

Background/Overview	
Article Citation	Billinger, S., Mattlage, A., Ashenden, A., Lentz, A., & Harter, G. Aerobic exercise in subacute stroke improves cardiovascular health and physical performance. <i>Journal of Neurologic Physical Therapy</i> , 2012, 36, 159-165.
Study Objective/Purpose (hypothesis)	<p>Purpose: Determine whether an 8-week moderate- to high-intensity aerobic exercise intervention using a seated exercise modality would improve cardiovascular health and physical performance in participants with subacute stroke (&lt;6months).</p> <p>Hypothesis: improved brachial artery FMD bilaterally, improved cardiovascular measures, improved VO2max and improved functional testing post-testing and at 1 month follow-up</p>
Brief Background (why issue is important; summary of previous literature)	Evidence is clear that stroke survivors suffer many impairments post-stroke including unilateral limb adaptations on the affected side as well as impaired cardiovascular fitness. These impairments may play a significant role in blood pressure regulation as well as cardiac function in the early stages of stroke recovery. Aerobic exercise interventions have shown to be beneficial in the chronic stages of stroke recovery though have not been examined in acute or subacute stages of recovery. Therefore, it is important to examine the feasibility of exercising at a moderate to high intensity with this stroke population. At the same time, the authors wanted to examine the changes in blood flow that occur post stroke to determine if there could be a change with an early exercise intervention.
Methods	
Study Design (type of trial, randomization, blinding, controls, study groups, length of study, follow-up)	<p><u>Design</u>: Pilot study to determine feasibility of exercise early after stroke. Pre and post-test study was done with a 1 month follow up</p> <p><u>Randomization</u>: None. Patients were recruited as a sample of convenience from a local hospital</p> <p><u>Blinding</u>: assessor is separate from person running exercise groups</p> <p><u>Controls</u>: None</p> <p><u>Length of study</u>: 8-week exercise intervention with a 1 month follow up</p>
Target Population (dx, acuity, inclusion/exclusion criteria)	10 first-time stroke patients between 50-70 y/o in the subacute stage of stroke recovery (<6 months). Participants were required to be ambulatory with or without device with at least SBA. Participants were excluded if they had an acute cardiac event <3 months ago, had CHF, smoked or if they had renal failure. They were also excluded if affected UE could not be positioned for brachial artery testing and if they had severe peripheral artery disease (ABI <0.4) which may skew results.

Interventions (if applicable): (specificity of interventions, ability to replicate, frequency, duration)	Participants underwent an 8-week exercise intervention on the Nu-Step Moderate to high exercise intensity 50-59% HR reserve 1 <sup>st</sup> 4 weeks 60-69% HR reserve 2 <sup>nd</sup> 4 weeks Patients were given encouragement to maintain HR range. Exercise sessions included warm-up/stretching as well as cool-down. Exercise duration was 20-40 minutes, progressing as able based on RPE. Blood glucose was monitored for diabetic patients. BP and HR were monitored at rest and throughout exercise.
Outcome Measures (relevant to purpose of the study; reliable, valid, clinical utility)	All outcome measures were taken at baseline, post-intervention and 1 month follow up Vasomotor reactivity (Flow Mediated Dilation (FMD)) Cardiorespiratory Fitness (VO2 peak) Hemodynamic Measures: heart rate, blood pressure 6 Minute Walk Test Maximal power from VO2 test (watts)
Statistical Analysis (statistics used, appropriate application)	Descriptive statistics were performed for each outcome measure. For baseline and post-intervention data, comparisons were used using a 1-tailed paired t-test. Because of multiple comparisons and risk of inflating type I error the p-value was adjusted so that results were significant when P was 0.02 or less.
<b>Results</b>	
Enrollment/Subject Characteristics (sample size, gender, age, functional level; were groups similar on important variables prior to application of the intervention)	Not applicable- this was a pilot study to determine feasibility
Summary of Primary and Secondary Outcomes (include aggregate and sub-group findings if reported); note results that were statistically significant; How many reached a level of clinical significance (exceed MCID if known); Was there retention of changes following intervention (if studied)	Exercise adherence was 85% and the primary reason for missing was transportation. <u>Brachial artery diameter and FMD:</u> significant improvements bilaterally for both post-intervention, FMD maintained at 1 month follow up but arterial diameter did not. <u>6 minute walk test:</u> Baseline to 1 month follow up = 44.9 m <u>Cardiovascular Health and Peak Exercise Testing:</u> HR, SBP and DBP all decreased (SBP only one that was significant), other values did not reach significance
<b>Authors' Discussion and Conclusions</b>	
Brief Summary of Authors' Main Discussion Points; Authors' Conclusion	First study to demonstrate that vasomotor reactivity was improved in both affected and non-affected sides after exercise. This study showed that immediately after stroke we see a

	<p>difference in vasomotor reactivity between sides (unsure of cause at this point) and that exercise can help improve blood flow. Changes seen here were not as great as in other studies when participants exercised at a higher intensity. The change in walking endurance as seen in the 6MWT demonstrates a small to moderate change. It is notable that this was seen as the patients were not walking but were on a NuStep. The VO2 peak measure improved in some patients though the improvements did not reach significance. Of those that were significant, the VO2 peak measures were still below normal values. Patients did have a significant 11 mmHg decrease in resting SBP which is very significant considering that research has shown as little as a 5 mmHg drop decreases mortality and risk for additional cardiovascular problems. Patients also had a decrease in perceived RPE and were able to tolerate increased watts on exercise tests and during exercise sessions which may be important for them to carry out their daily activities and to perceive less fatigue. Overall, it is encouraging to see that there were no adverse events while exercising stroke patients as early as 10 days post-stroke and that they were able to make improvements. The authors recognize that there was a small sample size with a pre-test/post-test design and that we should use caution in interpreting the results from the study.</p>
<b>Reviewer's Discussion and Conclusion</b>	
Study Strengths	No adverse events, used sound reasoning to determine the intensity for the intervention, use of functional measure, easy for intervention to be reproduced
Study Limitations and Potential for Bias	Unable to control for natural recovery in ambulation (6MWT), did not look at amount of activity patients were doing outside of intervention, did not have a control group, small sample size
<p>Applicability: Types of patients (dx) that results apply to Types of settings or patient acuity that the results apply to Can interventions be reproduced? Can results be applied to other pt populations?</p>	<p>This study is applicable to stroke patients who have mild to moderate impairments (those whose motor impairments do not limit their ability to perform activity). In the study, adaptive devices were used to strap UE's to the NuStep for those who were unable to grip the device. The patients in this study were specifically in the subacute stage of recovery (&lt;6 months after stroke) but other evidence shows similar improvements in vasomotor function in chronic stroke as well. The intervention can be reproduced easily as the NuStep is available at many clinics and fitness centers, though the 3x/week exercise may not be realistic for patients in PT. However, patients may benefit from trial in PT to determine safety with exercise and may benefit from follow-up elsewhere if this is feasible for the patient. As many populations benefit from regular exercise, the cardiovascular changes may occur in other populations as well though the unilateral changes seen in the affected limb are specific to stroke patients.</p>
<p>How will study results impact PT management of this patient population? List suggestions for how to implement</p>	<p>Since the study there has been a taskforce who has determined the most appropriate exercise recommendations for stroke patients. They have developed a set of recommendations titled Aerobic Exercise Recommendations to Optimize Best practices In Care after Stroke (AEROBICS).</p>

<p>changes in your clinic/department to integrate study findings into patient care.</p>	<p>There have also been more studies looking at exercise early after stroke as well as what else might be contributing the differences in blood flow. Follow up studies have continued to confirm benefits of exercising early after stroke at higher intensities than previously thought. We can apply this to our practice by determining safety of high intensity exercise with appropriate patients and helping them to have success after therapy (gyms, wellness groups, etc). Would be interesting to look into feasibility of stroke exercise groups, similar to cardiac rehab.</p>
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