SDC 1: Effect of exercise training on cardiac, autonomic and cardiometabolic outcomes in SCI with low-CVRF

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| **Authors, date** | | **Training** | **n** | | **Age (yr)** | | **TSI (yr)** | | **Level of injury** | | **Methods / VO2 testing** | | **Main outcomes** | | **Baseline value** | | | **Changes after training** |
| ***VO2peak and Fitness*** | | | | | | | | | | | | | | | | | | |
| ***Cervical injuries*** |  | | |  | |  | |  | |  | |  | |  | |  |  | |
| **Mohr, 1997**[**28**](#_ENREF_28) | | FES-cycling | 10 | | 27 - 45 | | 3–23 | | C6-T4 | | Uncontrolled study | | Peak VO2, L/min | | 1.20 ± 0.08 | | | ↑23%, *P* < .05 |
|  | |  |  | |  | |  | | ASIA A-C | | 52 wk 3x/wk, 30' | | Peak PO, W | | 4 ± 1 | | | ↑ 425% |
|  | |  |  | |  | |  | |  | | Testing: FES-cycling ergometer | | Peak lactate | | 9.0 ± 1.2 | | | NS ↑ up to 11.8 ± 0.9 |
|  | |  |  | |  | |  | |  | |  | | MHC isoform IIA | | 33% | | | ↑ 61% |
| **Hjeltnes, 1998**[**30**](#_ENREF_30) | | Arm cycling | 10 | | 25 ± 2 | | < 0.5 | | C6-C8 | | Case -controlled study | | Peak VO2, L/min - Cervical | | 0.78 ± 0.07 | | | No changes in Cervicals |
|  | |  | 10 | | 31 ± 4 | | < 0.5 | | T7 - T11 | | Arm cycling | | Peak VO2, L/min - Thoracic | | 1.37 ± 0.08 | | | ↑ 28%, *P* < .001 |
|  | |  |  | |  | |  | | ASIA A-B | | 12-16 wk 3x/wk, 30' | | Peak PO, W | | 22 ± 2 | | | ↑ 45%, *P* < .01 |
|  | |  |  | |  | |  | |  | | Testing: Arm crank ergometer | | Peak HR, bpm | | 110 ± 5 | | | No changes |
|  | |  |  | |  | |  | |  | |  | | Peak Lactate, mmol/L | | 5.86 ± 1.32 | | | No changes |
| **Janssen, 2008**[**31**](#_ENREF_31) | | FES-cycling | 12 | | 36 ± 16 | | 11 ± 9 | | C4-T11 | | Uncontrolled study | | Peak VO2, L/min | | 0.81 ± 0.28 | | | NS ↑ 30% |
|  | |  |  | |  | |  | | ASIA A-C | | 6 wk 3x/wk, 30' | | Peak PO, W | | 8.6 ± 9.9 | | | ↑56% |
|  | |  |  | |  | |  | |  | | Interval training | | Peak HR, bpm | | 97.4 ± 11.2 | | | NS ↑ to 113.3 ± 23.0 |
|  | |  |  | |  | |  | |  | | Testing: FES-cycling ergometer | | Peak VE, L/min | | 41.3 ± 12.3 | | | NS ↑ to 49.1 ± 9.1 |
|  | |  |  | |  | |  | |  | |  | | Peak CO, L/min | | 8.6 ± 1.9 | | | NS ↑ to 9.5 ± 2.3 |
|  | |  |  | |  | |  | |  | |  | | Peak lactate, mmol/L | | 6.6 ± 1.9 | | | NS ↑ to 8.7 ± 1.0 |
| **Qiu, 2016**[**57**](#_ENREF_57) | | FES rowing | 12 | | 33 ± 4 | | 8 ± 3 | | C4 – T2 | | Uncontrolled study | | Peak VO2 ,mL/min/kg | | 15.3 ± 1.5 | | | ↑ 12% (*P* = .02) |
|  | |  |  | |  | |  | |  | | 24 wk 2-3x/wk, 75%, 30' | | Peak PO, W | | 34.6 ± 4.4 | | | ↑ 28% (*P* < .01) |
|  | |  |  | |  | |  | |  | | Testing: FES-rowing | | Peak VE, L/min | | 37.5± 4.4 | | | tendency *P* = .09 |
|  | |  |  | |  | |  | |  | |  | | Peak HR, bpm | |  | | | No changes |
|  | |  |  | |  | |  | |  | |  | | RER | |  | | | No changes |
|  | |  |  | |  | |  | |  | |  | | R. Peak VO2 vs. Peak VE | | R2 = 0.62 | | | ↑ to r2 = 0.84 |
| **Wouda, 2018**[**33**](#_ENREF_33) | | Treadmill-85-95% | 10 | | 50 ± 15 | | < 0.5 | | 7C/1T/2L | | Randomized controlled trial | | Peak VO2, L/min | | 2.70 ± 0.81 | | | ↑ ~10% no ≠ btw gps |
|  | | Treadmill 70% | 10 | | 34 ± 15 | | < 0.5 | | 4C/4T/2L | | 12 wk, 2x/wk, 35' vs. 45' | | 6MWD, m | | 561 ± 93 | | | ↑ ~15% no ≠ btw gps |
|  | | Usual care | 10 | | 41 ± 19 | | < 0.5 | | 7C/2T/2L | | Testing: Treadmill | | Daily energy expenditure, KJ | | 2666 ± 528 | | | No changes |
|  | |  |  | |  | |  | | ASIA C-D | |  | |  | |  | | |  |
|  | |  |  | |  | |  | |  | |  | | Peak lactate, mmol/L | | 6.6 ± 1.9 | | | NS ↑ to 8.7 ± 1.0 |
| ***Thoracic injuries*** | | | |  | |  | |  | |  | |  | |  | |  |  | |
| **Valent, 2009**[**51**](#_ENREF_51) | | Hand cycle | 35 | | 42 ± 14 | | < 0.5 | | T1-T12 | | Cohort study | | Peak VO2, Para, L/min | | 1.10 ± 0.23 | | | ↑29% vs. bsl |
|  | | Control | 56 | | 40 ± 15 | | < 0.5 | | T1-T12 | | 20-30 wk, 1-3/wk, 20-30' | | Peak VO2 Para – Cont. | | 1.22 ± 0.48 | | | ↑7% vs. bsl |
|  | | Hand cycle | 20 | | 33 ± 10 | | < 0.5 | | C5-C8 | | Testing: Wheelchair treadmill | | Peak VO2 Tetra, L/min | | 0.86 ± 0.32 | | | No changes |
|  | | Control | 26 | | 44 ± 14 | | < 0.5 | | C5-C8 | |  | | Peak VO2 Tetra – Cont. | | 0.97 ± 0.38 | | | No changes |
| **Tordi, 2001**[**29**](#_ENREF_29) | | Wheelchair | 5 | | 27 ± 8.1 | | ~ 2 | | T6-L4 | | Uncontrolled study | | Peak VO2 , mL/kg/min | | 21 (17 - 33) | | | ↑18.5% |
|  | |  |  | |  | |  | | ASIA A | | 4 wk 3x/wk, 30' | | Peak PO, W | | 45 (35 - 45) | | | ↑27.9% |
|  | |  |  | |  | |  | |  | | interval training | | Peak HR, bpm | | 176 | | | ↓ 5% |
|  | |  |  | |  | |  | |  | | Testing: Wheelchair treadmill | | Peak VE, L/min | | 64 (47 - 78) | | | No changes |
| *Cardiac structure and function* | | | | | | | | | | | | | | | | | | |
| ***Cervical injuries*** |  | | |  | |  | |  | |  | |  | |  | |  |  | |
| **Nash, 1991**[**35**](#_ENREF_35) | | NMES Quad | 8 | | 28 ± 5 | | 6 ± 3 | | C5-C7 | | Uncontrolled study | | LV internal dimension, mm | | 48.9 ± 3.4 | | | ↑ 6.5% (*P* <·02) |
|  | | + FES-cycling |  | |  | |  | | ASIA A | | 24 wk, 3/wk, 30’ | | ISWT, mm | | 7.5 ± 1.3 | | | ↑ 18% (*P* <·002) |
|  | |  |  | |  | |  | |  | | Echocardiography | | Posterior wall thickness, mm | | 7.4 ± 1.2 | | | ↑ 20% (*P* <.01) |
|  | |  |  | |  | |  | |  | | End-diastolic measurements | |  | |  | | |  |
| **Hooker, 1992**[**34**](#_ENREF_34) | | FES-cycling | 18 | | 30 ± 2 | | 6 ± 1 | | C4-T11 | | Uncontrolled study | | Peak VO2, L/min | | 0.78 ± 0.05 | | | ↑ 23% *P* < .05 |
|  | |  |  | |  | |  | |  | | 12-16 wk, 2/3x/wk, 10-30’ | | Peak CO, L/min | | 8.5 ± 0.5 | | | ↑ 13% *P* < .05 |
|  | |  |  | |  | |  | |  | | Impedance cardiography | | Total peripheral resistance, mmHg/L/min | | 11.3 ± 0.9 | | | ↓ 14% *P* < .05 |
|  | |  |  | |  | |  | |  | |  | | Peak VE, L/min | | 28.1 ± 1.2 | | | ↑ 27% *P* < .05 |
| **Taylor, 1993**[**36**](#_ENREF_36) | | NMES + stand ES | 7 | | 27 ± 7 | | 2 ± 1 | | C5-T12 | | Uncontrolled study | | Resting CO mL/min resting? | | 4360 ± 2790 | | | NS ↑ to 5230 ± 1750 |
|  | |  |  | |  | |  | |  | | 3 mo program | | Thigh blood flow mL/min | | 167 ± 70 | | | ↑ 115% *P* < .001 |
|  | |  |  | |  | |  | |  | | 300 ms, 20 Hz, up to 150mA | | Quadriceps depth, mm | | 14.5 ± 4.2 | | | ↑ 70% *P* < .001 |
|  | |  |  | |  | |  | |  | | Impedance cardiography | | Subcutaneous fat, | | 15.9 ± 4.4 | | | NS ↑ to 17 ± 4 |
| **Hjeltnes, 1998**[**30**](#_ENREF_30) | | Arm cycling | 10 | | 25 ± 2 | | < 0.5 | | C6-C8 | | Case controlled study | | Peak VO2, L/min - Cervical | | 0.78 ± 0.07 | | | No changes in Cervicals |
|  | |  | 10 | | 31 ± 4 | | < 0.5 | | T7 - T11 | | Arm cycling | | Peak VO2, L/min - Thoracic | | 1.37 ± 0.08 | | | ↑ 28%, *P* <.001 |
|  | |  |  | |  | |  | |  | | CO2-rebreathing method | | Submax CO - Cervical | | 5.5 ± 0.6 | | | NS ↑ to 6.8 ± 1.2 |
|  | |  |  | |  | |  | |  | |  | | Submax CO - Thoracic | | 7.3 ± 0.4 | | | No changes |
|  | |  |  | |  | |  | |  | |  | | Submax SV - Cervical | | 50 ± 4 | | | NS ↑ to 69 ± 14 |
|  | |  |  | |  | |  | |  | |  | | Submax SV - Thoracic | | 52 ± 4 | | | No changes |
| **D.E. Rossi, 2014**[**68**](#_ENREF_68) | | Sedentary | 29 | | 31 ± 1 | | 7 ± 1 | | C4-T12 | | Cross-sectional analysis | | SV, mL | | 61.2 ± 2.3 | | | > 15% in athletes, *P* < .05 |
|  | | Athletes | 29 | | 29 ± 1 | | 9 ± 1 | | C4-T12 | | > 1 yr sport practice | | LV end-diastolic diameter, mm | | 44.6 ± 0.7 | | | > 7% in athletes, *P* < .05 |
|  | |  |  | |  | |  | | ASIA A/B | | Echocardiography | | LV end-systolic diameter, mm | | 28.0 ± 0.6 | | | > 8% in athletes, *P* < .05 |
| **Gibbons, 2016**[**58**](#_ENREF_58) | | FES-rowing | 5 | | 32 ± 5 | | 7 ± 7 | | C4-T10 | | Uncontrolled study | | VO2peak, L/min | | 0.97 ± 0.22 | | | ↑ 11%, *P* < .05 |
|  | |  |  | |  | |  | | ASIA A-B | | 8 wk, 3/wk, 30' | | Peak HR, bpm | | 151 ± 7 | | | ↑ 8%, *P* < .05 |
|  | |  |  | |  | |  | |  | | Doppler | | LV mass, g | | 110 ± 6 | | | ↑ 7%, *P* < .05 |
|  | |  |  | |  | |  | |  | | Echocardiography | | EDV, mL | | 65 ± 8 | | | ↑ 40% *P* < .05 |
|  | |  |  | |  | |  | |  | |  | | ESV, mL | | 28 ± 5 | | | ↑ 25%, *P* < .05 |
|  | |  |  | |  | |  | |  | |  | | Diastolic function (E/A) | | 1.38 ± 0.05 | | | ↑ 9%, *P* < .05 |
| ***Thoracic injuries*** | | | |  | |  | |  | |  | |  | |  | |  |  | |
| **Gates, 2002\***[**67**](#_ENREF_67) | | Power | 11 | | 25 ± 7 | | 5-24 | | T1-T10 | | Cross-sectional analysis | | Wall thickness, cm | | 0.83 ± 0.10 | | | Tend to ↑ in whole group |
|  | | Endurance | 10 | | 30 ± 9 | | 8-18 | | T4-L1 | | Doppler | | LV mass, g | | 164 ± 66 | | | Tend to ↑ in whole group |
|  | | Sedentary | 5 | | 29 ± 6 | | 3-16 | | T1-T4 | | Echocardiography | |  | |  | | | no ≠ between groups |
| **Maggioni, 2012**[**64**](#_ENREF_64) | | Endurance | 10 | | 33 ± 7 | | NA | | T1–L1 | | Cross-sectional analysis | | VO2peak, mL/kg/min | | 13.3 ± 3.3 | | | > 61% in trained, *P* = .001 |
|  | | Untrained | 7 | | 36 ± 10 | |  | | T1–L3 | | 5 yr / 3-5h /wk | | IVST, mm | | 8.6 ± 0.8 | | | >18% in trained, *P* = .01 |
|  | |  |  | |  | |  | | ASIA A | | Echocardiography | | posterior wall thickness, mm | | 8.4 ± 1.1 | | | NS ≠ in trained |
|  | |  |  | |  | |  | |  | |  | | LV mass, g/m2 | | 56.3 ± 17.5 | | | > 48% in trained, *P* = .01 |
|  | |  |  | |  | |  | |  | |  | | E/A ratio | | 1.64 ± 0.80 | | | NS ≠ in trained |
| *Autonomic function* | | | | | | | | | | | | | | | | | | |
| **Bloomfield, 1994**[**39**](#_ENREF_39) | | FES-cycling | 7 | | 28 ± 2 | | 5 ± 1 | | C5-T7 | | Uncontrolled study | | VO2peak, L/min | | 0.72 ± 0.1 | | | No changes |
|  | |  |  | |  | |  | |  | | Catecholamine | | Resting EPI pmol/L | | 163 ± 32 | | | ↓ 80%, *P* < .05 |
|  | |  |  | |  | |  | |  | |  | | Exercise NE pmol/L | | 1350 ± 610 | | | No changes |
|  | |  |  | |  | |  | |  | |  | | Exercise EPI pmol/L | | 510 ± 293 | | | No changes |
| **Ditor, JAP 2005**[**37**](#_ENREF_37) | | BWSTT | 8 | | 27.6 | | 9.6 ± 7.5 | | C4–C5 | | Uncontrolled study | | HR bpm | | 61.9 ± 6.9 | | | ↓10%, *P* < .05 |
|  | |  |  | |  | |  | | ASIA B-C | | 24 wk, 3x/wk, 15' | | LF HRV (0.04-0.15 Hz) bpm | | 5894 ± 815 | | | ↓13%, *P* < .05 |
|  | |  |  | |  | |  | |  | | 10' Finapres | | HF HRV (0.15-0.40 Hz) bpm | | 5493 ± 1472 | | | No changes |
|  | |  |  | |  | |  | |  | |  | | LF-to-HF ratio | | 1.23 ± 0.47 | | | ↓19%, *P* < .05 |
|  | |  |  | |  | |  | |  | |  | | LF SBP (0.04-0.15 Hz) mmHg2 | | 183.1 ± 46.8 | | | ↓14%, *P* < .01 |
|  | |  |  | |  | |  | |  | |  | | LF DBP (0.15-0.40 Hz) mmHg2 | | 191.0 ± 26.4 | | | No changes |
| **Ditor, SC 2005**[**38**](#_ENREF_38) | | BWSTT | 6 | | 37 ± 15 | | 7.6 ± 9.4 | | C4-T12 | | Uncontrolled study | | HR bpm | | 61.9 ± 9.7 | | | No changes |
|  | |  |  | |  | |  | |  | | 16 wk 15-60 min | | LF HRV (0.04-0.15 Hz) b/min | | 6302 ± 1251 | | | No changes |
|  | |  |  | |  | |  | |  | | 10' Finapres | | HF HRV (0.15-0.40 Hz) bpm | | 4647 ± 664 | | | No changes |
|  | |  |  | |  | |  | |  | |  | | LF/HF ratio | | 1.45 ± 0.44 | | | No changes |
| **Millar, 2009**[**40**](#_ENREF_40) | | BWSTT | 6 | | 37 ± 8 | | 5.0 ± 4.4 | | C5-T10 | | Cross-over study | | Normalized LF HRV | | 68.1 ±10.3 | | | No changes |
|  | |  |  | |  | |  | | ASIA A-C | | 4 wk, 3x/wk | | Normalized HF HRV | | 31.9 ±10.3 | | | No changes |
|  | |  |  | |  | |  | |  | | 5' Finapres | | LF/HF ratio | | 4.45 ± 1.32 | | | No changes |
|  | |  |  | |  | |  | |  | | (breathing 12/min) | | RMSSD | | 40.1 ± 23.0 | | | No changes |
| **Solinsky, 2020**[**15**](#_ENREF_15) | | FES-rowing | 15 | | 30 ± 1 | | 0.8 ± 0.1 | | C1-T10 | | Randomized controlled | | VO2peak, mL/kg/min | | 18.3 ± 1.3 | | | ↑ 11% vs. bsl |
|  | | Control | 17 | | 25 ± 1 | |  | | C1-T10 | | 24 wk, 2x/wk, 30' | | LF HRV (0.05–0.15 Hz) ms2 | | 316 ± 55 | | | No changes |
|  | |  |  | |  | |  | | ASIA A-C | | 5' Finapres | | HF HRV (0.20–0.30 Hz) ms2 | | 682 ± 135 | | | No changes |
|  | |  |  | |  | |  | |  | | (breathing 15/min) | | LF BPV (0.05–0.15 Hz) mmHg2 | | 1.39 ± 0.18 | | | No changes |
|  | |  |  | |  | |  | |  | |  | | HF BPV (0.20–0.30 Hz) mmHg2 | | 3.23 ± 0.51 | | | No changes |
| *Cardiovascular function* | | | | | | | | | | | | | | | | | | |
| ***Cervical injuries*** |  | | |  | |  | |  | |  | |  | |  | |  |  | |
| **Ditor, SC 2005**[**38**](#_ENREF_38) | | BWSTT | 6 | | 37 ± 15 | | 7.6 ± 9.4 | | C4-T12 | | Uncontrolled study | | Femoral compliance, | | 0.07 ± 0.03 | | | ↑42%, *P* = .07 |
|  | |  |  | |  | |  | |  | | 16 wk, 15-60 min | | mm2/mmHg | |  | | |  |
|  | |  |  | |  | |  | |  | | Doppler ultrasound | |  | |  | | |  |
| **Matos-Souza, 2016**[**41**](#_ENREF_41) | | Upperbody | 8 | | 28 ± 2 | | 5.1 ± 1.3 | | C5-T9 | | Non randomized controlled | | Resting HR, bpm | | 71.4 ± 5.4 | | | ↑ in controls only |
|  | | Controls | 9 | | 33 ± 2 | | 7.6 ± 1.5 | | C4-T8 | | 5 yr follow up | | Resting SV, mL | | 71.4 ± 5.4 | | | No changes |
|  | |  |  | |  | |  | | ASIA A-B | | Carotid ultrasonography | | Resting CO, L/min | | 5.0 ± 0.3 | | | No changes |
|  | |  |  | |  | |  | |  | |  | | Carotid IMT, mm | | 0.74 ± 0.05 | | | ↓ 24% in trained only |
|  | |  |  | |  | |  | |  | |  | | CCA diameter, mm | | 5.3 ± 0.2 | | | No changes |
|  | |  |  | |  | |  | |  | |  | | CCA resistive index | | 0.82 ± 0.02 | | | No changes |
| **Schreiber, 2018**[**74**](#_ENREF_74) | | Athletes | 25 | | 30 ± 6 | | 9.7 ± 4.5 | | C4 to < T6 | | Cross-sectional comparison | | Carotid IMT, mm | | 0.69 ± 0.10 | | | < 19% in athletes, *P* < .01 |
|  | | Sedentary | 16 | | 34 ± 7 | | 8.2 ± 3.0 | | C4 to < T6 | | Athletes: 5 yr, 11 h/wk | | E/A ratio | | 1.43 ± 0.38 | | | > 13% in athletes, *P* = .14 |
|  | |  |  | |  | |  | |  | | Carotid ultrasonography | | E/Em ratio | | 7.7 ± 2.5 | | | NS ≠ in trained |
|  | |  |  | |  | |  | |  | | Echocardiography | | Adipocytokines | | - | | | NS ≠ in trained |
| **Faulkner, 2019**[**42**](#_ENREF_42) | | Exoskeleton | 6 | | 30 (13) | | 2.7 (1.3) | | ASIA A-C | | Non-randomized trial | | Augmentation index (AIx), % | | 30 ± 18 | | | ↓ 30%, *P* = .001 |
|  | | Usual care | 6 | | 38 (17) | | 3.6 (2.5) | | ASIA A-C | | 5 d, 90 min | | Normalized AIx to HR, % | | 21 ± 18 | | | ↓ 33%, *P* = .001 |
|  | |  |  | |  | |  | |  | | SphygmoCor | | MAP, mmHg | | 89 ± 11 | | | NS ↓, *P* = .47 |
|  | |  |  | |  | |  | |  | |  | | Central SBP, mmHg | | 117 ± 17 | | | No changes |
|  | |  |  | |  | |  | |  | |  | | Central DBP, mmHg | | 72 ± 8 | | | No changes |
| ***Thoracic injuries*** | | | |  | |  | |  | |  | |  | |  | |  |  | |
| **Nash, 1997**[**72**](#_ENREF_72) | | FES-walking | 12 | | 28 ± 7 | | 3.9 ± 3.1 | | T4-T11 | | Uncontrolled study | | Cross-sectional area, cm | | 0.36 ± 0.06 | | | ↑ 33%, *P* < .0001 |
|  | |  |  | |  | |  | |  | | Doppler ultrasound | | CFA Flow velocity integral, cm | | 16.8 ± 3.8 | | | ↑ 26%, *P* < .05 |
|  | |  |  | |  | |  | |  | | CFA = common femoral artery | | CFA pulse volume, mL | | 6.0 ± 1.7 | | | ↑ 67% (*P* = .001) |
|  | |  |  | |  | |  | |  | |  | | CFA inflow mL/min | | 417.1 ± 122 | | | ↑ 56% (*P* < .01) |
|  | |  |  | |  | |  | |  | |  | | Resting HR, bpm | | 70.1 ± 10.1 | | | ↓ 7% (*P* < .05) |
| *Blood markers of cardiovascular risk* | | | | | | | | | | | | | | | | | | |
| ***Cervical injuries*** |  | | |  | |  | |  | |  | |  | |  | |  |  | |
| **Hjeltnes, 1997**[**65**](#_ENREF_65) | | FES-cycling | 5 | | 35 ± 3 | | 10 ± 3 | | C5-C7 | | Uncontrolled study | | VO2peak, mL/kg/min | | ~7.5 ± 2.0 | | | ↑70% (*P* < .05) |
|  | |  |  | |  | |  | |  | | DEXA and CT scan | | Whole body fat | | 29.7 ± 2.6 | | | ↓ 7% (*P* < .05) |
|  | |  |  | |  | |  | |  | |  | | Lower limb muscles CSA, cm2 | | 267 ± 27 | | | ↑ 21% (*P* < .05) |
| **Midha, 1999**[**44**](#_ENREF_44) | | Wheelchair | 12 | | 22-58 | | 12 ± 7 | | C6-L3 | | Uncontrolled study | | VO2peak, mL/kg/min | | 19 + 6 | | | ↑ 25%, *P* = .02 |
|  | |  |  | |  | |  | |  | | 10 wk, 2-3/wk, 30' | | Resting HR, bpm | | 93 ± 14 | | | ↓ 29%, *P* = .02 |
|  | |  |  | |  | |  | |  | | Blood samples | | Fasting serum cholesterol, mg/dL | | 185 ± 42 | | | ↓ 8%, *P* = .04 |
| **de Groot, 200343** | | Arm-crank High | 3 | | 39 (2) | | 0.3 ± 0.3 | | C5 to L1 | | Randomized controlled study | | VO2peak, mL/kg/min | | ~14 ± 6 | | | ↑+33% High vs. Low |
|  | | Arm-crank Low | 3 | | 52 (2) | | 0.3 ± 0.3 | | C5 to L1 | | 8 wk, 3/wk [75% vs. 45%HRR] | | Total Chol/HDL (post/pre) | | 100 (20) | | | ↓ 23% High vs. Low |
|  | |  |  | |  | |  | |  | | Fasting blood samples | | Triglycerides (post/pre) | | 95 (14) | | | ↓ 32% High vs. Low |
|  | |  |  | |  | |  | |  | | HOMA-CIGMA test | | Insulin sensitivity | | 156 (55) | | | NS↓ High vs. NS↑ Low |
| **Kim, 2019**[**45**](#_ENREF_45) | | Aerobic + resistance | 11 | | 36 ± 6 | | (2-27) | | C4-L1 | | Randomized controlled trial | | VO2peak, mL/kg/min | | 11.7 ± 8.1 | | | ↑ 35%vs. bsl, *P* < .05 |
|  | | Control | 6 | |  | |  | |  | | 6 wk, 3/wk, 60' | | Insulin, μU/ml | | 7.5 ± 4.7 | | | ↓ 40%, *P* < .05 |
|  | |  |  | |  | |  | |  | | Fasting blood samples | | HOMA-IR | | 1.5 ± 1.0 vs | | | ↓ 40%, *P* < .05 |
|  | |  |  | |  | |  | |  | |  | | Fat mass, % | | 35.3 ± 10.8 | | | ↓ 6%, *P* < .05 |
|  | |  |  | |  | |  | |  | |  | | Total Chol, mg/dL | | 162.3 ± 34.1 | | | No change |
|  | |  |  | |  | |  | |  | |  | | HDL-C, mg/dL | | 48.7 ± 21.3 | | | ↑ 12%, *P* < .05 |
| ***Thoracic injuries*** | | | |  | |  | |  | |  | |  | |  | |  |  | |
| **Ordonez, 2013**[**46**](#_ENREF_46) | | Arm-crank | 9 | | 29 ± 3 | | 4.6 ± 0.3 | | < T5 | | Randomized controlled trial | | VO2peak, ml/kg/min | | 23.2 ± 2.1 | | | ↑10% vs. pretest |
|  | | Control | 8 | | 30 ± 3 | | 4.6 ± 0.3 | | < T5 | | 12 wk, 3/wk, 30' | | PTAS, mmol/L | | 0.64 ± 0.2 | | | ↑ 37% vs. pretest |
|  | |  |  | |  | |  | |  | | 50 - 65%HRR | | GP activity, U/g Hb | | 23.6 ± 2.4 | | | ↑ 18% vs. pretest |
|  | |  |  | |  | |  | |  | | Fasting blood samples | | Lipid peroxidation, mmol/L | | 0.48 ± 0.13 | | | ↓ 27% vs. pretest |
|  | |  |  | |  | |  | |  | |  | | Protein oxidation, nmol/mg | | 1.92 ± 0.3 | | | ↓ 31% vs. pretest |
| **Rosety-Rodriguez, 2014**[**47**](#_ENREF_47) | | Arm-crank | 9 | | 29 ± 3 | | 4.6 ± 0.3 | | < T5 | | Randomized controlled trial | | PAI-1, ng/dL | | 29.8 ± 6.2 | | | No change |
|  | | Controls | 8 | | 30 ± 3 | | 4.6 ± 0.3 | | < T5 | | 12 wk, 3/wk, 30' | | Adiponectin, ng/mL | | 18.8 ± 4.1 | | | No change |
|  | |  |  | |  | |  | |  | | Fasting blood samples | | Leptin, ng/mL | | 9.6 ± 2.7 | | | ↓ 20% vs. pretest and Control |
|  |  | |  | |  | |  | |  | | TNF-a, pg/mL | | 23.3 ± 5.6 | | | ↓ 13% vs. pretest and Control |
|  | |  |  | |  | |  | |  | |  | | IL-6, pg/mL | | 6.7 ± 2.2 | | | ↓ 61% vs. pretest and Control |

\*SCI and spina bifida

**Abbreviations**: Aix, Augmentation index; ASIA, American Spinal Injury Association impairment scale; BPV, Blood pressure variability; Bsl = baseline; CCA, common carotid artery; CFA, common femoral artery; CO, cardiac output; DBP, diastolic blood pressure; E/A, peak early/atrial velocity ratio; EDV, end diastolic volume; E, peak early inflow velocity; EPI, epinephrine; ESV, end-systolic volume; GP, glutathione peroxidase ; Hb, hemoglobin; HDL, high density lipoprotein, HF, high frequency; HOMA-IR, homeostasic model assessment of insulin resistance; HR, heart rate; HRV, heart rate variability; IMT, intima media thickness; ISWT, interventricular septal wall thickness; IVST, intra-ventricular septum thickness; LF, Low frequency; IL-6, interleukin 6; LV, left ventricle; MAP, mean arterial pressure; MHC, myosin heavy chain; NE, Norepinephrine; PA, physical activity; PAI-1, plasminogen activator inhibitor type 1; PO, power output; PTAS, Plasmatic total antioxidant status; PWV, pulse wave velocity; RER,respiratory equivalent ratio; RMSSD, root means square standard deviation; SBP, systolic blood pressure; SV, stroke volume; TNF-α, tumor necrosis factor alpha; VE, minute ventilation; VFR, ventricular filling rate; VO2peak, peak O2 uptake; 6MWD, 6 minute walking distance.