

PICO question: For people ≤ 1-year s/p CVA, is therapeutic exercise more effective than no exercise regimen at all in reducing impairments and functional limitations associated with stroke?

Author, Year, Journal, Title	Study Purpose	Design/ Subjects	Intervention	Outcomes/Results	Conclusions	Clinical Relevance
Eng et al., 2003, <i>Med Sci Sports Exerc.</i> A community-based group exercise program for persons with chronic stroke	To evaluate the physical and psychosocial effects of an 8-week community-based functional exercise program in a group of individuals with chronic stroke, including health-related QOL, balance, walking ability, and functional capacity.	Single-group, repeated measures design. N = 25; subjects were recruited from the community through advertisements and community centers.	Duration: 1 hour/day, 3 days/week for 8 weeks. Components: light aerobic warm-up, stretching, functional lower-extremity strengthening with/without light weights, balance and weight-shifting exercises, aerobic stepping with steppers, a walking circuit, and a cool-down with stretching.	Outcome Measures: BBS, 12MWT, self-paced and fast-paced gait speed, self-paced and fast stair climbing speed, 11-item Reintegration to Normal Living Index (RNL Index), Canadian Occupational Performance Measure (COPM). Results: Significant test time effect for the BBS, 12MWT distance, self-paced and fast gait speed, self-pace and fast stair climbing speed (intervention effect and retention effect). Significant intervention effect for the COPM (performance and satisfaction score).	A short-term community-based exercise intervention can improve mobility, functional capacity, and balance and retain these improvements. The results of this study would be more generalizable if the authors provided a more detailed description of the intervention. There is little information on the frequency, duration, and intensity of exercises.	This study highlights that importance of implementing safe and effective community-based group exercise interventions for chronic stroke survivors and the role that PTs can play in organizing and leading such programs.
Langhammer & Stanghelle, 2010, <i>Clin Rehabil.</i> Exercise on a treadmill or walking outdoors? A randomized controlled trial comparing effectiveness of two walking exercise programmes late after stroke.	To evaluate the efficiency of treadmill training compared to walking outdoors and to evaluate spatial and temporal gait characteristics (bilateral stride length, step width, cadence, and walking speed).	Single-blind RCT with pretest-posttest control group design. N = 31; subjects were recruited from a private rehabilitation center	<u>Treadmill walking group</u> : walking exercises 30 min/day, 5 days/week during their stay at the rehab center (~2.5 weeks). <u>Outdoors walking group</u> : outdoors walk up to 30 min/day, 5 days/week during their stay at the rehab center (~2.5 weeks). <u>Both groups</u> : all participants received 30 min of individual therapy, 60 min of circle training, and 30 minutes of group exercise training each day. A 20 min relaxation group was offered 2x/wk. Each participant was encouraged to complete 30 min of exercise on their own each afternoon. The total amt of PT per day was 3 hours, with an additional 20 mins of relaxation and 30 min of education, giving a total of ~21 hrs of therapy per week.	Outcome Measures: 10-m walk test (step/stride length, step width, cadence, and gait speed) and 6MWT (distance walked and gait velocity). Results: The mean time per session for the treadmill group was 12 mins, with a total exercising time of 107 mins. The mean time per session for the outdoors walking group was 29 mins, with a total exercising time of 316 mins. The treadmill group made significant improvements in 6MWT distance and speed, 10-m walking speed, bilateral stride length and step width. No significant differences between groups in cadence. No significant difference in pulse rate at rest or during activity between groups.	Treadmill walking could serve as an effective and important tool in rehabilitation and it could be beneficial for use in regions of the world where the climate hinders outdoor activity. Results stress the importance of “booster doses” of rehabilitation in chronic stroke patients in order to maintain physical function levels.	(1) Treadmill walking improves spatial and temporal gait characteristics in stroke patients more effectively than walking outdoors. (2) Treadmill walking results in a more symmetrical gait in stroke patients than outdoor walking in a significantly shorter time. (3) Increase in the pulse rate during exercise indicates an endurance impact in stroke patients both by treadmill walking and by walking outdoors.
Marigold et al., 2005, <i>J Am Geriatr Soc.</i> Exercise leads to faster postural reflexes, improved balance and mobility, and fewer falls in older persons with chronic stroke.	To determine the effect of two different community-based group exercise programs (agility vs stretching/weight-shifting program) on functional balance, mobility, postural reflexes, and falls in older adults with chronic stroke.	RCT N = 31 in stretching/weight-shifting group; 30 in agility program. Subjects were recruited from hospital databases, stroke groups, and advertisements.	Duration for each group: 1 hour/day, 3 times/week for 10 weeks. Components: each group began with a warm-up and ended with a cool-down of light stretching. <u>Stretching/weight-shifting group</u> : focus on slow, low-impact movements consisting of stretching and weight-shifting. <u>Agility group</u> : challenged dynamic balance, where the tasks progressively increased in difficulty based on set criteria and the individual's ability.	Outcome Measures: BBS, TUG, ABC, Nottingham Health Profile, standing postural reflexes, step reaction time, induced falls, and falls in the community. Results: Significant decrease in step reaction time and trend for improved TUG in the agility group. All clinical measures were improved in both groups with no significant difference. The paretic rectus femoris onset latency was significantly faster after the agility program. The number of falls on the platform decreased for the agility group and increased for the stretching/weight-shifting group. Of those with a history of falls, fewer participants continued to fall in the agility group.	Exercise training improved functional balance and mobility, led to faster standing paretic limb postural reflexes and step reaction time, and resulted in greater balance confidence and health-related QOL in older adults with chronic stroke.	Exercise programs for chronic stroke survivors should include dynamic balance training with an emphasis on multisensory and agility tasks and task-specific techniques.

Year, Journal, Title	Subjects					
<p>Noh et al., 2008, <i>Clin Rehabil.</i></p> <p>The effect of aquatic therapy on postural balance and muscle strength in stroke survivors—a randomized controlled pilot trial.</p>	<p>To evaluate the effect of an aquatic therapy program based on the Halliwick and Ai Chi methods, designed to increase balance in stroke survivors.</p>	<p>RCT</p> <p>N = 44; subjects were recruited from a hospital-based outpatient clinic in Korea.</p>	<p>Duration: both groups completed therapy 1 hour/day, 3 days/week for 8 weeks.</p> <p>Components: <u>Aquatic therapy group:</u> 10-min warm up in the water, followed by 20 min of Halliwick method, 20 min of round and balancing according to the Ai Chi method, and a 10-min cool down. <u>Conventional therapy group:</u> 10-min warm up, followed by LE strengthening, UE strengthening, and 10 mins of gait training.</p>	<p>Outcome Measures: BBS, weight-bearing ability (rising from a chair, weight-shift laterally/forward/backward), Modified Motor Assessment Scale (gait ability), isokinetic flexor and extensor muscle strengths of affected and unaffected knee and lumbar joints.</p> <p>Results: The aquatic therapy group showed significant improvements in mean BBS, WB ability when rising from chair, forward/backward shifting to the affected side. No significant change between groups in lateral weight-shift to the affected side or in trunk muscle strength. Gait ability and knee extensor torque was improved in both groups with no significant difference.</p>	<p>An aquatic therapy program based on the Halliwick and Ai Chi methods may be effective for promoting the balance function and strength of the hemiparetic leg in stroke survivors. Aquatic therapy combined with land-based balance activities may be effective in enhancing balance and reducing falls. Further studies with larger sample sizes are needed.</p>	<p>Non-conventional therapies, such as aquatic therapy should be considered for chronic stroke survivors. If more intensive therapeutic and specific balance-challenging exercises were stressed in aquatic therapy programs, they may prove to be helpful for maintaining or enhancing balance function in stroke patients.</p>
<p>Tang et al., 2009, <i>Neurorehabil Neural Repair.</i></p> <p>Effects of an aerobic exercise program on aerobic capacity, spatiotemporal gait parameters, and functional capacity in subacute stroke.</p>	<p>To evaluate the feasibility of adding aerobic cycle ergometer training to conventional rehabilitation early after stroke and to determine effects on aerobic capacity, walking ability, and health-related QOL.</p>	<p>Prospective matched control design.</p> <p>N = 23 subjects in the exercise group; 22 in the control group. Subjects were recruited from the Toronto Rehabilitation Institute.</p>	<p>All participants received 1 to 1.5 hours of PT, 1 hour of OT, and/or 30 mins of speech and language therapy, 5 days/week for 4-5 weeks. PT did not include an aerobic training program.</p> <p><u>Control group:</u> received conventional therapy only.</p> <p><u>Exercise group:</u> individualized aerobic training program on a semi-recumbent cycle ergometer 3 days/week for up to 30 mins/session. Initial intensity and program progression are described.</p>	<p>Outcome Measures: <i>Primary:</i> Distance covered during 6MWT, Stoke Impact Scale score. <i>Secondary:</i> peak aerobic capacity, gait speed, and between-limb temporal symmetry ratio.</p> <p>Results: Preferred walking speed, fast-paced walking speed, peak VO₂, work rate (WR), and SIS score improved in both groups, with no significant differences. The exercise group demonstrated a trend toward greater improvement in gait symmetry and 6MWT distance. None of the above results were statistically significant.</p>	<p>Aerobic fitness is modifiable early after stroke and early exercise may be effective in reducing the impact of compromised fitness after stroke. Short-term aerobic ergometry training may improve lower limb dyscoordination during walking in individuals with already compromised motor control, which may reduce energy costs during gait.</p>	<p>A longer training period beyond impatient rehabilitation could contribute to greater aerobic benefits in stroke survivors. The subacute phase poststroke provides an important window to minimize cardiorespiratory deconditioning and to improve neuromotor recovery and early behavioral change.</p>
<p>Duncan et al., 2003, <i>Stroke.</i></p> <p>Randomized clinical trial of therapeutic exercise in subacute stroke.</p>	<p>To determine whether a structured, progressive, physiologically based exercise program for subacute stroke produces gains in strength, balance, endurance, and upper-extremity function greater than those attributable to spontaneous recovery and usual care.</p>	<p>Single-blind RCT</p> <p>N = 50 in the intervention group; 50 in the usual care group. Subjects were selected from the Kansas City Stroke Registry, which had 17 participating medical facilities.</p>	<p><u>Exercise group:</u> subjects received an intervention targeting strength, balance, endurance, and UE function. The intervention was supervised by a PT or OT at home and included 36 sessions of 90-minutes over 12-14 weeks. Subjects did not receive any other therapy, unless they required speech therapy. There were structured protocols for the exercise tasks, criteria for progression, and guidelines for reintroducing therapy after intercurrent illness.</p> <p><u>Usual care group:</u> subjects did not receive an intervention.</p>	<p>Outcome Measures: Orpington Prognostic Scale, Fugl-Meyer Motor Score, Wolf Motor Function Test, grip strength, isometric strength testing for ankle DF and knee extension, 10-m walk, 6-Minute Walk Test, Berg Balance Scale, Functional reach.</p> <p>Results: The overall effect of the intervention compared with usual care on the combined outcomes was highly significant. Both the intervention and usual care groups demonstrated improvements from baseline to 3 months in strength, balance, upper- and lower-extremity motor control, UE function, and gait velocity. The usual care group did not show gains in endurance. The intervention group achieved greater gains in measures of endurance, balance, 6-minute walk distance, and gait velocity.</p>	<p>Physiologically based, intensive exercise is effective in improving multiple-domains during the subacute phase of stroke recovery, where increased structure, intensity, and progression may be key elements in effective therapy. There were significant gains in fitness as a result of the intervention, which may help reduce the risk of future decline in this population.</p>	<p>Hospital stays are becoming increasingly shorter in duration and recovery is often not complete when patients leave. Therapeutic exercise programs have been shown to improve motor and functional recovery in chronic stroke patients, which confirms the importance of implementing structured, intensive rehabilitation programs after hospital discharge.</p>

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Langhammer et al., 2009, <i>Physiother Theory Pract</i> . An evaluation of two different exercise regimes during the first year following stroke: A randomised controlled trial.	To evaluate the effects of two different exercise approaches during the first 12 months post stroke on IADLs, motor function, gait performance, balance, grip strength, and muscle tone.	Double-blind, intention to treat, longitudinal RCT. N = 35 in the intensive exercise group; 40 in the self-initiated exercise group.	<u>Intensive exercise group</u> : subjects completed 80 hours of supervised PT over the first year poststroke. Subjects attending a private PT clinic completed 2-3 sessions per week, while those attending inpatient rehab completed daily exercise sessions. The exercise protocol is provided in the article. <u>Self-initiated exercise group</u> : subjects were encouraged to keep exercise levels high, but no specific treatment was recommended to this group. It was left to the subject to decide whether they should exercise or not.	Outcome Measures: Duke Older Americans Resources and Service Procedures (OARS) Multidimensional Functional Assessment of Older Adults, Motor Assessment Scale (MAS), 6MWT, BBS, TUG, grip strength, Modified Ashworth Scale. Results: Impairments and functional activities as measured by MAS, 6MWT, BBS, TUG, and grip strength improved significantly in both groups from admission to 12 months after stroke. At the 12-month follow-up, the self-initiated exercise group walked significantly longer and faster than the intensive exercise group. There were no significant differences between the groups at any time for the TUG. The pulse rate did not differ significantly between the groups. There were no differences in muscle tone between the two groups.	Results point to a steady improvement in IADLs, motor function, gait parameters, balance, and grip strength up to 6 months post stroke, regardless of group assignment. Authors were surprised by these results and attribute them to both groups being very active and showing high compliance with exercises. Results indicate that if accessible exercise opportunities are available, self-initiated exercises in the first year post stroke are as equally effective as compulsory exercises.	Chronic stroke survivors would experience functional gains if rehabilitation were extended beyond the acute period. The results suggest that exercise doesn't have to be organized to be effective, which leaves room for therapists to be creative in the ways they approach exercise with this population.
Bayouk et al., 2006, <i>Int J Rehabil Res</i> . Balance training following stroke: Effects of task-oriented exercises with and without altered sensory input.	The main objective was to compare the effects of a task-oriented exercise program with and without altered sensory input on postural stability in two groups of hemiparetic subjects secondary to stroke. A second objective was to establish the feasibility of multisensory training in older adults with stroke.	Prospective matched control design. N = 8 in the experimental group; 8 in the control group. Subjects were recruited from PT clinics, hospital centers, and local stroke community groups.	Subjects from both groups participated in a 1 hour exercise class, 2x/week for 8 weeks. Each group performed a series of task-oriented exercises that are detailed in the article. <u>Control group</u> : performed all exercises under normal conditions (i.e. eyes open, hard surface). <u>Experimental group</u> : performed half of the exercises under normal conditions and half while the proprioception of their feet and ankles and/or vision was manipulated. Both groups completed each session with a 10-min cool down focusing on flexibility and ROM exercises.	Outcome Measures: Displacement of the center of pressure (COP) during double-legged stance and sit-to-stand from a chair, performed under four sensory conditions (eyes open, firm surface; eyes open, soft surface; eyes closed, firm surface; eyes closed, soft surface); 10-m walk test. Results: During the double-legged stance task, the experimental group significantly reduced their COP variability in M/L and A/P axes for the eyes open, firm surface and the eyes open, soft surface conditions. During the sit-to-stand task, both groups significantly reduced their COP total excursion in A/P axis for the eyes open, soft surface condition. No significant effects were found under the other sensory conditions for this task. Both groups significantly decreased the time needed to complete the 10-m walk test after the exercise program.	A task-oriented exercise program assisted by sensory manipulation is feasible and more effective for improving standing balance of hemiparetic subjects secondary to stroke than a conventional task-oriented program. Results suggest that pertinent sensory inputs for postural stability can occur and be improved with proper sensory training after a CVA.	Many stroke survivors present with balance impairments, and while it may be easy to shy away from implementing challenging components (i.e. those that challenge proprioception, vision, and the vestibular system) into a rehab program, it is necessary in order to help our patients make as many functional gains as possible.