Author Year; Country Score Research Design Total Sample Size	Methods	Outcome
Faghri & Yount 2002 USA RCT Level 2 PEDro=2 N=29	**Population:** 7 individuals with paraplegia, 7 with tetraplegia; 4 incomplete and 10 complete injuries; 15 controls without SCI. **Treatment:** Random order of standing with or without FES (30 mins) for participants with SCI; voluntary tiptoe contractions during 30 minutes standing for participants without SCI. **Outcome Measures:** Hemodynamics during supine-sitting-30 min standing.	1. Significant reductions (up to 10%) in BP measures for participants with SCI from sitting to passive standing; but minimal changes when moving to FES standing. 2. After 30 min of passive standing there was a reduction in stroke volume and cardiac output. 3. After 30 min of FES standing, the pre-standing hemodynamics were maintained except for a significant reduction in SV.
Sampson et al. 2000 USA RCT Level 2 PEDro=3 N=6	**Population:** Motor complete SCI (lesions above T6); 3 with recent injury, 3 with long standing injury **Treatment:** With and without lower-extremity FES while tilted by 10° increments every 3 minutes, from 0-90° with varying intensities of stimulation. **Outcome Measures:** BP, HR, perceived syncope score.	1. HR increased for both groups with increasing incline angle. Mean diastolic BP was lower for the recent SCI group (105 mmHg) compared with chronic (123 mmHg). 2. Systolic and diastolic BP increased with increasing FES stimulation intensities and BP decreased with increasing incline angle of tilt regardless of the site of stimulation. 3. Participants tolerated higher angles of incline with FES than without. The higher the intensity of FES, regardless of stimulation site, the greater the tilt incline tolerated.
Elokda et al. 2000 USA RCT Level 2	**Population:** 2 individuals with tetraplegia, 3 with paraplegia; all complete injuries; 2-4 weeks post-injury. **Treatment:** Tilt table - 6 minutes at each tilt angle (0, 15, 30, 45 and 60 degrees), with 4 minutes of recovery between each, with or	1. At tilt angles of 15, 30, 45 and 60 degrees, systolic BP was significantly lower when FNS was not applied compared to when it was administered, and it was more marked with increasing tilt angles. 2. There was a progressive decrease in BP with increasing tilt angle and

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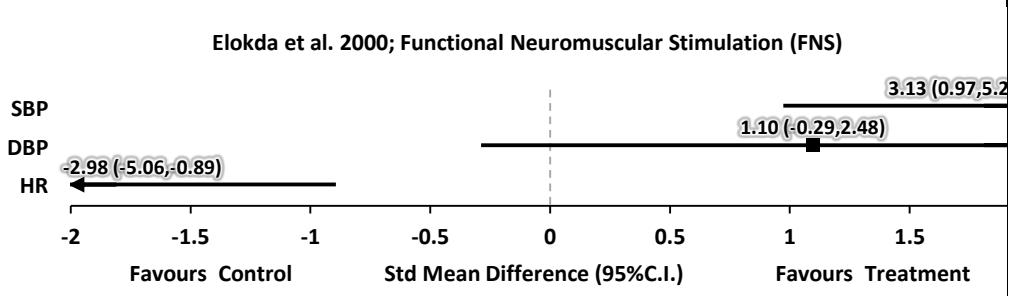
PEDro=3 N=5	without bilateral ankle plantar flexor and knee extensor electrical stimulation. Application order or absence of functional neuromuscular stimulation (FNS) was counterbalanced. **Outcome Measures:** HR, BP, perceived exertion.	this increase was less pronounced in the FNS condition. 3. Post hoc analysis showed that HR was significantly higher with FNS compared to without FNS at 60 degrees tilt.
	Effect Sizes: Forest plot of standardized mean differences (SMD ± 95%C.I.) as calculated from pre- and post-intervention data 	
Raymond et al. 2001 Australia Prospective controlled trial Level 2 N=16	**Population:** 8 male individuals with complete paraplegia, 8 male controls without SCI. **Treatment:** Lower-body negative pressure (LBNP) was used to provide the orthostatic challenge. Participants were evaluated: (1) during supine rest, (2) supine rest with submaximal arm crank exercises (ACE), (3) ACE+LBNP, and (4) ACE+LBNP+leg electrical stimulation (ES). Controls participated in the first 3 trial only. **Outcome measures**: HR, stroke volume, cardiac output.	1. ES increased stroke volume from ACE+LBNP to ACE+LBNP+ES condition for SCI group. 2. ES did not affect oxygen uptake or cardiac output in the SCI group.

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Faghri et al. 2001 USA Prospective controlled trial Level 2 N=14	**Population:** 7 individuals with tetraplegia, 7 with paraplegia; 4 incomplete and 10 complete injuries. **Treatment:** FES augmented standing (active) and non-FES standing (passive), for 30min duration; tests were separated by at least 24 hours. **Outcome Measures:** Hemodynamics.	1. BP changed 8-9% when moving from sitting to passive standing (no FES). 2. The augmented FES condition prevented BP change when moving from sitting to standing.
Chao & Cheing 2005 China Post-test Level 4 N=16	**Population:** Motor complete tetraplegia **Treatment**: Progressive HUT maneuver with and without the FES to 4 muscle groups. **Outcome Measures:** BP, HR, perceived presyncope score.	1. Increasing tilt angle without FES significantly reduced systolic and diastolic BP and increased HR. 2. Adding FES to HUT significantly attenuated the drop in systolic BP by 3.7±1.1 mmHg, the drop in diastolic BP by 2.3±0.9 mmHg, and HR increased by 1.0±0.5 beats/min for every 15 degrees increment in the tilt angle. 3. FES increased the overall mean standing time by 14.3±3.9 min.
Daunoraviciene et al. 2018 Lithuania Pre-post Level 4 N=6, N=3 SCI	**Population:** N=6, 3 SCI, 3 stroke **Treatment:** 10 sessions of physical therapy with the verticalization robot, Erigo, during primary inpatient rehabilitation. Passive leg movements were started for 10-20 minutes if the participant was stable at 20 degrees. If the participant was stable after the first training exercise and had good orthostatic tolerance, sBP, and dBP, FES was applied to the quadriceps and calf muscles for 5 mins.	1. Verticalization with FES reduced the occurrence of orthostatic hypotension and stabilised blood pressure (124.67 ± 7.57 mmHg to 114.67 ± 2.31 mmHg) and HR (65.67 ± 5.69 bpm to 64.00 ± 5.29 bpm), especially in participants with SCI. 2. Robotic training in combination with FES is safe and effective for gradually improving the cardiovascular system, orthostatic reactions, and postural control

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	Outcome Measures: Functional recovery, sBP, dBP, pain, and emotions.	
Yoshida et al. 2013 Canada Cross-sectional Level 5 N=10	**Population:** 10 adults with SCI (C4-T7); 44±11 years; range 27-59; AIS: A (n=5), B (n=3), C (n=1), D (n=1); duration of injury: 10±9 years; range 2-29. **Treatment:** During head-up tilt (HUT), participants underwent four 10 min conditions in random sequence: 1) no intervention 2) passive stepping 3) isometric functional electrical stimulation (FES) of leg muscles 4) FES of leg muscles combined with passive stepping (dynamic FES). **Outcome measures:** Blood pressure (BP), heart rate, stroke volume, systemic vascular resistance, EMG signals of leg muscles, cross-sectional area of the inferior vena cava.	1. Incidents of OH during tests (based on changes in BP of participants): 6 during head-up tilt (HUT), 5 during passive stepping, 4 during isometric FES, 3 during dynamic FES. Despite this, no participants reported perceived symptoms of OH during the experiments. 2. FES and passive stepping independently mitigated a ↓ in stroke volume and helped maintain mean BP. 3. Effects of FES on stroke volume and mean BP were greater during passive stepping. FES and passive stepping combined didn't interfere with each other but did not synergistically ↑ stroke volume or mean BP.
Craven et al. 2013 UK Cross-sectional Level 5 N=6	**Population:** 6 individuals with SCI (C3-T9); Lesion grade: 3 complete (cSCI), 3 incomplete (iSCI); 22±4 years; range 18-25), iSCI 50±6; range 44-54); duration of injury: cSCI 18±3 years; range 16-21, iSCI 32±20 years; range 9-46). **Treatment:** Three experimental sessions (passive, active and FES-assisted) using a Robotic Assisted Tilt-Table (RATT); five phases of testing protocol for each session (phase 1&2: body positioning; phase 3: robotic orthoses with full guidance force; phase 4a:	1. Head-up tilt (HUT) tolerated well; no instances of hypotension or autonomic dysreflexia. 2. Incomplete (iSCI) participants: no change in oxygen uptake, respiratory exchange ratio (RER), minute ventilation, or heart rate (HR) in the first three testing phases; volitional participation in the stepping cycle and addition of functional electrical stimulation (FES) (phase 4a and b) led to significant ↑ in oxygen uptake, Respiratory exchange ratio (RER), minute ventilation, and HR; no

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	reduced guidance force for robotic orthoses, increased volitional effort; phase 4b: added FES to augment volitional force). **Outcome measures:** Oxygen uptake, respiratory exchange ratio (RER), minute ventilation, heart rate (HR), mean arterial blood pressure (MAP).	significant change in mean arterial pressure (MAP). 3. Complete (cSCI) participants: small statistically significant ↑ in minute ventilation. 4. iSCI and cSCI participants: no difference in RER, minute ventilation, or HR response between groups in the first three testing phases. During phase 4b oxygen uptake, minute ventilation, and HR of participants with iSCI was significantly larger than those with cSCI. MAP was significantly larger across all phases for people with iSCI.
Faghri et al. 1992 USA Pre-post Level 4 N=13	**Population:** 6 people with paraplegia (T4-T10); 7 with tetraplegia (C4-C7). **Treatment**: FES-leg cycle ergometer (FES-LCE) training, 3X/week, for about 12 weeks (36 sessions). **Outcome Measures***: Oxygen* uptake, pulmonary ventilation (VE), respiratory exchange ratio (RER), BP, HR, stroke volume (SV) and cardiac output (Q).	1. After training, resting HR and systolic BP were increased in participants with tetraplegia but were reduced in individuals with paraplegia. 2. In both groups, HR and BP during submaximal exercise significantly decreased and stroke volume and cardiac output significantly increased after training. 3. These results suggest that FES-LCE training improves peripheral muscular and central cardiovascular fitness in people with SCI.
Davis et al. 1990; USA Pre-post Level 4 N=12	**Population:** 12 males with paraplegia (T5-L2); FES Group, n=6; Non-FES (Control) group, n=6. **Treatment**: Sub-maximal and maximal arm-crank exercise with or without FES of paralyzed leg muscles.	1. No significant differences between the FES and Control groups in terms of peak VO_2 (2.09 l/min), maximal HR, V_E, respiratory exchange ratio and perceived exertion. 2. No differences in power output or VO_2 during peripheral FES application but stroke volume and Q were higher during the FES-induced leg contractions on

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	Outcome Measures: Peak VO_2, expired ventilation (V_E), perceived exertion respiratory exchange ratio (RER), BP, HR, resting stroke volume (SV) and cardiac output (Q), total peripheral resistance.	individuals that demonstrated visible isometric contractions. Neither rest nor exercise HR was significantly influenced by lower limb FES. Increase of peripheral and overall ratings of perceived exertion. 3. HR, SV and Q were not significantly altered at rest or during hybrid exercise in Control group. Decrease of peripheral and overall ratings of perceived exertion. 4. No changes in BP, impedance indexes of myocardial contractility and differentiated subjective ratings of perceived exertion during hybrid exercise compared with non-FES conditions.