Wheeled mobility in sports: Optimal training in handcycling

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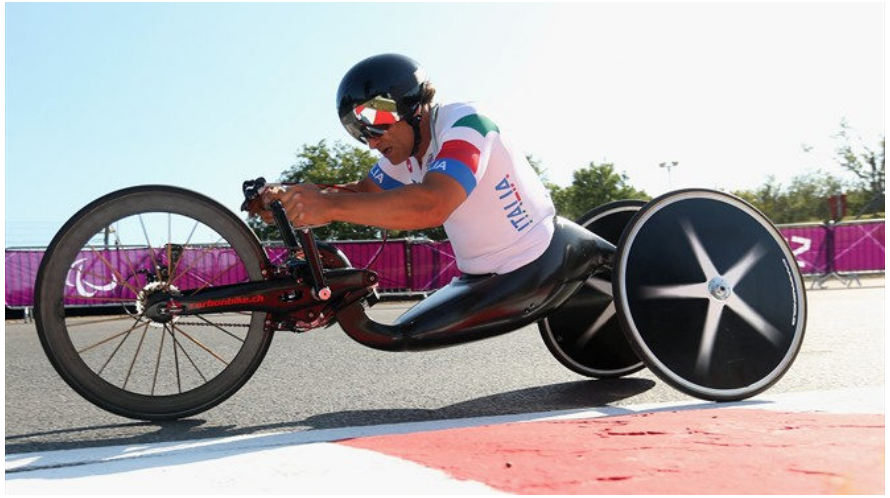

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Paralympic sport: a true challenge

Adapted sports: a challenge for science

- Literature is scarce
- Different handicaps, so no large groups to test with large variation
- Current training guidelines (ACSM) not necessarily true for upper body exercise……

Upper body training: Possibilities of handcycling

- Reference values able-bodied individuals to understand upper body physiology
  - Training responses the same as in lower body?
- Adapt to individual athletes/patients with each their own handicap.

Training studies on handcycling: 55%HRR

Knechtle B, Muller G, Knecht H. Optimal exercise intensities for fat metabolism in handbike cycling and cycling. Spinal Cord 42 (10), 564-572

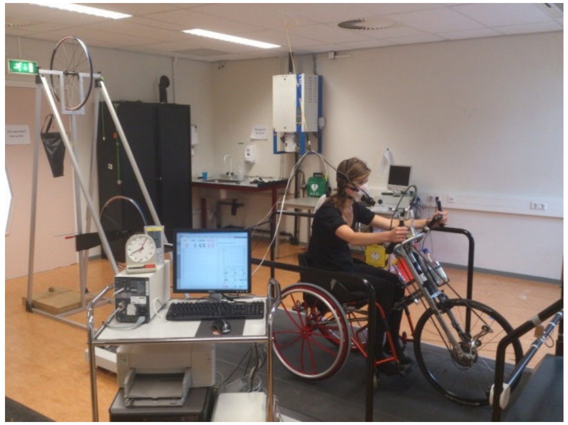
Able-bodied sports sciences: HIT

Seiler KS, Kjerland GO. Quantifying training intensity distribution in elite endurance athletes: is there evidence for an 'optimal'distribution? Scan J Med Sci Sports; 16(1):49-56

HIT vs CT: 7 weeks, 3 times per week High Intensity vs Continuous (M): resistance and velocity

Maximal incremental exercise test

- Constant velocity (1,11 m/s; 70 rpm)
- Resistance with a pulley system
  - Start 20 W; 7 W/minute (PO)

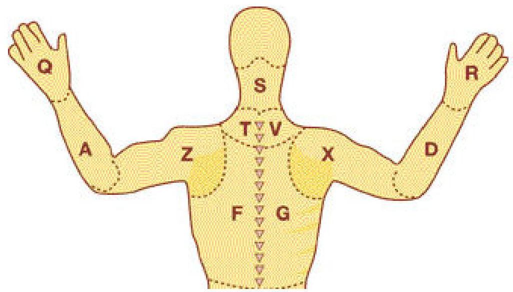


Respiratory and metabolic parameters

- VO_2, RER, VE, HR (Oxycon Delta)

Gross-efficiency (GE)

RPE and LPD



HIT vs CT

CT = Continuous Training Protocol (n=8)

3 CT training / week 30-min at 55 % HRR

HIT = High Intensity Training Protocol (n=8)

2 HIT training / week at 85 % HRR, 1 CT / week at 55 % HRR

HIT protocol: 4 x 4 - minutes excessive exercise (85 % HRR)[24]

3 - minutes of passive rest

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High intensity

		Continuous Training	High Intensity Training	Interaction effect
VO_{2peak} ($ml \cdot min^{-1}$)	pre[1]	2484.7 (436.0)	2624.1 (366.6)	< 0.01 **
	post	2715.4 (234.5) *	3249.8 (354.1) *	
V_{Epeak} ($l \cdot min^{-1}$)	pre[1]	89.7 (20.3)	99.7 (20.1)	0.141
	post	109.4 (13.4) *	130.4 (13.9) *	
HR_{peak} (bpm)	pre[1]	179.6 (21.1)	188.4 (9.2)	0.366
	post	185.6 (13.3)	190.3 (7.8)	
RER	pre[1]	1.17 (0.05)	1.18 (0.05)	0.144
	post	1.24 (0.03) *	1.22 (0.06)	
PO_{peak} (W)	pre[1]	128.9 (26.9)	133.2 (26.2)	< 0.01 **
	post	169.0 (27.9) *	191.3 (16.2) *	

- Notable increases **CT** and **HIT. I**mprovements in VO_{2peak} (+ 23.8 %) and PO_{peak} (+ 43.6%) were larger in **HIT** compared to **CT**.
- No diff. total work HIT (2288 ± 288kJ) and CT (2319 ± 258kJ)

Conclusions

- As in other endurance sports, HIT improved physical capacity and PPO in handcycling
- VO_{2peak} and PPO improved more after HIT compared to CT, even though total work spent in the 2 training sessions was equal

Peak capacity: SCI vs. able-bodied

	VO_{2peak} (l/min)	PO_{peak} (W)	HR_{peak} (bpm)
Able-bodied males	2.56 ± 0.32	143.0 ± 1 8.0	169 ± 12
Mixed (Paraplegia)	2.14 ± 0.43	111.0 ± 16	172 ± 5
Tetraplegia	1.21 ± 0.32	38.4 ± 16.7	122 ± 16

Future aims

- Create understanding of upper body physiology
- Get insight into physiology of different handicaps
- Apply knowledge in ADL and sports practice: training guidelines

Thank you

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