Author, Year; Country Score Research Design Sample Size	Methods	Outcomes
Berry et al. 2012; UK Longitudinal study Level 2 N=11	**Population**: N=11 (9M;2F) participantswith T3-T9 SCI; mean(SD) age: 41.8(7.6) yrs old; at least 2 yrs since injury; all AIS A. **Treatment:** Participants completed a 12-month, home-based progressive FES cycle training programme (up to 5x60min sessions per wk). **Outcome Measures:** Stimulation cost, oxygen cost, efficiency and markers of anaerobic metabolism were determined before and after 6 and 12 months of training, during constant work-rate tests.	1. Oxygen cost and efficiency did not significantly change after training. 2. Total stimulation cost and blood lactate values reduced overall. The high metabolic cost of FES cycling is a result of non-physiological recruitment of predominantly fast muscle fibres. The electrical cost of cycling reduced by 37%, probably due to motor unit hypertrophy, and lactate oxidation capacity improved. 3. Respiratory exchange ratios remained relatively high. 1.
Fornusek et al. 2014 Australia Pre-post Level 4 N=8	**Population:** 8 individuals with chronic paraplegia (T4- T11). 7 with complete SCI (AIS-A) and 1 with incomplete SCI (AIS- C) **Treatment:** Participants performed electrical stimulation (ES) on 2 separate sessions one week apart. The first day consists of 5 min of rest followed by 35 min of FES cycling and 15 min intermittent isometric exercise where the pedals were locked in a fixed position using the same ES parameters. The second day, the order and durations of the ES isometric and FES cycling were swapped. **Outcome Measure:** Cardiorespiratory activity (oxygen consumption- VO2, ventilation, tidal volume), heart rate, power output during FES cycling	2. No differences during the first 35 minutes of isometric exercise on each day when comparing the 2 modes of exercise for average rate of oxygen consumption, average heart rate, isometric or minute ventilation. 3. No differences between exercise modes for any peak cardiorespiratory values recorded during the initial 35 minute of exercise or the following 15-minute crossover exercise phase. 4. Both FES cycling and isometric ES induced significant increases from rest values for all cardio respiratory measures.
Kahn et al. 2010; USA Pre-post Level 4 N = 12	**Population:** 14 participants with paraplegia (T1-T10) or tetraplegia (C4-C8); >1 year post injury. 12 participants completed the trial. **Treatment:** FES-leg cycle ergometry training (2 sessions per week for 4 weeks). Each training session consisted of multiple exercise bouts (total 30 min, with 5-min rest period between boots). Stimulation was applied to quadriceps, hamstrings and gluteal muscle groups bilaterally **Outcome Measures:** Thrombin activity, antithrombin III activity, fibrinogen level, coagulation factor levels, cyclic adenosine monophosphate (cAMP) level and platelet aggregation in blood.	1. After the 1st session, significant increase were found for Antithrombin III (103.8 ± 8.9% to 110 ± 6.9%) and camp levels (9.9 ± 2.5% to 15.8 ± 3%) 2. After the eight session, significant increase were found in antithrombine III activity, cAMP levels (17.8 ± 4.2% to 36.5 ± 7.6%) and coagulation factors V and X (respectively 88 ± 27 to 103 ± 23% and 100 ± 40 to 105 ± 7%). In addition, thrombine levels decreased (pre: 12.5 ± 2.0 s to post: 11.1 ± 1.7s) and platelet aggregation was inhibited by 40%.
Griffin et al. 2009; USA Pre-Post Level 4 N = 18	**Population:** 18 SCI participants (age 40 $\pm$ 2.4, YPI 11 $\pm$ 3.1) with no cardiovascular disease **Treatment:** FES cycling 2-3 times per week for 10 weeks **Outcome Measures:** Cycling power; body composition; ASIA impairment scale (AIS)	1. Cycling power and work done were greater during weeks 8, 9, and 10 compared to week 1 2. Total body mass and lean muscle mass increased significantly after training. 3. Lower extremity total AIS scores and the motor and sensory components of the AIS tests were

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		all significantly higher after training.
Janssen & Pringle 2008; The Netherlands Pre-Post Level 4 N = 12	**Population:** 12 men with SCI (6 tetraplegia and 6 paraplegia), including 4 participants (age 44 $\pm$ 14, YPI 13 $\pm$ 8) who had previous training on ES-LCE **Treatment:** Computer controlled electrical stimulation induced leg cycle ergometry (ES-LCE); total of 18 training sessions with each session lasting 25-30 minutes **Outcome Measures:** Heart rate; power output; oxygen uptake (VO_2); Carbon dioxide production; minute ventilation (volume of gas into lungs)	1. Significantly higher heart rate (+16%) and power output (+57%) after training, compared to baseline 2. Significantly higher peak values for VO_2 (+29%), carbon dioxide production (+22%), and minute ventilation (+19%)
Zbogar et al. 2008; Canada Pre-Post Level 4 N = 4	**Population:** 4 SCI participants, all female, age 19-51, lesion level C4-T7 **Treatment:** 30-min sessions of FES leg cycle ergometry, 3 times per week for 12 weeks **Outcome Measures:** Large and small artery compliance	1. There was no significant change in large artery compliance. 2. All participants demonstrated increased small artery compliance after training, an average of 63% increase (from 4.2 $\pm$ 1.8 to 6.9 $\pm$ 3.2 $mL{\cdot}mmHg^{-1} \times 100$)
Crameri et al. 2004; Denmark Pre-post Level 4 N = 6	**Population:** Paraplegia, complete, C6-T7, ages 26–54 yrs, 3–21 yrs post-injury. **Treatment:** FES training 45 min/d, 3 d/wk, 10 wks. One leg: dynamic cycle ergometry involved bilateral quadriceps and hamstring stimulation; contralateral leg: isometric contractions. **Outcome Measures:** muscle biopsies, capillary-to-muscle fibre ratio, muscle proteins, and oxygenation, citrate synthase activity (marker of intact mitochondria).	1. The isometric-trained leg showed larger mean increases in force, increase in type 1 fibres, fibre cross-sectional area, capillary-to-fibre ratio, citrate synthase activity, and relative oxygenation after static training in comparison to baseline and the dynamically trained leg.
Hopman et al. 2002; The Netherlands Pre-post Level 4 N = 9	**Population:** 9 males; Level of injury: thoracic and cervical; Type of injury: AIS A; Time since injury: range 1-22 years. Mean age (including 2 other participants not included in this part of the study) = 40.7±7.2 yrs. **Treatment:** Cycle training was performed by using a computer-controlled leg cycle ergometer with electrodes placed over hamstring, gluteal, and quadriceps muscles. Participants trained for 30 minutes, 3x/week for 6 wks. **Outcome Measures:** Mean arterial pressure, resting blood flow in femoral artery	1. Mean arterial pressure was similar after training compared with values before training. 2. Larger resting blood flow in the femoral artery was found after training. Peak systolic blood flow increased from 1330 ± 550 to 1710 ± 490 $mL{\cdot}min^{-1}$ and mean blood flow increased from 270 ± 120 to 370 ± 160 $mL{\cdot}min^{-1}$. 3. Calculated vascular resistance decreased by 30% after 6 weeks of training.
Gerrits et al. 2001; The Netherlands Pre-post Level 4 N = 9	**Population:** 9 males; Age: mean 39.2 yrs, range 26-61; Level of injury: C4-T6, 4 cervical and 5 thoracic; Time since injury: mean 11.1 yrs, range 2-27; Type of injury: 3 AIS B, 5 AIS A, 1 AIS C **Treatment:** All participants trained for 6 weeks, 3 d/wk. A training session consisted of a 30-minute FES-leg cycle ergometry (LCE) exercise. **Outcome Measures:** Longitudinal images and	1. Increased work output (300%). 2. No change HR and systolic BP. 3. Six weeks of FES-LCE training resulted in an increase in diameter of the femoral artery (pre-training 7.5±1.5 mm vs. post-raining 8.1±1.5 mm) whereas the diameter of the common carotid artery remained unchanged. 4. Velocity index, an indicator for peripheral

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	simultaneous velocity spectra of the common carotid and femoral arteries (capturing blood flow); arterial diameters, peak systolic inflow volumes, mean inflow volume, velocity index	resistance, decreased from 1.24±0.11 to 1.14±0.12 in the femoral artery; unchanged in common carotid 5. Larger resting inflow volumes of the femoral artery were found after training as peak systolic inflow increased from 1330 ± 550 to 1710 ± 490 mL·min^{-1} and mean inflow volume increased from 270 ± 120 to 370 ± 160 mL·min^{-1}. 6. After training, hyperaemic response is augmented.
Hjeltnes et al. 1997; Norway Pre-post Level 4 N = 5	**Population:** 5 males, complete chronic lesions, 2 C5, 2 C6, 1 C7, 4 AIS A, 1 AIS A/B, age 35 yrs, 10.2 yrs post-injury. **Treatment:** FES leg cycling, 7 x/wk, 8 wks. **Outcome Measures:** DXA (Body composition), VO_2peak.	1. VO_2peak increased (70%) during FES leg cycling but not during arm exercise. 2. Increase in lean body mass (3.0%) and muscle cross-sectional area (21.3%). 3. Decrease in body fat (6.4%).
Mohr et al. 1997; Denmark Pre-post Level 4 N = 10	**Population:** 6 tetraplegia at C6, 4 paraplegia at T4, all complete, ages 27–45 yrs, 3–23 yrs post-injury. **Treatment:** 1-yrs exercise training using an FES cycle ergometer (30 min/d, 3 d/wk). **Outcome Measures:** VO_2max, total work output, blood lactate, muscle properties.	1. 4-fold increase in work output and 12% increase in thigh muscle mass with FES. 2. VO_2max increased 17.5% (6 months) and 19.2% (12 months). 3. Shift toward more fatigue-resistant contractile proteins and a doubling of citric synthase activity.
Barstow et al. 1996; USA Pre-post Level 4 N = 9	**Population:** 9 males, 2 tetraplegia, 7 paraplegia, all AIS A, age 34.4 yrs, 10.1 yrs post-injury. **Treatment:** FES leg-cycle exercise, 30 min (minimum of 24 sessions, 3d/wk). **Outcome Measures:** Work rate, VO_2peak, oxygen pulse.	1. Training significantly increased VO_2peak (10.9%), peak work rate (46.5%), and peak oxygen pulse (12.6%).
Faghri et al. 1992; USA Pre-post Level 4 N = 13	**Population:** 6 paraplegics (5 complete), 7 tetraplegics (all incomplete), C4-C7 and T4-T10, age 30.5 yrs, 8 yrs post-injury. **Treatment:** FES leg cycle, 3 d/wk, 12 wks. **Outcome Measures:** BP, power output, HR, VO_2peak, stroke volume, and cardiac output.	1. Increased resting HR and systolic blood pressure in the tetraplegics, while decreased systolic, diastolic, and mean arterial BP in the paraplegics after training. 2. In both groups, decreased submaximal exercise HR and BP and increased stroke volume after training. 3. After training, submaximal cardiac output increased significantly in the paraplegic group.
Hooker et al. 1992; USA Pre-post Level 4 N = 18	**Population:** 17 males, 1 female, 10 tetraplegia (C5-C7), 8 paraplegia (T4-T11), 7 incomplete, age 30.6 yrs, 6.1 yrs post-injury. **Treatment:** FES leg-cycle training 10–30 min/d, 2–3 d/wk, 12–16 wks. **Outcome Measures:** VO_2peak, power output, cardiac output, stroke volume, total peripheral resistance, and HR.	1. Increase in power output (45%), VO_2peak (23%), cardiac output (13%), HR (11%), and a reduction in total peripheral resistance (-14%) during peak FES leg cycle. 2. No changes in stroke volume (6%), mean arterial BP (-5%), or arteriovenous oxygen difference (+10%). 3. No differences during peak arm cranking exercise for any of the cardiovascular

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		variables.
Janssen and Pringle 2008; The Netherlands Pre-Post Level 4 N = 12	**Population:** All participantst are male, 6 participants with tetraplegia and 6 with paraplegia, including 4 participants (mean (SD) age 44 (14), yrs post-injury 13 (8)) who had previous training on ES-LCE. **Treatment:** Computer controlled ES-LCE; total of 18 training sessions with each session lasting 25-30 minutes. **Outcome Measures:** Heart rate; power output; oxygen uptake (VO_2); Carbon dioxide production (VCO_2); pulmonary ventilation (V_e); peak torque.	1. Significantly higher heart rate (+16%) and power output (+57%) after training, compared to baseline 2. Significantly higher peak values for VO_2 (+29%), VCO_2 (+22%), and V_e (+19%) 3. Peak torques were significantly higher for most of the relevant muscles
Ragnarsson et al. 1988; USA Pre-post Level 4 N = 19	**Population:** 16 male, 3 females (7 paraplegics T4-T10, 12 tetraplegics C4-C7), ages 19–47 yrs, 2–17 yrs post-injury. **Treatment:** Phase I: quadriceps stimulation with dynamic knee extensions against increasing resistance, 3 d/wk, 4 wks; Phase II: leg-cycle FES, 15-30 min/d, 3 d/wk for 12 wks. **Outcome Measures:** HR, work, BP, and VO_2peak.	1. Most showed an increase in strength and endurance. 2. VO_2peak increased nonsignificantly (14.9%) after training.
Hakansson et al. 2012; USA Post-test Level 4 N=9	**Population:** N = 11 participants (8M;3F) with T4-T12 SCI; mean (SD) age: 28(9) yr old; DOI: 1.25-17 yr; all AIS A **Treatment:** Participants pedaled the ergometer 3x/wk (30 min/session) during the first 3 weeks and once per week during the last 5 weeks. The last 4 weeks (used in analysis) were divided into two 2-week time blocks of StimErg and Stim3, which were randomly assigned. **Outcome Measures:** Work, VO_2, blood lactate	1. Participants performed 11% more work pedaling with Stim3 than with existing stimulation patterns (StimErg). 2. Average VO2 and blood lactate concentrations were not significantly different between Stim3 (442 $mL \cdot min^{-1}$; 5.9 $mmoL \cdot L^{-1}$) and StimErg (417 $mL \cdot min^{-1}$; 5.9 $mmoL \cdot L^{-1}$).

Note: AIS = ASIA Impairment Scale; BP = blood pressure; d = day; FES = functional electrical stimulation; hr = hour; HR = heart rate; min = minute; wk = week; yrs = year.