Peripheral Artery Disease & Stroke

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Outline

- Peripheral artery disease rehabilitation
- Cardiac rehabilitation roles in stroke
- Case study
Peripheral Artery Disease
Peripheral Artery Disease

Atherosclerosis – a systemic disease

Coexistence of CAD, PAD and CVD in 1886 patients ≥ 62 years in nursing homes

Aronow et al. Am J Cardiol. 1994; 74: 64-65
Asymptomatic

Intermittent claudication
- Calf pain, increasing with walking, disappear quickly at rest
- More proximal level i.e. the aortoiliac segment, pain extension into thighs and buttocks
- Edinburgh Claudication Questionnaire is a standardized method to screen and diagnose intermittent claudication, with a 80–90% sen & 95% spec
**PAD Symptoms**

- **Ischemic rest pain**
  - Pain at rest, in supine position
  - Rest pain often in the foot
  - Permanent coldness in feet
  - Should be distinguished from muscle cramping or arthritis

- **Ulceration, gangrene**
  - Indicate severe ischaemia and begin mostly at the level of toes and distal part of the limb.
  - Often complicated by local infection and inflammation
Differential Diagnosis of Leg Pain

- Spinal canal stenosis
- Peripheral neuropathy
- Peripheral nerve pain
  - Herniated disc impinging on sciatic nerve
- Osteoarthritis of the hip or knee
- Venous claudication
- Symptomatic Baker’s cyst
- Chronic compartment syndrome
- Muscle spasms or cramps
### Clinical Staging of Lower Extremity Artery Disease (LEAD)

<table>
<thead>
<tr>
<th>Fontaine classification</th>
<th>Rutherford classification</th>
<th>Stage</th>
<th>Symptoms</th>
<th>Grade</th>
<th>Category</th>
<th>Symptoms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stage I</td>
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<td>0</td>
<td>0</td>
<td>Asymptomatic</td>
<td>0</td>
<td>Asymptomatic</td>
</tr>
<tr>
<td>Stage II</td>
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<td>1</td>
<td>1</td>
<td>Mild claudication</td>
<td>1</td>
<td>Moderate claudication</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1</td>
<td>2</td>
<td>Moderate claudication</td>
<td>1</td>
<td>Severe claudication</td>
</tr>
<tr>
<td>Stage III</td>
<td></td>
<td>1</td>
<td>3</td>
<td>Severe claudication</td>
<td>1</td>
<td>Ischaemic rest pain</td>
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<tr>
<td>Stage IV</td>
<td></td>
<td>1</td>
<td>5</td>
<td>Minor tissue loss</td>
<td>1</td>
<td>Major tissue loss</td>
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</tbody>
</table>

Edinburgh Claudication Questionnaire

(1) Do you get a pain or discomfort in your leg(s) when you walk?  
Yes  
No  
I am unable to walk

If you answered "Yes" to question (1) - please answer the following questions.  
Otherwise you need not continue.

(2) Does this pain ever begin when you are standing still or sitting?  
Yes  
No

(3) Do you get it if you walk uphill or hurry?  
Yes  
No

(4) Do you get it when you walk at an ordinary pace on the level?  
Yes  
No

(5) What happens to it if you stand still?  
Usually continues more than 10 minutes  
Usually disappears in 10 minutes or less

(6) Where do you get this pain or discomfort? Mark the place(s) with "x" on the diagram below

Figure 2  Measurement of the ankle–brachial index (ABI), calculated by dividing the ankle systolic blood pressure by the arm systolic blood pressure.
Treadmill Testing in LEAD

- For diagnostic confirmation and/or baseline quantification of functional severity
- Objective assessment of treatment in patients with intermittent claudication
- Either fixed or graded standardized exercise treadmill test
- Pre and postexercise ABI: differentiate arterial claudication from nonarterial claudication (“pseudoclaudication”).
- **6-minute walk test**: objective assessment of functional limitation and response to therapy in elderly or others not amenable to treadmill testing.
The integrated use of graded treadmill testing protocols and appropriate questionnaires will permit clinically meaningful changes to be accurately assessed in patients with PAD.


## 2 Major Goals in Treating PAD

<table>
<thead>
<tr>
<th>Limb Outcomes</th>
<th>Cardiovascular Morbidity &amp; Mortality Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>• Relieve symptoms</td>
<td>• Decrease mortality/morbidity from MI, stroke, and cardiovascular death</td>
</tr>
<tr>
<td>• Increase in peak walking distance, improve exercise capacity</td>
<td></td>
</tr>
<tr>
<td>• Improvement in quality of life</td>
<td></td>
</tr>
<tr>
<td>• Prevention of progression to CLI and amputation</td>
<td></td>
</tr>
</tbody>
</table>
Mechanisms by Which Exercise May Improve Function & Symptoms in Claudication

- Peripheral artery disease
  - Reduced oxygen

- Endothelial dysfunction

- Ischemic reperfusion

- Systemic inflammation
  - Free radical generation

- Deconditioning and worsening:
  - Obesity, Hypertension
  - Hyperlipidemia
  - Hyperglycemia
  - Thrombotic risk

- Effects of exercise training on pathophysiological correlates of claudication
  - Good evidence for improvement
  - Potential improvement
  - Short-term: may worsen
  - Long-term: may improve

- Impaired walking ability
  - Decreased quality of life

- Poor aerobic capacity
  - Reduced muscle strength and endurance

- Muscle fiber denervation
  - Muscle fiber atrophy
  - Altered myosin heavy chain expression

- Altered muscle metabolism
  - Lactate, Acylcarnitine accumulation
  - Altered electron transport
Management of intermittent claudication

Conservative therapy
(Risk factors control, exercise training, pharmacotherapy 3–6 months)

Favourable results

No favourable results

Image lesions

Endovascular therapy feasible?

yes

Endovascular therapy

Follow up:
- Symptoms
- CV risk control

no

Bypass surgery

Essentials of PAD Management

Risk Factor Normalization

- Tobacco use
  - Goal complete cessation
- Lipid management
  - Goal LDL <100 mg/dL or 70 if high risk
- Blood pressure control
  - Goal <140/90 mm Hg
  - Goal <130/80 mm Hg (DM, CKD)
- Blood sugar control (patients with diabetes)
  - Goal A1C <7%
- BW control

Antiplatelet Therapy

- Clopidogrel, ASA

Claudication Therapy

- Blood pressure control
- Supervised exercise rehabilitation
- Cilostazol (1st line)
- Pentoxifylline
- Revascularization therapy
# Claudication Pain Scale

<table>
<thead>
<tr>
<th></th>
<th>Minimal</th>
<th>Onset of Pain</th>
<th>Mild Pain</th>
<th>Moderate Pain</th>
<th>Severe Pain</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>No Pain</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Moderate</td>
<td>Onset of Pain</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Intense</td>
<td>Mild Pain</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Unbearable pain</td>
<td>Moderate Pain</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Severe Pain</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Indicates the point at which pain becomes noticeable.
Goals of Medical Evaluation before PAD Exercise Rehabilitation

- To confirm diagnosis of PAD and intermittent claudication
- To confirm absence of
  - Critical limb ischemia
  - Unstable angina
  - Decompensated heart failure
  - Uncontrolled cardiac arrhythmias
  - Severe or symptomatic valvular disease
  - Other conditions that could be aggravated by exercise including, but not limited to, severe joint disease, uncontrolled diabetes, or uncontrolled hypertension
  - Poor healing or non-healing wound of legs and feet which could limit exercise training
- To screen for exercise-induced myocardial ischemia & arrhythmias
  - Exercise stress testing is preferred
  - Careful questioning for symptoms is an alternative
Options

- Formal treadmill testing protocols
- 6 minute walk test
- Observation during initial treadmill exercise session
- Telemetry monitoring at least during initial sessions

Goal is to determine

- Claudication threshold
- Cardiovascular response to exercise
- Establish parameters for the exercise prescription
PAD Exercise Prescription

**Frequency:** 3-5 times/week

**Intensity:** Initial treadmill speed & grade – elicits claudication pain (3-4 of 5) in 3-5min until “near maximum pain”, maintain for 8-10 min then stand or sit. Resume walking immediately when the pain is gone as a cycle.

**Type:** treadmill, track walking

**Timing:** Initially, accumulate 30 min of walking in bouts of 8-10 min each. Progress to 30-45 min, including 5 minutes warm up and cool down. Goal 45-60 min, including rest periods

**Total Time:** At least 12 weeks

**Warm-up and cool-down:** 5 min each -10 min if cold
Progression: After the participant can exercise for at least 8 min without stopping for 3-4/5 claudication pain & cumulative exercise duration of 50 min including rest periods

-> Increase inclination by 1-2% maintain the same speed

Advance speed and inclination over time to maintain a claudication stimulus to exercise training
PAD Exercise Rehabilitation

- After 12 wk, continue daily walking, treadmill
- Clinical benefits have been observed after 4-8 wk of program & increase over 12 wk.
- Outcome: Pain-free distance, Maximum walking distance

**Options**
- Coordination/balance training (Impaired from leg pain), intrinsic foot exer, Accelerometer feedback, arm exercise in patients who can not walk
- Resistance training is used, as tolerated, for general fitness is complementary to, **but not a substitute for walking.**

Additional advice for home training

**Warm up**

1. Roll the feet from tip toe to heel position

2. Intermittent extension of right and left leg; thigh remains in contact with seat

3. Intermittent crossing of left and right leg

4. Massage the leg from the knee down to the ankles
Strength training:

- Repetition of tiptoe standing (approx. 1/sec.): distribute your weight evenly between the two legs.

- Stepping: exercise always until symptoms appear, then stop and pause until pain has disappeared completely.

- Stretching of calf

- Stretching of thigh

- Massage the leg from the knee down to the ankles.
Patients with LEAD associated with CAD are at twice the level of risk as those presenting with CAD alone.

Lowering the target for LDL cholesterol from 100 to 70 mg/dl should be considered.

Strict control of risk factors
Assessing Outcomes and Program Effectiveness

- Treadmill Testing (graded or constant)
- Six Minute Walk Test
- Shuttle Walk Test
- Four Meter Walking Velocity
- Repeated Chair Rise
- Standing Balance
- Quality of Life Questionnaire
- Program Demographics
- Attendance
Stroke
Cerebrovascular Disease (CVD)

Atherosclerosis – a systemic disease

- Coronary Artery Disease: 21% (8% overlap with cerebrovascular disease)
- Cerebrovascular Disease: 9% (5% overlap with coronary artery disease)
- Peripheral Artery Disease: 8% (3% overlap with cerebrovascular disease)

Coexistence of CAD, PAD, and CVD in 1886 patients ≥ 62 years in nursing homes

Aronow et al. Am J Cardiol. 1994; 74: 64-65
Patients after Hospitalisation from CVD

Severe neurological deficit → Intensive/IPD neurorehabilitation

Small neurological deficit → Ambulatory neurorehabilitation

Minimal neurological deficit → Cardiac rehabilitation model
Goals of Physical Activity and Exercise Prescription for Stroke Survivors

- Prevent complications of prolonged inactivity
- Decrease recurrent stroke and cardiovascular events
- Increase aerobic fitness

Cardiorespiratory Response to Acute Exercise in Stroke Survivors

Lower maximal workload, HR, BP responses than control subjects during progressive exercise testing due to volitional fatigue.

Peak oxygen uptake is reduced, compared with healthy subjects.
Evidence now suggests that the exercise trainability of stroke survivors may be comparable to that of their age matched, healthy counterparts.

Aerobic capacity is lower in stroke than in cardiac patients, but similar post CR program improvement in VO2 peak and anaerobic threshold.
Mean (±SD) % change in SBP (a), and DBP (b) between baseline and post exercise 8 wk for exercise and control groups

Mean (±SD) % change in Pulse Pressure (a), and HR (b) and Double Product (c) baseline and post exercise 8 wk for exercise and control groups.
- The large cohort of TIA/MNDS (Mild nondisabling stroke) patients to undergo systematic investigation in CCR
- Prospective cohort, no control group
- 88 attended exercise program, 80 patients completed CCR
- 64 attended the facility-based exercise option, with mean sessions attended 33.9 (4–60; SD, 10.9), or 67.8% of the standard 50 sessions.
- 24 enrolled in home-based exercise.

Comprehensive Cardiac Rehabilitation for Secondary Prevention After Transient Ischemic Attack or Mild Stroke: I: Feasibility and Risk Factors
Peter L. Prior, Vladimir Hachinski, Karen Unsworth, Richard Chan, Sharon Mytka, Christina O'Callaghan and Neville Suskin

*Stroke*. 2011;42:3207-3213; originally published online September 22, 2011; doi: 10.1161/STROKEAHA.111.620187
# Mean Intermediate Outcome: Exit VS Intake

<table>
<thead>
<tr>
<th>Outcome</th>
<th>n</th>
<th>Target</th>
<th>Intake, Mean (SD)</th>
<th>Exit, Mean (SD)</th>
<th>Change, Units (%)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>METs</td>
<td>82</td>
<td>≥7.00</td>
<td>6.49 (3.07)</td>
<td>8.53 (3.36)</td>
<td>2.04 (31.4)</td>
<td>&lt;0.001*</td>
</tr>
<tr>
<td>TC, mmol/L</td>
<td>79</td>
<td>&lt;4.00</td>
<td>4.41 (1.16)</td>
<td>4.11 (0.94)</td>
<td>−0.30 (−6.8)</td>
<td>0.008*</td>
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<tr>
<td>LDL, mmol/L</td>
<td>79</td>
<td>&lt;2.00</td>
<td>2.33 (1.03)</td>
<td>2.09 (0.79)</td>
<td>−0.24 (−10.3)</td>
<td>0.015</td>
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<tr>
<td>HDL, mmol/L</td>
<td>79</td>
<td>&gt;1.00</td>
<td>1.35 (0.41)</td>
<td>1.41 (0.39)</td>
<td>0.06 (4.4)</td>
<td>0.069</td>
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<tr>
<td>TC/HDL</td>
<td>79</td>
<td>&lt;4.00</td>
<td>3.44 (0.98)</td>
<td>3.04 (0.71)</td>
<td>−0.40 (−11.6)</td>
<td>&lt;0.001*</td>
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<tr>
<td>TG, mmol/L</td>
<td>79</td>
<td>&lt;1.80</td>
<td>1.62 (1.15)</td>
<td>1.35 (0.67)</td>
<td>−0.27 (−16.5)</td>
<td>0.003*</td>
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<tr>
<td>FBG, mmol/L</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All</td>
<td>79</td>
<td>&lt;6.00</td>
<td>5.96 (1.66)</td>
<td>5.95 (1.32)</td>
<td>−0.01 (−0.2)</td>
<td>0.95</td>
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<tr>
<td>Nondiabetic</td>
<td>59</td>
<td>&lt;6.00</td>
<td>5.32 (0.74)</td>
<td>5.49 (0.79)</td>
<td>0.17 (3.2)</td>
<td>0.022*</td>
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<tr>
<td>Diabetic</td>
<td>20</td>
<td>&lt;7.00</td>
<td>7.83 (2.16)</td>
<td>7.28 (1.64)</td>
<td>−0.55 (−7.0)</td>
<td>0.365</td>
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<tr>
<td>BP, mm Hg</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All SBP</td>
<td>82</td>
<td>&lt;140</td>
<td>132.02 (13.80)</td>
<td>128.82 (13.33)</td>
<td>−3.21 (−2.4)</td>
<td>0.098</td>
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<tr>
<td>All DBP</td>
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<td>&lt;90</td>
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<tr>
<td>Nondiabetic SBP</td>
<td>61</td>
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<td>130.43 (13.45)</td>
<td>129.10 (13.93)</td>
<td>−1.33 (−1.0)</td>
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<tr>
<td>Nondiabetic DBP</td>
<td>61</td>
<td>&lt;90</td>
<td>78.51 (9.78)</td>
<td>76.05 (8.75)</td>
<td>−2.46 (−3.1)</td>
<td>0.094</td>
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<tr>
<td>Diabetic SBP</td>
<td>21</td>
<td>&lt;130</td>
<td>136.67 (14.07)</td>
<td>128.0 (11.66)</td>
<td>−8.67 (−6.3)</td>
<td>0.032</td>
</tr>
<tr>
<td>Diabetic DBP</td>
<td>21</td>
<td>&lt;80</td>
<td>76.67 (8.03)</td>
<td>74.67 (7.83)</td>
<td>−2.00 (−2.7)</td>
<td>0.413</td>
</tr>
<tr>
<td>WC, cm</td>
<td>80</td>
<td>Males &lt;102; females &lt;88</td>
<td>100.25 (10.89)</td>
<td>97.81 (11.00)</td>
<td>−2.44 (−2.4)</td>
<td>&lt;0.001*</td>
</tr>
<tr>
<td>BMI, kg/m²</td>
<td>80</td>
<td>&lt;25</td>
<td>29.57 (4.60)</td>
<td>29.03 (4.53)</td>
<td>−0.53 (−1.8)</td>
<td>0.003*</td>
</tr>
<tr>
<td>Body weight, kg</td>
<td>80</td>
<td>n/a</td>
<td>81.74 (13.81)</td>
<td>80.32 (13.77)</td>
<td>−1.43 (−1.7)</td>
<td>0.001*</td>
</tr>
</tbody>
</table>

METs indicates metabolic equivalents; TC, total cholesterol; LDL, low-density lipoprotein; HDL, high-density lipoprotein; TG, triglycerides; FBG, fasting blood glucose; BP, blood pressure; SBP, systolic blood pressure; DBP, diastolic blood pressure; WC, waist circumference; BMI, body mass index; SD, standard deviation.

*Statistically significant.
Objectives
To determine whether fitness training after stroke reduces death, dependence, and disability. The secondary aims were to determine the effects of training on physical fitness, mobility, physical function, quality of life, mood, and incidence of adverse events.

Selection criteria
Randomised trials comparing either cardiorespiratory training or resistance training, or both, with no intervention, a non-exercise intervention, or usual care in stroke survivors.

45 trials, 2188 participants, which comprised cardiorespiratory (22 trials, 995 participants), resistance (8 trials, 275 participants), and mixed training interventions (15 trials, 918 participants).

### Analysis 1.8. Comparison of Cardiorespiratory training versus control - end of intervention, Outcome 8

**Physical fitness - peak VO2 (ml/kg/min).**

**Review:** Physical fitness training for stroke patients

**Comparison:** Cardiorespiratory training versus control - end of intervention

**Outcome:** Physical fitness - peak VO2 (ml/kg/min)

<table>
<thead>
<tr>
<th>Study or subgroup</th>
<th>Training</th>
<th>Control</th>
<th>Mean Difference</th>
<th>Weight</th>
<th>Mean Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>Mean(SD)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>During usual care</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>da Cunha 2002</td>
<td>6</td>
<td>11.55 (2.76)</td>
<td></td>
<td>16.2 %</td>
<td>3.43 [0.56, 6.30]</td>
</tr>
<tr>
<td><strong>Subtotal (95% CI)</strong></td>
<td>6</td>
<td>6</td>
<td>16.2 %</td>
<td>3.43 [0.56, 6.30]</td>
<td></td>
</tr>
<tr>
<td><strong>Heterogeneity:</strong> not applicable</td>
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<tr>
<td><strong>Test for overall effect:</strong> Z = 2.34 (P = 0.019)</td>
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</table>

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<tr>
<td></td>
<td>N</td>
<td>Mean(SD)</td>
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<tr>
<td><strong>After usual care</strong></td>
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<td></td>
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<tr>
<td>Potempa 1995</td>
<td>19</td>
<td>18.8 (4.79)</td>
<td></td>
<td>16.9 %</td>
<td>3.60 [0.82, 6.38]</td>
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<tr>
<td>Lennon 2008</td>
<td>23</td>
<td>12 (2.2)</td>
<td></td>
<td>41.9 %</td>
<td>0.90 [-0.29, 2.09]</td>
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<tr>
<td>Moore 2010</td>
<td>10</td>
<td>18 (5.4)</td>
<td></td>
<td>5.4 %</td>
<td>2.00 [-3.53, 7.53]</td>
</tr>
<tr>
<td>Ivey 2010</td>
<td>29</td>
<td>16.6 (5.64)</td>
<td></td>
<td>1.8 %</td>
<td>3.80 [-6.02, 13.62]</td>
</tr>
<tr>
<td>Ivey 2011</td>
<td>19</td>
<td>17.4 (6.99)</td>
<td></td>
<td>10.7 %</td>
<td>4.60 [0.86, 8.34]</td>
</tr>
<tr>
<td>Globas 2012</td>
<td>18</td>
<td>24.4 (6.6)</td>
<td></td>
<td>7.2 %</td>
<td>3.50 [-1.22, 8.22]</td>
</tr>
<tr>
<td><strong>Subtotal (95% CI)</strong></td>
<td>118</td>
<td>117</td>
<td>83.8 %</td>
<td>2.32 [0.81, 3.84]</td>
<td></td>
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<tr>
<td><strong>Heterogeneity: Tau^2 = 0.88; Chi^2 = 6.59, df = 5 (P = 0.25); I^2 = 24%</strong></td>
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<tr>
<td><strong>Test for overall effect:</strong> Z = 3.00 (P = 0.0027)</td>
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<tbody>
<tr>
<td></td>
<td>N</td>
<td>Mean(SD)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total (95% CI)</strong></td>
<td>124</td>
<td>123</td>
<td>100.0 %</td>
<td>2.46 [1.12, 3.80]</td>
<td></td>
</tr>
<tr>
<td><strong>Heterogeneity: Tau^2 = 0.75; Chi^2 = 7.83, df = 6 (P = 0.25); I^2 = 23%</strong></td>
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<tr>
<td><strong>Test for overall effect:</strong> Z = 3.59 (P = 0.00003)</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td><strong>Test for subgroup differences:</strong> Chi^2 = 0.44, df = 1 (P = 0.50), I^2 = 0.0%</td>
<td></td>
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</tr>
</tbody>
</table>

Review: Physical fitness training for stroke patients

Comparison: 1 Cardiorespiratory training versus control - end of intervention

Outcome: 14 Mobility - gait endurance (6-MWT metres)

<table>
<thead>
<tr>
<th>Study or subgroup</th>
<th>Training</th>
<th>Control</th>
<th>Mean Difference</th>
<th>Weight</th>
<th>Mean Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>Mean(SD)</td>
<td></td>
<td></td>
<td>N</td>
</tr>
<tr>
<td>Globas 2012</td>
<td>18</td>
<td>332.1 (138)</td>
<td>265.9 (189)</td>
<td>2.6%</td>
<td>66.20 [-41.91, 174.31]</td>
</tr>
<tr>
<td>Ivey 2011</td>
<td>19</td>
<td>242.62 (125.57)</td>
<td>197.21 (106.68)</td>
<td>5.4%</td>
<td>45.41 [-28.68, 119.50]</td>
</tr>
<tr>
<td>Moore 2010</td>
<td>10</td>
<td>226 (130)</td>
<td>201 (134)</td>
<td>2.3%</td>
<td>25.00 [-90.71, 140.71]</td>
</tr>
<tr>
<td>Mudge 2009</td>
<td>31</td>
<td>282 (117)</td>
<td>200 (99)</td>
<td>9.0%</td>
<td>82.00 [26.41, 137.59]</td>
</tr>
<tr>
<td>Salbach 2004</td>
<td>44</td>
<td>249 (136)</td>
<td>209 (132)</td>
<td>9.2%</td>
<td>40.00 [-15.13, 95.13]</td>
</tr>
</tbody>
</table>

Subtotal (95% CI) 190 155 39.9% 44.09 [17.20, 70.98]

Heterogeneity: Tau² = 0.0; Chi² = 3.65, df = 6 (P = 0.72); I² = 0.0%
Test for overall effect: Z = 3.21 (P = 0.0013)

Total (95% CI) 251 217 100.0% 26.99 [9.13, 44.84]

Heterogeneity: Tau² = 113.82; Chi² = 11.42, df = 10 (P = 0.33); I² = 12%
Test for overall effect: Z = 2.96 (P = 0.0031)
Test for subgroup differences: Chi² = 20.6, df = 1 (P = 0.15), I² = 52%

(1) Ada 2013 2 month training group with 50% of the control participants
(2) Ada 2013 4 month training group with 50% of the control participants
Main Results

Authors’ conclusions

- The effects of training on death and dependence after stroke are unclear.
- Cardiorespiratory training reduces disability after stroke and this may be mediated by improved mobility and balance.
- There is sufficient evidence to incorporate cardiorespiratory and mixed training, involving walking, within post-stroke rehabilitation programs to improve the speed and tolerance of walking; improvement in balance may also occur.
- There is insufficient evidence to support the use of resistance training. Further well-designed trials are needed to determine the optimal content of the exercise prescription and identify long-term benefits.
Preexercise Evaluation

- It is recommended that stroke patients undergo graded exercise testing with ECG monitoring as part of a medical evaluation before beginning an exercise program.
- Careful medical history and physical examination to rule out contraindication of exercise
- Cognitive, communication evaluation
- If no exercise testing, start low intensity, similar to CAD patients

# Exercise Recommendations for Stroke

## TABLE 1. Summary of Exercise Programming Recommendations for Stroke Survivors*

<table>
<thead>
<tr>
<th>Mode of Exercise</th>
<th>Major Goals</th>
<th>Intensity/Frequency/Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Aerobic</strong></td>
<td>• Increase independence in ADLs</td>
<td>• 40%–70% peak oxygen uptake; 40%–70% heart rate reserve; 50%–80% maximal heart rate; RPE 11–14 (6–20 scale)</td>
</tr>
<tr>
<td></td>
<td>• Increase walking speed/efficiency</td>
<td>• 3–7 d/wk</td>
</tr>
<tr>
<td></td>
<td>• Improve tolerance for prolonged physical activity</td>
<td>• 20–60 min/session (or multiple 10-min sessions)</td>
</tr>
<tr>
<td></td>
<td>• Reduce risk of cardiovascular disease</td>
<td></td>
</tr>
<tr>
<td><strong>Strength</strong></td>
<td>• Increase independence in ADLs</td>
<td>• 1–3 sets of 10–15 repetitions of 8–10 exercises involving the major muscle groups</td>
</tr>
<tr>
<td></td>
<td>• Increase independence in ADLs</td>
<td>• 2–3 d/wk</td>
</tr>
<tr>
<td></td>
<td>• Isometric exercise</td>
<td></td>
</tr>
<tr>
<td><strong>Flexibility</strong></td>
<td>• Increase ROM of involved extremities</td>
<td>• 2–3 d/wk (before or after aerobic or strength training)</td>
</tr>
<tr>
<td></td>
<td>• Prevent contractures</td>
<td>• Hold each stretch for 10–30 seconds</td>
</tr>
<tr>
<td><strong>Neuromuscular</strong></td>
<td>• Coordinate and balance activities</td>
<td>• 2–3 d/wk (consider performing on same day as strength activities)</td>
</tr>
<tr>
<td></td>
<td>• Improve level of safety during ADLs</td>
<td></td>
</tr>
</tbody>
</table>

ADLs indicates activities of daily living; RPE, rating of perceived exertion; and ROM, range of motion.

*From references 67, 71, 73, 75, 94, 95, and 96.

Recommended intensity, frequency, and duration of exercise depend on each individual patient’s level of fitness. Intermittent training sessions may be indicated during the initial weeks of rehabilitation.
Secondary Prevention after Stroke/TIA

- BP reduction
- Glucose control
- Cholesterol and statin therapy
- Lifestyle modification
  - Smoking cessation
  - Limited alcohol consumption
  - Weight control
  - Regular aerobic physical activity
  - Salt restriction, and a diet that is rich in fruits, vegetables, and low-fat dairy products
- Antiplatelet agents: aspirin/clopidrogel
Comprehensive Secondary Prevention Program

- Physical training, Exercise prescription
- Optimized medical treatment
- Dietary management
- Multidisciplinary Team Approach
- Risk factor modification
- Psychosocial support
- Smoking cessation
Future Direction
Modern Secondary Prevention Center

Ambulatory cardiac rehabilitation programme

- coronary heart disease
- diabetes
- PAD
- obesity
- ischemic stroke

modern secondary prevention center
Thank You