abreu, A.M. (2023) Aerobic Physical Exercise versus Dual-Task Cognitive Walking in Cognitive Rehabilitation of People with Stroke: A Randomized Clinical Trial. *Frontiers in Psychology*, **14**, Article 1258262. https://doi.org/10.3389/fpsyg.2023.1258262

[21] Fernández-Lázaro, D., Santamaría, G., Sánchez-Serrano, N., Lantarón Caeiro, E. and Seco-Calvo, J. (2022) Efficacy of Therapeutic Exercise in Reversing Decreased Strength, Impaired Respiratory Function, Decreased Physical Fitness, and Decreased Quality of Life Caused by the Post-Covid-19 Syndrome. *Viruses*, **14**, Article 2797. https://doi.org/10.3390/v14122797

[22] Wist, S., Clivaz, J. and Sattelmayer, M. (2016) Muscle Strengthening for Hemiparesis after Stroke: A Meta-analysis. *Annals of Physical and Rehabilitation Medicine*, **59**, 114-124. https://doi.org/10.1016/j.rehab.2016.02.001

[23] Austin, M.W., Ploughman, M., Glynn, L. and Corbett, D. (2014) Aerobic Exercise Effects on Neuroprotection and Brain Repair Following Stroke: A Systematic Review and Perspective. *Neuroscience Research*, **87**, 8-15. https://doi.org/10.1016/j.neures.2014.06.007

[24] Lennon, O., Carey, A., Gaffney, N., Stephenson, J. and Blake, C. (2008) A Pilot Randomized Controlled Trial to Evaluate the Benefit of the Cardiac Rehabilitation Paradigm for the Non-Acute Ischaemic Stroke Population. *Clinical Rehabilitation*, **22**, 125-133. https://doi.org/10.1177/0269215507081580

[25] Podsiadlo, D. and Richardson, S. (1991) The Timed "Up & Go": A Test of Basic Functional Mobility for Frail Elderly Persons. *Journal of the American Geriatrics Society*, **39**, 142-148. https://doi.org/10.1111/j.1532-5415.1991.tb01616.x

[26] Mahoney, F.I. and Barthel, D.W. (1965) Functional Evaluation: The Barthel Index. *Maryland State Medical Journal*, **14**, 61-65.

[27] Bohannon, R.W., Magasi, S.R., Bubela, D.J., Wang, Y. and Gershon, R.C. (2012) Grip and Knee Extension Muscle Strength Reflect a Common Construct among Adults. *Muscle & Nerve*, **46**, 555-558. https://doi.org/10.1002/mus.23350

[28] Bohannon, R.W. (1997) Comfortable and Maximum Walking Speed of Adults Aged 20-79 Years: Reference Values and Determinants. *Age and Ageing*, **26**, 15-19. https://doi.org/10.1093/ageing/26.1.15

[29] Petr, E.J., Ayers, C.R., Pandey, A., de Lemos, J.A., Powell-Wiley, T.M., Khera, A., *et al.* (2014) Perceived Lifetime Risk for Cardiovascular Disease (from the Dallas Heart Study). *The American Journal of Cardiology*, **114**, 53-58. https://doi.org/10.1016/j.amjcard.2014.04.006

[30] Meseguer-Henarejos, A., Rubio-Aparicio, M., López-Pina, J., Carles-Hernández, R. and Gómez-Conesa, A. (2019) Characteristics That Affect Score Reliability in the Berg Balance Scale: A Meta-Analytic Reliability Generalization Study. *European Journal of Physical and Rehabilitation Medicine*, **55**, 570-584. https://doi.org/10.23736/s1973-9087.19.05363-2

[31] Berg, K.O., Wood-Dauphinee, S.L., Williams, J.I. and Maki, B. (1992) Measuring Balance in the Elderly: Validation of an Instrument. *Canadian Journal of Public Health*, **82**, 7-11.

[32] Spruit, M.A., Singh, S.J., Garvey, C., ZuWallack, R., Nici, L., Rochester, C., *et al.* (2013) An Official American Thoracic Society/european Respiratory Society Statement: Key Concepts and Advances in Pulmonary Rehabilitation. *American Journal of Respiratory and Critical Care Medicine*, **188**, e13-e64. https://doi.org/10.1164/rccm.201309-1634st

[33] Cipriani, A., Higgins, J.P.T., Geddes, J.R. and Salanti, G. (2013) Conceptual and Technical Challenges in Network Meta-Analysis. *Annals of Internal Medicine*, **159**, 130-137. https://doi.org/10.7326/0003-4819-159-2-201307160-00008

[34] Higgins, J.P.T. (2003) Measuring Inconsistency in Meta-Analyses. *BMJ*, **327**, 557-560. https://doi.org/10.1136/bmj.327.7414.557

[35] Aguiar, L.T., Nadeau, S., Britto, R.R., Teixeira-Salmela, L.F., Martins, J.C., Samora, G.A.R., *et al.* (2020) Effects of Aerobic Training on Physical Activity in People with Stroke: A Randomized Controlled Trial. *NeuroRehabilitation*, **46**, 391-401. https://doi.org/10.3233/nre-193013

[36] Baer, G.D., Salisbury, L.G., Smith, M.T., Pitman, J. and Dennis, M. (2017) Treadmill Training to Improve Mobility for People with Sub-Acute Stroke: A Phase II Feasibility Randomized Controlled Trial. *Clinical Rehabilitation*, **32**, 201-212. https://doi.org/10.1177/0269215517720486

[37] Dean, C.M., Ada, L. and Lindley, R.I. (2014) Treadmill Training Provides Greater Benefit to the Subgroup of Community-Dwelling People after Stroke Who Walk Faster than 0.4m/s: A Randomised Trial. *Journal of Physiotherapy*, **60**, 97-101. https://doi.org/10.1016/j.jphys.2014.03.004

[38] Gambassi, B.B., Coelho-Junior, H.J., Paixão dos Santos, C., de Oliveira Gonçalves, I., Mostarda, C.T., Marzetti, E., *et al.* (2019) Dynamic Resistance Training Improves Cardiac Autonomic Modulation and Oxidative Stress Parameters in Chronic Stroke

Survivors: A Randomized Controlled Trial. *Oxidative Medicine and Cellular Longevity*, **2019**, Article ID: 5382843. https://doi.org/10.1155/2019/5382843

[39] Gjellesvik, T., Becker, F., Tjønna, A., *et al.* (2021) Effects of High-Intensity Interval Training after Stroke (The HIIT Stroke Study) on Physical and Cognitive Function: A Multicenter Randomized Controlled Trial. *Archives of Physical Medicine and Rehabilitation*, **102**, 1683-1691. https://www.sciencedirect.com/science/article/pii/S0003999321004366

[40] Hyun, S., Lee, J. and Lee, B. (2021) The Effects of Sit-To-Stand Training Combined with Real-Time Visual Feedback on Strength, Balance, Gait Ability, and Quality of Life in Patients with Stroke: A Randomized Controlled Trial. *International Journal of Environmental Research and Public Health*, **18**, Article 12229. https://doi.org/10.3390/ijerph182212229

[41] In, T., Jin, Y., Jung, K. and Cho, H. (2017) Treadmill Training with Thera-Band Improves Motor Function, Gait and Balance in Stroke Patients. *NeuroRehabilitation*, **40**, 109-114. https://doi.org/10.3233/nre-161395

[42] Ivey, F.M., Prior, S.J., Hafer-Macko, C.E., Katzel, L.I., Macko, R.F. and Ryan, A.S. (2017) Strength Training for Skeletal Muscle Endurance after Stroke. *Journal of Stroke and Cerebrovascular Diseases*, **26**, 787-794. https://doi.org/10.1016/j.jstrokecerebrovasdis.2016.10.018

[43] Lattouf, N.A., Tomb, R., Assi, A., Maynard, L. and Mesure, S. (2021) Eccentric Training Effects for Patients with Post-Stroke Hemiparesis on Strength and Speed Gait: A Randomized Controlled Trial. *NeuroRehabilitation*, **48**, 513-522. https://doi.org/10.3233/nre-201601

[44] Lee, I. (2014) Does the Speed of the Treadmill Influence the Training Effect in People Learning to Walk after Stroke? A Double-Blind Randomized Controlled Trial. *Clinical Rehabilitation*, **29**, 269-276. https://doi.org/10.1177/0269215514542637

[45] Srivastava, A., Taly, A.B., Gupta, A., Kumar, S. and Murali, T. (2016) Bodyweight-supported Treadmill Training for Retraining Gait among Chronic Stroke Survivors: A Randomized Controlled Study. *Annals of Physical and Rehabilitation Medicine*, **59**, 235-241. https://doi.org/10.1016/j.rehab.2016.01.014

[46] Thompson, E.D., Pohlig, R.T., McCartney, K.M., Hornby, T.G., Kasner, S.E., Raser-Schramm, J., *et al.* (2024) Increasing Activity after Stroke: A Randomized Controlled Trial of High-Intensity Walking and Step Activity Intervention. *Stroke*, **55**, 5-13. https://doi.org/10.1161/strokeaha.123.044596

[47] Vanroy, C., Feys, H., Swinnen, A., Vanlandewijck, Y., Truijen, S., Vissers, D., *et al.* (2017) Effectiveness of Active Cycling in Subacute Stroke Rehabilitation: A Randomized Controlled Trial. *Archives of Physical Medicine and Rehabilitation*, **98**, 1576-1585.e5. https://doi.org/10.1016/j.apmr.2017.02.004

[48] Eyvaz, N., Dundar, U. and Yesil, H. (2018) Effects of Water-Based and Land-Based Exercises on Walking and Balance Functions of Patients with Hemiplegia. *NeuroRehabilitation*, **43**, 237-246. https://doi.org/10.3233/nre-182422

[49] Gjellesvik, T.I., Becker, F., Tjønna, A.E., Indredavik, B., Lundgaard, E., Solbakken, H., *et al.* (2021) Effects of High-Intensity Interval Training after Stroke (the HIIT Stroke Study) on Physical and Cognitive Function: A Multicenter Randomized Controlled Trial. *Archives of Physical Medicine and Rehabilitation*, **102**, 1683-1691. https://doi.org/10.1016/j.apmr.2021.05.008

[50] Haruyama, K., Kawakami, M. and Otsuka, T. (2016) Effect of Core Stability Training on Trunk Function, Standing Balance, and Mobility in Stroke Patients: A Randomized Controlled Trial. *Neurorehabilitation and Neural Repair*, **31**, 240-249.

https://doi.org/10.1177/1545968316675431

[51] Kim, J. and Lee, H. (2017) The Effect of Action Observation Training on Balance and Sit to Walk in Chronic Stroke: A Crossover Randomized Controlled Trial. *Journal of Motor Behavior*, **50**, 373-380. https://doi.org/10.1080/00222895.2017.1363697

[52] Middleton, A., Merlo-Rains, A., Peters, D.M., Greene, J.V., Blanck, E.L., Moran, R., *et al.* (2014) Body Weight-Supported Treadmill Training Is No Better than Overground Training for Individuals with Chronic Stroke: A Randomized Controlled Trial. *Topics in Stroke Rehabilitation*, **21**, 462-476. https://doi.org/10.1310/tsr2106-462

[53] Yeh, T., Chang, K., Wu, C., Chen, C. and Chuang, I. (2021) Clinical Efficacy of Aerobic Exercise Combined with Computer-Based Cognitive Training in Stroke: A Multicenter Randomized Controlled Trial. *Topics in Stroke Rehabilitation*, **29**, 255-264. https://doi.org/10.1080/10749357.2021.1922045

[54] Bei, N., Long, D., Bei, Z., *et al.* (2024) Effect of Water Exercise Therapy on Lower Limb Function Rehabilitation in Hemiplegic Patients with the First Stroke. *Alternative Therapies in Health & Medicine*, **29**, 429-433. https://search.ebscohost.com/login.aspx?direct=true&profile=ehost&scope=site&authtype=crawler&jrnl=10786791&AN=173309357&h=PLS7YJPXWkSoVzA9vTuM-HsTI7qEloG7GlXBRB6EWx2bl4QZu%2BUlc%2BA8GHN2iDDQfbdGKI3FSAhlnozJwVyTA8Q%3D%3D&crl=c

[55] Brunelli, S., Iosa, M., Fusco, F.R., Pirri, C., Di Giunta, C., Foti, C., *et al.* (2019) Early Body Weight-Supported Overground Walking Training in Patients with Stroke in Subacute Phase Compared to Conventional Physiotherapy: A Randomized Controlled Pilot Study. *International Journal of Rehabilitation Research*, **42**, 309-315. https://doi.org/10.1097/mrr.0000000000000363

[56] Nave, A.H., Rackoll, T., Grittner, U., Bläsing, H., Gorsler, A., Nabavi, D.G., *et al.* (2019) Physical Fitness Training in Patients with Subacute Stroke (PHYS-STROKE): Multicentre, Randomised Controlled, Endpoint Blinded Trial. *BMJ*, **366**, L5101. https://doi.org/10.1136/bmj.l5101

[57] Park, H., Lee, H., Lee, S. and Lee, W. (2020) Land-based and Aquatic Trunk Exercise Program Improve Trunk Control, Balance and Activities of Daily Living Ability in Stroke: A Randomized Clinical Trial. *European Journal of Physical and Rehabilitation Medicine*, **55**, 687-694. https://doi.org/10.23736/s1973-9087.18.05369-8

[58] Taricco, M., Dallolio, L., Calugi, S., Rucci, P., Fugazzaro, S., Stuart, M., *et al.* (2014) Impact of Adapted Physical Activity and Therapeutic Patient Education on Functioning and Quality of Life in Patients with Postacute Strokes. *Neurorehabilitation and Neural Repair*, **28**, 719-728. https://doi.org/10.1177/1545968314523837

[59] Kerimov, K., Coskun Benlidayi, I., Ozdemir, C. and Gunasti, O. (2021) The Effects of Upper Extremity Isokinetic Strengthening in Post-Stroke Hemiplegia: A Randomized Controlled Trial. *Journal of Stroke and Cerebrovascular Diseases*, **30**, Article ID: 105729. https://doi.org/10.1016/j.jstrokecerebrovasdis.2021.105729

[60] Kim, C., Lee, J., Kim, H. and Kim, J. (2015) The Effect of Progressive Task-Oriented Training on a Supplementary Tilt Table on Lower Extremity Muscle Strength and Gait Recovery in Patients with Hemiplegic Stroke. *Gait & Posture*, **41**, 425-430. https://doi.org/10.1016/j.gaitpost.2014.11.004

[61] Liu, P., Wang, Y., Hu, H., Mao, Y., Huang, D. and Li, L. (2014) Change of Muscle Architecture Following Body Weight Support Treadmill Training for Persons after Subacute Stroke: Evidence from Ultrasonography. *BioMed Research International*, **2014**, Article ID: 270676. https://doi.org/10.1155/2014/270676

[62] Cabanas-Valdés, R., Bagur-Calafat, C., Girabent-Farrés, M., Caballero-Gómez, F.M., du Port de Pontcharra-Serra, H., German-Romero, A., *et al.* (2017) Long-Term Follow-Up of a Randomized Controlled Trial on Additional Core Stability Exercises Training for Improving Dynamic Sitting Balance and Trunk Control in Stroke Patients. *Clinical Rehabilitation*, **31**, 1492-1499. https://doi.org/10.1177/0269215517701804

[63] Chen, I., Yang, Y., Chan, R. and Wang, R. (2013) Turning-based Treadmill Training Improves Turning Performance and Gait Symmetry after Stroke. *Neurorehabilitation and Neural Repair*, **28**, 45-55. https://doi.org/10.1177/1545968313497102

[64] Graham, S.A., Roth, E.J. and Brown, D.A. (2018) Walking and Balance Outcomes for Stroke Survivors: A Randomized Clinical Trial Comparing Body-Weight-Supported Treadmill Training with versus without Challenging Mobility Skills. *Journal of NeuroEngineering and Rehabilitation*, **15**, Article No. 92. https://doi.org/10.1186/s12984-018-0442-3

[65] Lee, S.Y., Im, S.H., Kim, B.R. and Han, E.Y. (2018) The Effects of a Motorized Aquatic Treadmill Exercise Program on Muscle Strength, Cardiorespiratory Fitness, and Clinical Function in Subacute Stroke Patients: A Randomized Controlled Pilot Trial. *American Journal of Physical Medicine & Rehabilitation*, **97**, 533-540. https://doi.org/10.1097/phm.0000000000000920

[66] Gama, G.L., Celestino, M.L., Barela, J.A., Forrester, L., Whitall, J. and Barela, A.M. (2017) Effects of Gait Training with Body Weight Support on a Treadmill versus Overground in Individuals with Stroke. *Archives of Physical Medicine and Rehabilitation*, **98**, 738-745. https://doi.org/10.1016/j.apmr.2016.11.022

[67] Hornby, T.G., Holleran, C.L., Hennessy, P.W., Leddy, A.L., Connolly, M., Camardo, J., *et al.* (2015) Variable Intensive Early Walking Poststroke (Views). *Neurorehabilitation and Neural Repair*, **30**, 440-450. https://doi.org/10.1177/1545968315604396

[68] Hornby, T.G., Holleran, C.L., Leddy, A.L., Hennessy, P., Leech, K.A., Connolly, M., *et al.* (2015) Feasibility of Focused Stepping Practice during Inpatient Rehabilitation Poststroke and Potential Contributions to Mobility Outcomes. *Neurorehabilitation and Neural Repair*, **29**, 923-932. https://doi.org/10.1177/1545968315572390

[69] Holleran, C., Rodriguez, K., *et al.* (2015) Potential Contributions of Training Intensity on Locomotor Performance in Individuals with Chronic Stroke. *Journal of Neurologic Physical Therapy*, **39**, 95-102. https://journals.lww.com/jnpt/fulltext/2015/04000/Potential_Contributions_of_Training_Intensity_on.4.aspx?context=FeaturedArticles&collectionId=2

[70] Kim, K.H., Lee, K.B., Bae, Y.H., Fong, S.S.M. and Lee, S.M. (2024) Effects of Progressive Backward Body Weight Supported Treadmill Training on Gait Ability in Chronic Stroke Patients: A Randomized Controlled Trial. *Technology and Health Care*, **25**, 867-876. https://content.iospress.com/articles/technology-and-health-care/thc160720

[71] Linder, S.M., Bischof-Bockbrader, A., Davidson, S., Li, Y., Lapin, B., Singh, T., *et al.* (2024) The Utilization of Forced-Rate Cycling to Facilitate Motor Recovery Following Stroke: A Randomized Clinical Trial. *Neurorehabilitation and Neural Repair*, **38**, 291-302. https://doi.org/10.1177/15459683241233577

[72] Tang, A., Eng, J.J., Krassioukov, A.V., Madden, K.M., Mohammadi, A., Tsang, M.Y.C., *et al.* (2013) Exercise-induced Changes in Cardiovascular Function after Stroke: A Randomized Controlled Trial. *International Journal of Stroke*, **9**, 883-889. https://doi.org/10.1111/ijs.12156

[73] McArdle, W., Katch, F. and Katch, V. (2010) Exercise Physiology: Nutrition, Energy,

and Human Performance. LWW.

[74] Westcott, W.L. (2012) Resistance Training Is Medicine: Effects of Strength Training on Health. *Current Sports Medicine Reports*, **11**, 209-216. https://doi.org/10.1249/jsr.0b013e31825dabb8

[75] Chang, K., Lin, C., Yen, C., Yang, C., Tanaka, T. and Guo, L. (2021) The Effect of Walking Backward on a Treadmill on Balance, Speed of Walking and Cardiopulmonary Fitness for Patients with Chronic Stroke: A Pilot Study. *International Journal of Environmental Research and Public Health*, **18**, Article 2376. https://doi.org/10.3390/ijerph18052376

[76] Chan, P.P., Si Tou, J.I., Tse, M.M. and Ng, S.S. (2017) Reliability and Validity of the Timed up and Go Test with a Motor Task in People with Chronic Stroke. *Archives of Physical Medicine and Rehabilitation*, **98**, 2213-2220. https://doi.org/10.1016/j.apmr.2017.03.008

[77] Carvalho, L., Junior, R.M., Barreira, J., Schoenfeld, B.J., Orazem, J. and Barroso, R. (2022) Muscle Hypertrophy and Strength Gains after Resistance Training with Different Volume-Matched Loads: A Systematic Review and Meta-Analysis. *Applied Physiology, Nutrition, and Metabolism*, **47**, 357-368. https://doi.org/10.1139/apnm-2021-0515

[78] Kordi, H., Sohrabi, M., Kakhki, A.S. and Hossini, S.R.A. (2016) The Effect of Strength Training Based on Process Approach Intervention on Balance of Children with Developmental Coordination Disorder. *Archivos Argentinos de Pediatria*, **114**, 526-533.

[79] Del Vecchio, A., Casolo, A., Negro, F., Scorcelletti, M., Bazzucchi, I., Enoka, R., *et al.* (2019) The Increase in Muscle Force after 4 Weeks of Strength Training Is Mediated by Adaptations in Motor Unit Recruitment and Rate Coding. *The Journal of Physiology*, **597**, 1873-1887. https://doi.org/10.1113/jp277250

[80] Schroeder, E.C., Franke, W.D., Sharp, R.L. and Lee, D. (2019) Comparative Effectiveness of Aerobic, Resistance, and Combined Training on Cardiovascular Disease Risk Factors: A Randomized Controlled Trial. *PLOS ONE*, **14**, e0210292. https://doi.org/10.1371/journal.pone.0210292

[81] Paci, M., Nannetti, L., Casavola, D. and Lombardi, B. (2016) Differences in Motor Recovery between Upper and Lower Limbs: Does Stroke Subtype Make the Difference? *International Journal of Rehabilitation Research*, **39**, 185-187. https://doi.org/10.1097/mrr.0000000000000172

[82] Scheitz, J.F., Sposato, L.A., Schulz - Menger, J., Nolte, C.H., Backs, J. and Endres, M. (2022) Stroke-Heart Syndrome: Recent Advances and Challenges. *Journal of the American Heart Association*, **11**, e026528. https://doi.org/10.1161/jaha.122.026528

[83] Beyaert, C., Vasa, R. and Frykberg, G.E. (2015) Gait Post-Stroke: Pathophysiology and Rehabilitation Strategies. *Neurophysiologie Clinique/Clinical Neurophysiology*, **45**, 335-355. https://doi.org/10.1016/j.neucli.2015.09.005

[84] Bernard, N., Eglington, D., Hughes, B., Linville, J. and Pendergrass, J. (2008) Essentials of Strength Training and Conditioning. https://books.google.com/books?hl=pt-BR&lr=&id=rk3SX8G5Qp0C&oi=fnd&pg=PR9&dq=Baechle+T,+Earle+R,+National+Strength+%26+Conditioning+Association.+Essentials+of+Strength+Training+and+Conditioning.%3B+2008.&ots=o9eFuaE-jQT&sig=3U94IPX_Z8WnWZG1rrsZCeJV_eg

[85] Shumway-Cook, A., Woollacott, M.H., Profesör, E., *et al.* (2007) Motor Control: Translating Research into Clinical Practice. https://books.google.com/books?hl=pt-BR&lr=&id=BJcL3enz3xMC&oi=fnd&pg=PA1&dq=Shumway-

Cook+A,+Woollacott+M.+Motor+Control:+Translating+Research+Into+Clinical+Practice.%3B+2007&ots=lGqkouESsY&sig=hDOWgonrmh2xF6oD-sAecJvSSHEY

[86] Lephart, S.M., Pincivero, D.M., Giraido, J.L. and Fu, F.H. (1997) The Role of Proprioception in the Management and Rehabilitation of Athletic Injuries. *The American Journal of Sports Medicine*, **25**, 130-137. https://doi.org/10.1177/036354659702500126

[87] Hamed, A., Bohm, S., Mersmann, F. and Arampatzis, A. (2018) Exercises of Dynamic Stability under Unstable Conditions Increase Muscle Strength and Balance Ability in the Elderly. *Scandinavian Journal of Medicine & Science in Sports*, **28**, 961-971. https://doi.org/10.1111/sms.13019

[88] Hewett, T.E., Paterno, M.V. and Myer, G.D. (2002) Strategies for Enhancing Proprioception and Neuromuscular Control of the Knee. *Clinical Orthopaedics and Related Research*, **402**, 76-94. https://doi.org/10.1097/00003086-200209000-00008

[89] Solomon, T.P.J., Thyfault, J.P., Haus, J.M. and Karstoft, K. (2021) Editorial: Understanding the Heterogeneity in Exercise-Induced Changes in Glucose Metabolism to Help Optimize Treatment Outcomes. *Frontiers in Endocrinology*, **12**, Article 699354. https://doi.org/10.3389/fendo.2021.699354

[90] Sloan, R.P., Shapiro, P.A., DeMeersman, R.E., Bagiella, E., Brondolo, E.N., McKinley, P.S., *et al.* (2011) Impact of Aerobic Training on Cardiovascular Reactivity to and Recovery from Challenge. *Psychosomatic Medicine*, **73**, 134-141. https://doi.org/10.1097/psy.0b013e31820a1174

[91] Myers, T.R., Schneider, M.G., Schmale, M.S. and Hazell, T.J. (2015) Whole-body Aerobic Resistance Training Circuit Improves Aerobic Fitness and Muscle Strength in Sedentary Young Females. *Journal of Strength and Conditioning Research*, **29**, 1592-1600. https://doi.org/10.1519/jsc.0000000000000790

[92] Pollock, A., Baer, G., Campbell, P., *et al.* (2014) Physical Rehabilitation Approaches for the Recovery of Function and Mobility Following Stroke. *Cochrane Database of Systematic Reviews*, No. 4, CD001920.

[93] Patel, H., Alkhawam, H., Madanieh, R., Shah, N., Kosmas, C.E. and Vittorio, T.J. (2017) Aerobic*vs*anaerobic Exercise Training Effects on the Cardiovascular System. *World Journal of Cardiology*, **9**, 134-138. https://doi.org/10.4330/wjc.v9.i2.134

[94] Santos, S.M., Rubens, A., Silva, d., Terra, M.B., Almeida, I.A., Lúcio, B., *et al.* (2017) Balance versus Resistance Training on Postural Control in Patients with Parkinson's Disease: A Randomized Controlled Trial. *European Journal of Physical and Rehabilitation Medicine*, **53**, 173-183. https://doi.org/10.23736/s1973-9087.16.04313-6

[95] Gomes-Neto, M., Durães, A.R., Conceição, L.S.R., Roever, L., Liu, T., Tse, G., *et al.* (2019) Effect of Aerobic Exercise on Peak Oxygen Consumption, VE/VCO_2 Slope, and Health-Related Quality of Life in Patients with Heart Failure with Preserved Left Ventricular Ejection Fraction: A Systematic Review and Meta-Analysis. *Current Atherosclerosis Reports*, **21**, Article No. 45. https://doi.org/10.1007/s11883-019-0806-6

Appendix

Appendix A: Risk of Bias

Article	Selection Bias	Performance Bias	Detection Bias	Attrition Bias	Reporting Bias	Other Bias
Dean *et al.*, 2014	Low risk	High risk	Low risk	Low risk	Low risk	None
Liu *et al.*, 2014	Low risk	High risk	High risk	Low risk	Low risk	None
Middleton *et al.*, 2014	Low risk	Low risk	Low risk	Low risk	Low risk	None
Taricco *et al.*, 2014	Low risk	Low risk	Low risk	Low risk	Low risk	None
Lee *et al.*, 2014	Low risk	Low risk	Low risk	Low risk	Low risk	None
Chen *et al.*, 2014	Low risk	Low risk	Low risk	Low risk	Low risk	None
Tang *et al.*, 2014	Low risk	Low risk	Low risk	Low risk	Low risk	None
Holleran *et al.*, 2015	Low risk	Low risk	Low risk	Low risk	Low risk	None
Hornby *et al.*, 2015	Low risk	Low risk	Low risk	Low risk	Low risk	None
In *et al.*, 2016	Low risk	Low risk	Low risk	Low risk	Low risk	None
Srivastava *et al.*, 2016	Low risk	Low risk	Low risk	Low risk	Low risk	None
Ivey *et al.*, 2016	Low risk	Low risk	Low risk	High risk	Low risk	None
Gama *et al.*, 2016	Low risk	Low risk	Low risk	Low risk	Low risk	None
Haruyama *et al.*, 2017	Low risk	Low risk	Low risk	Low risk	Low risk	None
Vanroy *et al.*, 2017a	Low risk	Low risk	Low risk	Low risk	Low risk	None
Baer *et al.*, 2017	Low risk	Low risk	Low risk	Low risk	Low risk	None
Cabanas-Valdes *et al.*, 2017	Low risk	Low risk	Low risk	Low risk	Low risk	None
Graham *et al.*, 2018	Low risk	Low risk	Low risk	Low risk	Low risk	None
Eyvaz *et al.*, 2018	Low risk	Low risk	Low risk	Low risk	Low risk	None
Lee *et al.*, 2018	Low risk	Low risk	Low risk	Low risk	Low risk	None
Kim *et al.*, 2018	Low risk	Low risk	Low risk	Low risk	Low risk	None
Rose *et al.*, 2018	Low risk	Low risk	Low risk	Low risk	Low risk	None
Gambassi *et al.*, 2019	Low risk	Low risk	Low risk	Low risk	Low risk	None
Hornby *et al.*, 2019	Low risk	Low risk	Low risk	Low risk	Low risk	None
Nave *et al.*, 2019	Low risk	Low risk	Low risk	Low risk	Low risk	None
Aguiar *et al.*, 2020	Low risk	Low risk	Low risk	Low risk	Low risk	None
Park *et al.*, 2020	Low risk	Low risk	Low risk	Low risk	Low risk	None
Gjellesvik *et al.*, 2021	Low risk	Low risk	Low risk	Low risk	Low risk	None
Hyun *et al.*, 2021	Low risk	Low risk	Low risk	Low risk	Low risk	None
Lattouf *et al.*, 2021	Low risk	Low risk	Low risk	Low risk	Low risk	None
Yeh *et al.*, 2021	Low risk	Low risk	Low risk	Low risk	Low risk	None
Linder *et al.*, 2024b	Low risk	Low risk	Low risk	Low risk	Low risk	None
Thompson *et al.*, 2024	Low risk	Low risk	Low risk	Low risk	Low risk	None
Linder *et al.*, 2024	Low risk	Low risk	Low risk	Low risk	Low risk	None

Appendix B: Complete Search Strategy

The complete search strategy, including all search terms and combinations used, is detailed below.

We conducted a comprehensive literature search across four databases: PubMed, Scopus, Web of Science, and PEDro. The search was restricted to articles published from January 2014 to May 2024. For each database, the search terms and combinations were developed in consultation with a medical librarian, employing a combination of MeSH terms and free-text words related to "stroke," "aerobic training," and "anaerobic training." Boolean operators were utilized to refine the search strategy.

In PubMed, we used the following search terms: ("aerobic exercise" [MeSH Terms] OR "aerobic training" [All Fields]) AND ("anaerobic exercise" [MeSH Terms] OR "anaerobic training" [All Fields]) AND "stroke" [MeSH Terms].

In Scopus, the search was conducted using: TITLE-ABS-KEY ("aerobic training" OR "aerobic exercise") AND ("anaerobic training" OR "anaerobic exercise") AND ("stroke" OR "cerebrovascular accident").

In Web of Science, the search terms were: TS = ("aerobic training" OR "aerobic exercise") AND TS = ("anaerobic training" OR "anaerobic exercise") AND TS = ("stroke" OR "cerebrovascular accident").

In PEDro, we searched using: Abstract/Title: "aerobic training" OR "aerobic exercise" AND "anaerobic training" OR "anaerobic exercise" AND "stroke"

The inclusion criteria for the studies were as follows:

- Randomized controlled trials (RCTs) and quasi-experimental studies.
- Studies comparing the effects of aerobic training (TAE) or anaerobic training (TAN) on post-stroke recovery outcomes.
- Articles written in English.
- Human studies.
- Studies that included pre- and post-intervention evaluations.
- Studies with at least two experimental groups.
- Studies with at least five randomized patients.

The study selection process involved an initial screening of titles and abstracts to determine eligibility, followed by a full-text review of potential studies. We also examined the reference lists of relevant reviews and meta-analyses. Any disagreements were resolved by consensus, with a third party available if needed.

Data extraction included details on participant characteristics (number, age, sex, time since stroke, stroke etiology, stroke location), study design and methodological quality (parallel groups/crossed, PEDro scale), intervention details (number and duration of sessions, type and intensity of intervention), and outcomes (evaluations used, differences detected between groups).

The risk of bias in each study was evaluated using the Cochrane Risk of Bias Tool. Our findings indicated a low risk of selection bias in 100% of the studies. Performance bias was high in 6% of the studies, and detection bias was high in 6% of the studies. Attrition bias was low in 97% of the studies, with only 3% showing

a high risk.

Meta-analysis and statistical analysis were conducted with effect sizes for outcomes within each study calculated using standardized mean differences (SMDs) for continuous outcomes and risk ratios (RRs) for dichotomous outcomes, with 95% confidence intervals (CIs). A random-effects model was applied to account for expected heterogeneity. Heterogeneity among studies was assessed and addressed using the I^2 statistic, with values over 50% considered indicative of high heterogeneity. Sensitivity analyses were conducted by excluding studies with a high risk of bias. Funnel plots and Egger's regression test were used to assess reporting biases.

The statistical analysis was conducted using the Revman 5 software.

The certainty of evidence for each outcome was evaluated using the GRADE approach, with outcomes assessed and assigned a GRADE rating from "very low" to "high".

This systematic review was conducted in accordance with the PRISMA 2020 guidelines and the PRISMA-S extension for reporting literature searches in systematic reviews. The review protocol was registered in the International Prospective Register of Systematic Reviews (PROSPERO) under the registration number CRD42024528759.

Abbreviations

Aerobic Training—TAE, Anaerobic Training—TAN, 10-Meter Walk Test—10MWT, Timed Up and Go—TUG, Barthel Activities of Daily Living Index—BarthelADL, Berg Balance Scale BBS, 6-Minute Walk Test—6MWT, Maximal Isometric Strength—MaxIS.