| Author Year; Country<br>Score<br>Research Design<br>Total Sample Size | Methods | Outcome |
|---|---|---|
| Wadsworth et al. 2012<br>Australia<br>RCT<br>Level 2<br>PEDro=4<br>N=14 | **Population:** 14 adults with complete SCI (C3-T1; mean (SD) age: 32(16), range 18-73.<br>**Treatment:** Abdominal binder (AB) on/off while seated in an upright wheelchair, with three repeated measures at 6 weeks, 3 months, 6 months after commencing daily use of an upright wheelchair.<br>**Outcome measures:** Forced vital capacity, forced expiratory volume, peak expiratory flow, max inspiratory and expiratory pressures, mean arterial pressure (MAP), max sustained vowel time, sound pressure level. | 1. No statistically significant improvement in mean arterial pressure (MAP) with use of the abdominal binder.<br>2. Variable responses: MAP greater with the AB at the 1st and 3rd time points; MAP was less with the AB at the 2nd time point.<br>3. Measures of supine and seated blood pressure were taken (allowing diagnosis of OH) but this was not a key outcome. 7 occasions of OH were found across participants as indicated by systolic blood pressure changes; 4 had OH regardless of AB application and 3 had OH without the AB only. |
| Hopman et al. 1998a<br>The Netherlands<br>RCT<br>Level 2<br>PEDro=5<br>N=9 | **Population:** 9 males, 5 with tetraplegia, 4 with paraplegia; 8 complete, 1 incomplete.<br>**Treatment**: 5 discontinuous submaximal arm ergometer exercise tests on different days at 20, 40 and 60% of maximum power output while: 1) sitting, 2) supine, 3) sitting plus an anti-G suit, 4) sitting plus stockings and abdominal binder, and 5) sitting plus FES of the leg muscles.<br>**Outcome measures:** Oxygen uptake ($VO_2$), carbon dioxide output, respiratory parameters, HR, BP, stroke volume, cardiac output. | 1. Both FES and anti-G suit increased BP in participants with tetraplegia whereas binders and stockings reduced HR in those with tetraplegia<br>2. The interventions did not improve BP responses in participants with paraplegia, however FES and anti-G suit lowered HR. |
| Hopman et al. 1998b<br>USA<br>RCT | **Population:** Same participants as above study.<br>**Treatment:** 5 conditions as above except at maximal power output. | 1. The supine posture increased peak $VO_2$ in people with tetraplegia, but reduced HR in those with paraplegia compared to sitting. |

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| Level 2<br><br>PEDro=4<br><br>N=9 | **Outcome Measures:** $VO_2$, carbon dioxide output, respiratory parameters, HR, BP, stroke volume, cardiac output. | 2. The relatively low pressure generated by stockings and bindings did not improve the venous system or cardiovascular responses during exercise. The positive circulatory benefits from FES and the anti-G suite observed in submaximal exercise (Hopman et al. 1998a) was not found for maximal exercise. |
| Krassioukov & Harkema 2006<br><br>Canada<br><br>Prospective controlled trial<br><br>Level 2<br><br>N=20 | **Population**: 6 individuals with complete tetraplegia; 5 with complete paraplegia; AIS A; 9 controls without SCI.<br><br>**Treatment:** With and without harness for locomotor training during supine, sitting and standing (within participant analysis).<br><br>**Outcomes measures:** BP and HR. | 1. Orthostatic stress significantly decreased arterial BP only in individuals with cervical SCI.<br>2. Harness application had no effect on cardiovascular parameters in controls, whereas diastolic BP was significantly increased in those with SCI.<br>3. Orthostatic changes in cervical SCI when sitting were ameliorated by harness application. However, while standing with harness, individuals with cervical SCI still developed OH. |
| Kerk et al. 1995<br><br>USA<br><br>Prospective controlled trial<br><br>Level 2<br><br>N=6 | **Population:** Chronic complete paraplegia.<br><br>**Treatment:** Crossover design: with and without an abdominal binder.<br><br>**Outcome Measures:** BP, HR, $VO_2$max, respiratory parameters, and wheelchair propulsion. | 1. 5/6 participants demonstrated a mean increase of 31% in forced vital capacity with binder compared to without, which was not significant but this may be because the sixth participant showed an 18% decrease in forced vital capacity when wearing the binder.<br>2. BP, HR, $VO_2$max increased significantly with increased exercise intensity and during maximal exercise, but these variables were not |

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| | | significantly affected by the use of the binder. |
| Rimaud et al. 2012<br>France<br>Pre-post<br>Level 4<br>N=9 | **Population:** 9 men with (8 were highly-trained athletes who competed regularly at the national or international level); Level of lesion: >T6 (n=4), <T6 (n=5); age in years: 34±12 years; range 24-53; duration of injury: 10±10 years; range 2-34.<br>**Treatment:** Two maximal wheelchair exercise tests with and without graduated compression stockings (GCS).<br>**Outcome measures:** Heart rate variability (HRV): high frequency (HF), low frequency (LF), and LF/HF ratio; Norepinephrine (NOR) and epinephrine (EPI); BP, heart rate, max power output, oxygen uptake, stroke volume, cardiac output. | 1. Increase in sympathetic activity and decrease in parasympathetic activity after maximal exercise in participants when wearing GCS as shown by the increase in LF and decrease in HF components; results further supported by an enhanced sympathetic activity at rest in SCI, as demonstrated by a significant increase in noradrenergic response when wearing GCS.<br>2. When wearing GCS: LF increased significantly and $HF_{post}$ decreased significantly leading to an enhanced LF/HF ratio and a significant increase in resting NOR. |
| Rimaud et al. 2008<br>France<br>Pre-post<br>Level 4<br>N=9 | **Population:** 9 men with chronic traumatic SCI, were divided into 2 groups: high paraplegia with lesion levels between T4 and T6 (n=4), and low paraplegia with lesion levels between T10 and L1 (n = 5)<br>**Treatment:** 2 plethysmography tests: with and without graduated compression knee-length stockings (GCS) at rest.<br>**Outcome Measures:** venous capacitance (VC); venous outflow (VO); heart rate; blood pressure. | 1. No significant difference in HR or BP for either group or either treatment.<br>2. In both groups, VC values were lower with GCS than without.<br>3. VC and VO did not differ significantly with or without GCS. |
| Helmi et al. 2013<br>The Netherlands | **Population:** A 61-year-old male with C3/C4 traumatic SCI with symptoms of presyncope as a | 1. A 28% decrease in MAP when pressure decreased to 7 mmHg, below this level, dizziness rapidly occurred. |

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| Case report<br><br>Level 4<br><br>N=1 | result of severe OH after 60° head-up tilt.<br><br>**Treatment:** Inflatable external leg compression (ELC); minimal ELC pressure to prevent OH (15 mmHg) found via tolerability test then applied in different positions (supine, 45°, and 60° head-up tilt).<br><br>**Outcome measures:** External leg compression (ELC) pressure, mean arterial pressure (MAP), cardiac index, stroke volume index, heart rate, perfusion index (PI), peripheral tissue oxygen saturation (StO). | 2. With the application of ELC 15 mmHg pressure during 45° and 60° head-up tilt:<br>a. Stroke volume index and heart rate were maintained with no presyncopal symptoms.<br>3. Global and peripheral perfusion parameters improved. |