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A maximal perceptually-regulated exercise test is reliable and valid for measuring peak oxygen uptake in manual wheelchair users

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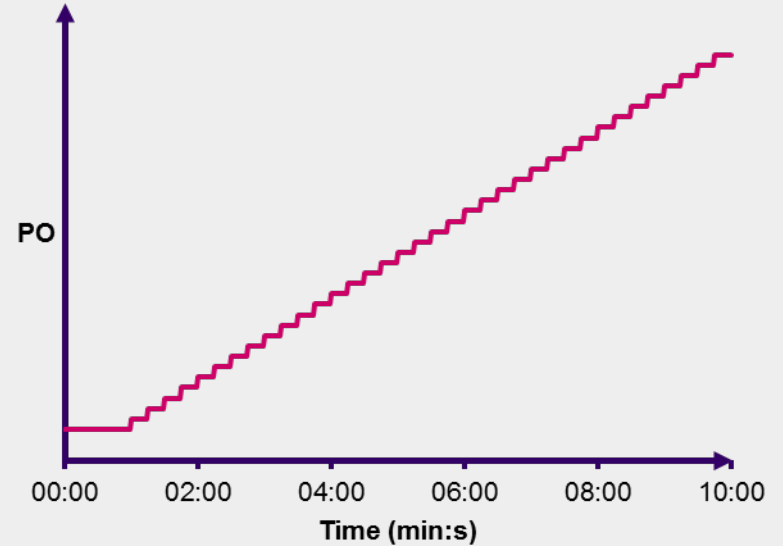
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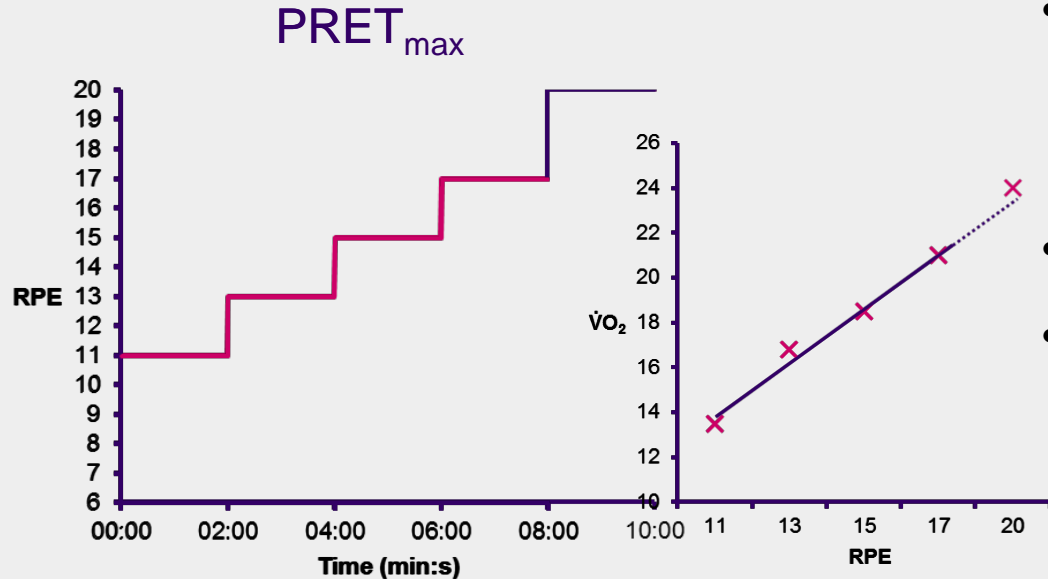
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Introduction

- Assessment of peak exercise responses the basis for many testing regimes.
 - Monitor fitness level.
 - Establish workloads for exercise prescription.
 - Adjustments in workload for progression.



Perceptually-regulated exercise test (PRET)



- Prediction of VO_{2peak} :
 - Al-Rahamneh & Eston (2011)
 - Goosey-Tolfrey et al. (2014)
- Wide limits of agreement.
- PRET_{max}:
 - Cycle ergometry: Straub et al. (2014).
 - Handcycle ergometry: Hutchinson et al. (2017).

Aim

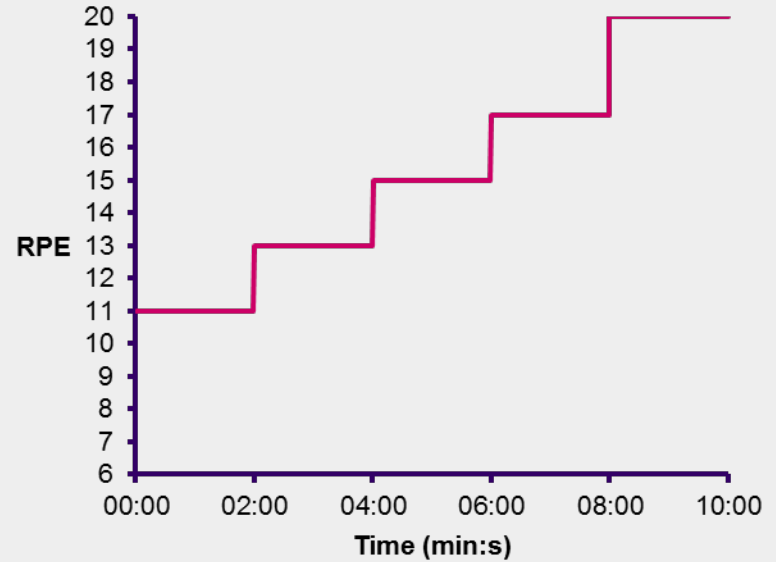
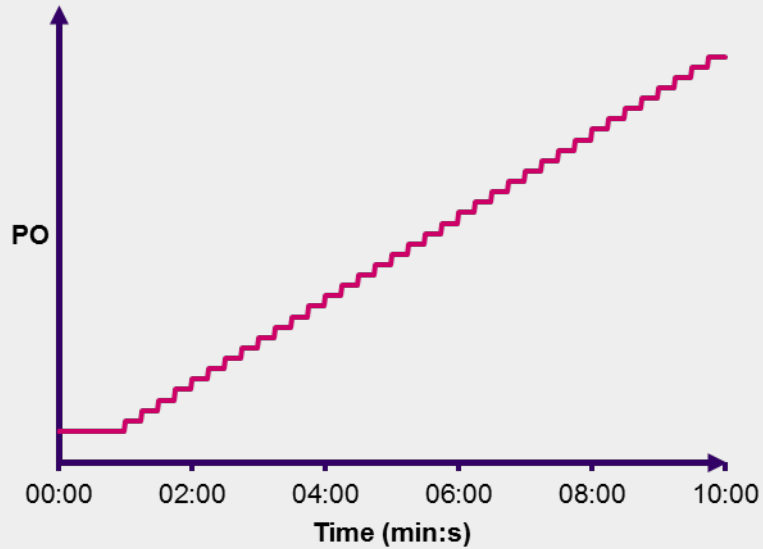
- Comparison between ramp-incremented and PRET_{max} protocols:
 - Test-retest reliability.
 - Maximal exercise responses.
 - Affective response.



Age (years)	56 ± 10
Height (m)	1.76 ± 0.15
Body mass (kg)	91 ± 22.4
Physical activity level ($\text{h}\cdot\text{week}^{-1}$)	4 ± 3

Methods

Week 1 ← → Week 2

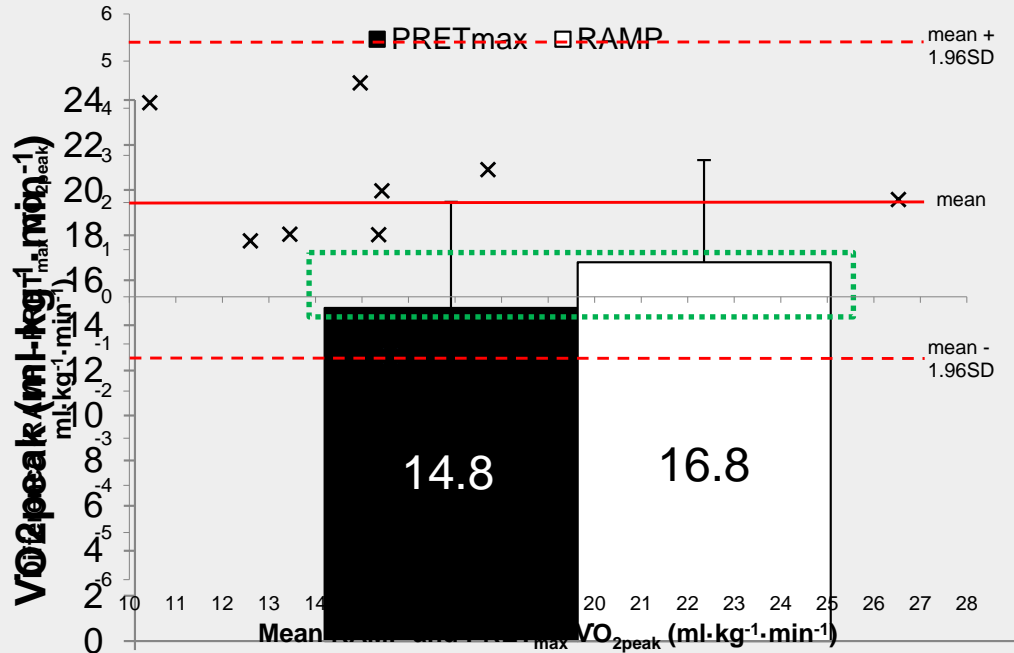


Results: Test-retest reliability

*Leicht et al. (2013)

	PRET _{max}			RAMP		
	ICC _{3,1}	CV	ME	ICC _{3,1}	CV	ME
$\dot{V}O_{2peak}$ (L·min ⁻¹)	0.91	5.2	0.1	0.76	7.1 4.5	0.2
HR _{peak} (beats·min ⁻¹)	0.96	3.7	8	0.96	3.2 1.2	9
RER _{peak}	0.92	2.8	0.18	0.89	4.0 4.0	0.10
PO _{peak} (W)	0.91	8.5	14	0.97	3.2	6

Results: Maximal exercise responses



- Measurement error = 2.4 ml.kg⁻¹.min⁻¹.
- 95% Limits of Agreement: 2.0 (-1.3 to 5.4) ml.kg⁻¹.min⁻¹.

Results: Affective response

	RAMP	PRET _{max}
RPE 11	3.0 (2.8 - 4.2)	😊 4.0 (3.8 - 4.5)*
RPE 13	2.5 (1.3 - 3.0)	😊 3.5 (3.0 - 3.8)*
RPE 15	1.0 (0.5 - 1.8)	😊 2.0 (1.0 - 3.0)*
RPE 17	0.0 (-1.4 - 1.3)	😊 1.5 (0.8 - 2.0)*
End RPE	-3.0 (-4.0 - -0.5)	😊 0.0 (-2.5 - 0.5)*

+5	Very good
+4	
+3	Good
+2	
+1	Fairly good
0	Neutral
-1	Fairly bad
-2	
-3	Bad
-4	
-5	Very bad

Implications for athletes

- Likely highly reliable.
- Ease of scheduling:
 - Test is of fixed duration (10 mins).
- No need to decide on starting workload or increment:
 - Useful for Talent ID or new athletes.
- Affect.

Conclusions

- Results would serve to justify use of the $PRET_{max}$:
 - $PRET_{max}$ can be used to measure VO_{2peak} in wheelchair users.
 - $PRET_{max}$ displays acceptable test-retest reliability.
 - Affective response more positive throughout $PRET_{max}$ compared to during RAMP.
- Should a RAMP test be the default?

Thank you

- References

- Al-Rahamneh H, Eston R (2011). The validity of predicting peak oxygen uptake from a perceptually guided graded exercise test during arm exercise in paraplegic individuals. *Spinal Cord*. 49(3); 430-434.
- Goosey-Tolfrey VL, Paulson T, Tolfrey K, Eston R (2014). Prediction of peak oxygen uptake from differentiated ratings of perceived exertion during wheelchair propulsion in trained wheelchair sportspeople. *Eur J Appl Physiol*. 114(6); 1251-1258.
- Hutchinson MJ, Paulson T, Eston R, Goosey-Tolfrey VL (2017). Assessment of peak oxygen uptake during handcycling: test-retest reliability and comparison of a ramp-incremented and perceptually-regulated exercise test. *Plos ONE*. 12(7); e0181008.
- Leicht CA, Tolfrey K, Lenton JP, Bishop NC, Goosey-Tolfrey VL (2013). The verification phase and reliability of physiological parameters in peak testing of elite wheelchair athletes. *Eur J Appl Physiol*. 113(2); 337-345.
- Straub AM, Midgley G, Zavorsky GS, Hillman AR (2014). Ramp-incremented and RPE-clamped test protocols elicit similar VO₂max values in trained cyclists. *Eur J Appl Physiol*. 114(8); 1581-1590.

Participant characteristics

Participant number	Gender	PAL (h-week ⁻¹)	Age (years)	Height (cm)	Body mass (kg)	Impairment	NLI	ASIA classification	TSI (years)
1	M	5	59	185	138.0	SCI	C4 (INC)	D	11
2	M	0	42	165	65.9	SCI	T5 (COMP)	A	17
3	M	5	75	178	92.4	SCI	T12 (INC)	D	10
4	M	0	49	170	61.6	SCI	L1 (INC)	D	11
5	M	0	57	193	90.6	SCI	L1 (INC)	D	18
6	M	5	63	183	87.5	MS			
7	M	10	50	178	91.1	MS			
8	M	6	60	190	107.0	MS			
9	F	4	48	145	85.0	Spina Bifida			
Mean		4	56	176	91.0				13
SD		3	10	15	22.4				4

		RAMP	PRET_{max}	<i>P</i>
% $\dot{V}O_{2peak}$	RPE11	47 ± 12	43 ± 9	0.328
	RPE13	56 ± 11	54 ± 9	0.563
	RPE15	73 ± 11	70 ± 8	0.429
	RPE17	88 ± 11	81 ± 8	0.111
% PO_{peak}	RPE11	34 ± 14	24 ± 10	0.065
	RPE13*	50 ± 12	39 ± 9	0.019
	RPE15*	71 ± 15	61 ± 9	0.029
	RPE17	86 ± 17	80 ± 14	0.258