

Hanbiken compared to cycling: peak values

- Preliminary results incremental testing Handbike (HB) vs. Bike (B):
 - VO_{2peak} HB at $\sim 60\%VO_{2max}$ B
 - HR_{peak} HB at $\sim 90\%HR_{max}$ B
 - PO_{peak} HB at $\sim 35\%PO_{max}$ B



Training: 3 programs

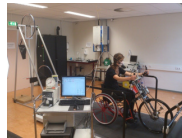
- ACSM: 7 weeks, 3 times per week at 70%HRR (F): resistance and velocity
- Low intensity: 7 weeks, 3 times per week at 30%HRR (F): resistance and velocity
- HIT vs CT: 7 weeks, 3 times per week High Intensity vs Continuous (M): resistance and velocity



Protocol to evaluate training

Maximal incremental exercise test

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

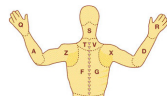


Respiratory and metabolic parameters

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

Gross-efficiency (GE)

RPE and LPD



Training conform ACSM: 7 weeks, 3 times per week at 70%HRR (F)

- VO_{2peak} : + 18.1%
- HR_{peak} : + 4.0%
- PO_{peak} : + 31.9% !!
- VO_{2peak} at 70% VO_{2max}
- PO_{peak} at 42% PO_{max}
- HR_{peak} at 96% HR_{max}



Low intensity training: 7 weeks, 3 times per week at 30%HRR (F)

Peak values pre and post test:

Table 1: Hand cycling incremental exercise peak values before (pre) and after (post) the training program for both the training and control group. Significant differences between pre and post test are marked with * ($p < 0.05$) and ** ($p < 0.01$).

	Control			Training		
	Pre-test	Post-test	Diff. (%)	Pre-test	Post-test	Diff. (%)
VO_2 (ml·min ⁻¹)	1,78 ± 0,42	1,81 ± 0,47	1,7	1,60 ± 0,20	1,68 ± 0,24	5,0
V_E (l·min ⁻¹)	73,0 ± 20,1	75,7 ± 25,5	3,7	69,2 ± 14,4	79,1 ± 17,5	14,3
HR (beats·min ⁻¹)	182 ± 9	183 ± 5	0,5	182 ± 11	188 ± 11	3,2*
PO_{peak} (W)	88,2 ± 18,9	91,3 ± 20,7	3,5	81,1 ± 11,2	97,4 ± 11,3	20,1**
RPE	19,2 ± 1,0	19,6 ± 0,5	2,1	19,4 ± 1,3	19,8 ± 0,4	2,1

Low intensity training

Submaxal values pre en post test:

Table 2: Values at submaximal stages (27 W and 55 W) of the maximal incremental pre- and post test. Significant differences between pre and post test are marked with * ($p < 0.05$) and ** ($p < 0.01$).

	Control			Training		
	Pre-test	Post-test	Diff. (%)	Pre-test	Post-test	Diff. (%)
VO_2 (ml·kg ⁻¹ ·min ⁻¹)	744 ± 94	703 ± 111	-5,5	690 ± 76	589 ± 101	-17,1*
V_E (l·min ⁻¹)	1151 ± 137	1067 ± 159	-7,3*	1148 ± 117	955 ± 133	-20,2*
HR (beats·min ⁻¹)	21,8 ± 2,2	20,8 ± 2,4	-4,6	21,4 ± 3,6	16,3 ± 3,1	-31,3*
PO_{peak} (W)	36,1 ± 5,5	34,1 ± 5,0	-5,5	37,6 ± 6,1	28,3 ± 4,5	-32,9*
RPE	131 ± 23	128 ± 15	-2,3	135 ± 18	121 ± 10	-11,6*
PO_{peak} (W)	160 ± 18	155 ± 15	-3,1	163 ± 15	154 ± 12	-5,8*
RPE	7,4 ± 1,6	7,6 ± 1,2	2,7	8,6 ± 1,2	6,3 ± 0,5	-36,5*
	13,8 ± 3,5	14,3 ± 3,2	3,6	14,8 ± 2,4	11,0 ± 3,2	-34,5*

HIT vs CT

CT = Continuous Training Protocol

(gebaseerd op handbike literatuur):

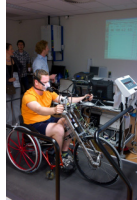
3 CT training / week 30-min at 55 % HRR

HIT = High Intensity Training Protocol

(gebaseerd op literatuur endurance training hardlopen)

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·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·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) *	

- No baseline differences between training groups on pretest.
- Notable increases **CT** and **HIT**. Improvements in VO_{2peak} (+ 23.8 %) and PO_{peak} (+ 43.6%) were larger in **HIT** compared to **CT**.

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Conclusions

- Training according to ACSM leads to improved performance and fitness. Can be used as basis.
- For high intensity (HIT) training, largest improvements were found.
- Low intensity training clearly showed submaximal benefits: mobility and ADL.



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Peak training parameters: patients vs. able-bodied

	VO _{2peak} (l/min)	PO _{peak} (W)	HR _{peak} (bpm)
Able-bodied males	2.56 ± 0.32	143.0 ± 18.0	169 ± 12
Mixed (Paraplegie)	2.14 ± 0.43	111.0 ± 16	172 ± 5
Tetraplegie	1.21 ± 0.32	38.4 ± 16.7	122 ± 16

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Future aims

Create an understanding of upper body physiology

Get insight into different handicaps

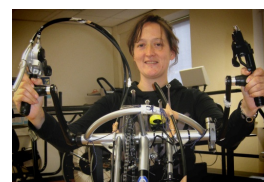
Apply knowledge: in ADL and elite sports



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Dank voor de aandacht

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