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Bioenergetic assessment of wheelchair fencing in men and women

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Introduction



Iglesias et al. (2023) - Bioenergetic assessment of wheelchair fencing in men and women



- There is little scientific evidence on the physiological responses to wheelchair fencing (WF), most focusing on injury typology or functional classification criteria.
- There is a previous study to assess the cardiopulmonary requirements of WF however it was performed with able bodied fencers (Iglesias et al., 2019).
- Direct measurement of physiological responses to WF is practically non-existent and little is known about the energy requirements in a competition of this Paralympic modality.
- Being able to estimate oxygen consumption (VO_2) from heart rate (HR) will allow us to better understand the demands of competition when only HR can be measured.

Objective

- To determine the cardiorespiratory demands of wheelchair fencing and validate an estimation method based on heart rate comparing values between women and men.



Materials and methods



Subjects

- The study has Informed consent of the participants and the authorization of an Ethics Committee (012020CEICEGC, February 10, 2020).
- At a WF training camp in Troyes (France), we analysed 7 WF athletes (5 class A & 2 class B), 3 women (27.0 ± 10 yrs) with 7.3 ± 3.8 years of experience and 8.3 ± 1.5 hours of weekly training, and 3 men ($27.0 \pm 9,3$ yrs) with 9.0 ± 7.1 years of experience and 9.3 ± 6.1 hours of weekly training.

Material



Moxly



K5 Cosmed



Lactate Pro2



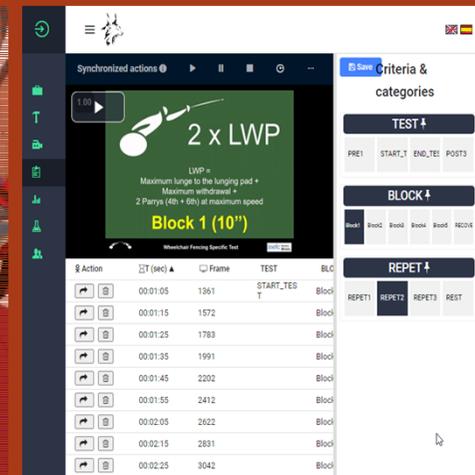
Polar H10



Video camera



Borg Scale

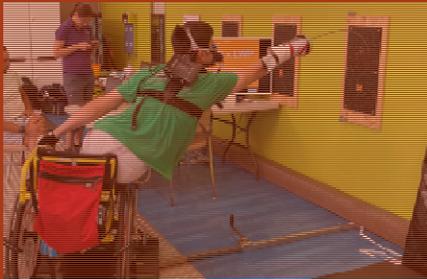


Wheelchair Fencing Test

LINCE PLUS

- The study was carried out in **3 phases**:

Phase 1



- ❖ A specific WF progressive test (n=7) of 5 submaximal stages in which a lunge was performed to a lunge pad and a retreat with 2 Parries (4th + 6th) was performed consecutively and progressively, measuring HR (Polar H10) and VO_2 (K5 Cosmed), lactate (La^-) and perceived exertion (RPE 1-10). An equation was calculated to estimate the VO_2 of each fencer with direct measurements of VO_2 and HR [$VO_2=a+(b \cdot HR)$].



Phase 2



- ❖ A training bout (n=11) of up to 15 hits with direct measurements of VO_2 and HR, and final La^- and RPE was performed. The VO_2 estimation method was validated by comparing the direct VO_2 measurement in this bout with the individually estimated VO_2 by the equation described in phase 1. The direct values were correlated with the VO_2 estimates.

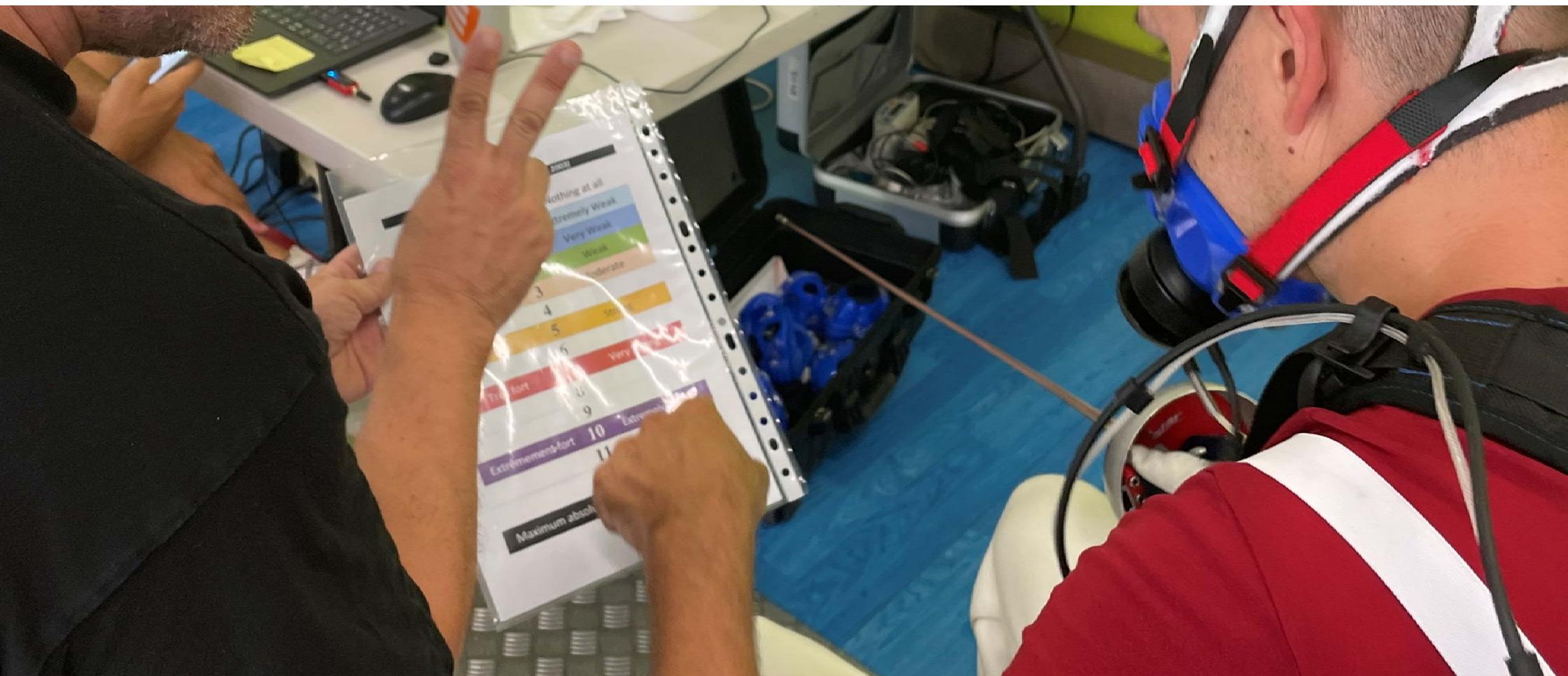
Phase 3



- ❖ A WF training épée competition (n=7) was performed with direct measurement of HR and final records of La^- and RPE. The VO_2 values in the competition were estimated by applying the linear regression of phase 1. The bout and rest times were verified by means of observation sheets and verification with the LINCE PLUS software (Soto-Fernández et al., 2022).



Results

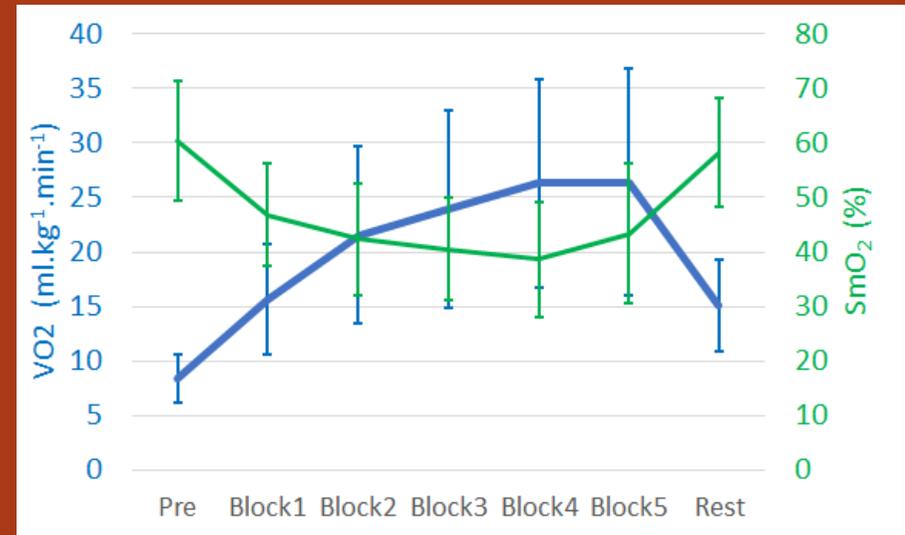
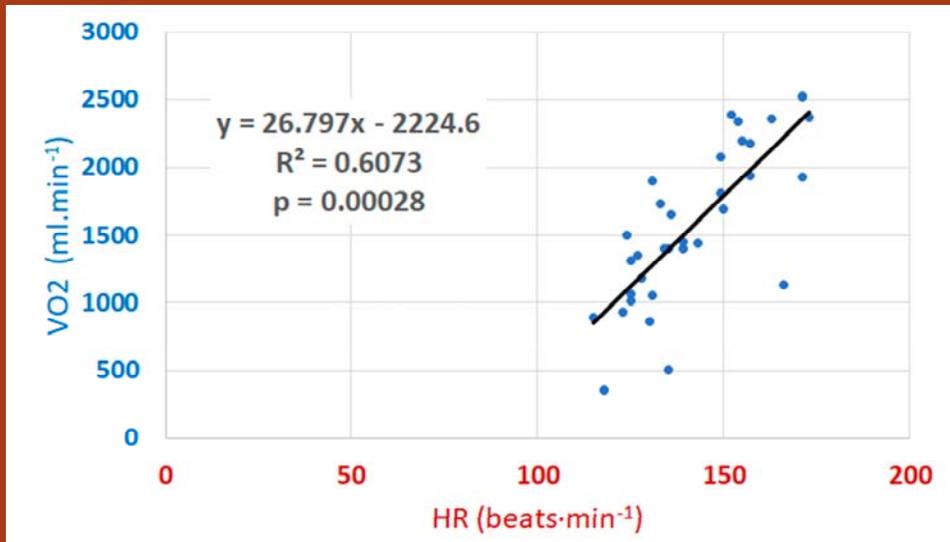
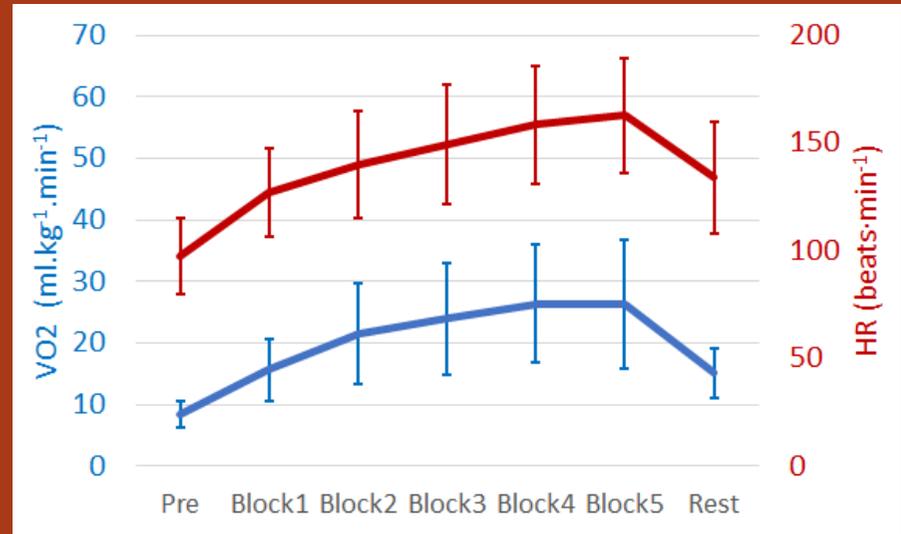


Phase 1



Figure 1 & 2.
HR and VO₂ values &
SmO₂ and VO₂ values
in a specific wheelchair fencing test

Figure 3. Relationship (subject 1) HR & VO₂
in a specific wheelchair fencing test



Phase 2



	VO ₂ ml·kg ⁻¹ ·min ⁻¹	HR beats·min ⁻¹	% HR _{max} %	Lactate mmol·L ⁻¹	RPE (1-10)
Women (n=3)	21.5 ± 2.0 7.3 - 31.2	141.8 ± 31.7 89.0 - 190.0	73.1 ± 13.3 48.6 - 93.6	2.6 ± 1.4 1.7 - 4.2	6.0 ± 3.6 3.0 - 10.0
Men (n=4)	25.3 ± 7.7 10.5 - 47.6	137.4 ± 9.4 103.0 - 163.0	71.4 ± 7.7 50.7 - 90.1	4.9 ± 6.0 1.4 - 13.9	2.8 ± 1.3 1.0 - 4.0

n.s. (Mann-Whitney U test)

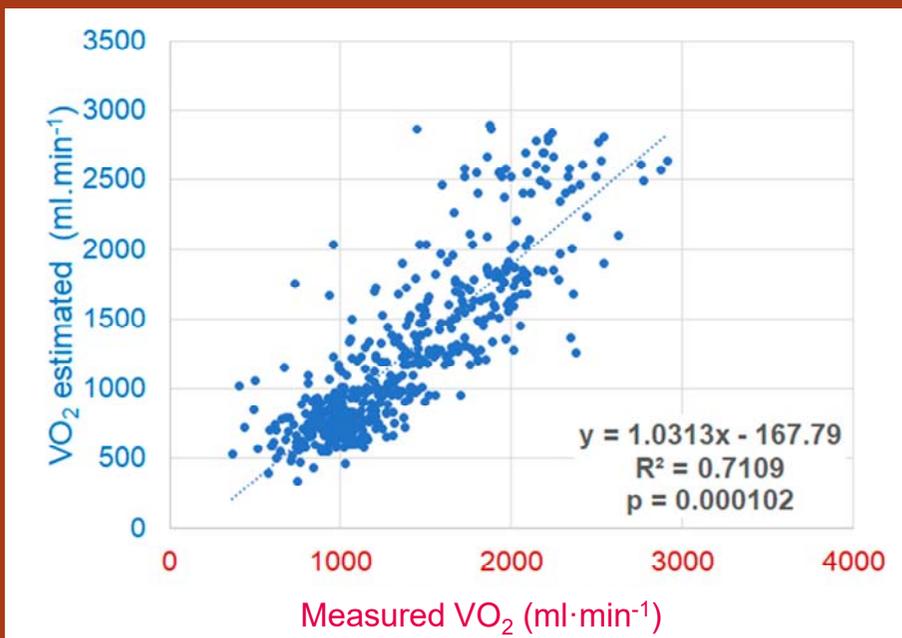


Figure 3. Relationship measured VO₂ & estimated VO₂ - wheelchair fencing bouts

Phase 3



	VO ₂ estimated ml·kg ⁻¹ ·min ⁻¹	HR beats·min ⁻¹	% HR _{max} %	Lactate mmol·L ⁻¹	RPE (1-10)
Women (n=3)	17.9 ± 3.2 4.6 - 32.0	147.6 ± 11.1 75.5 - 201.3	76.3 ± 5.8 41.3 - 99.2	3.2 ± 1.6 2.1 - 4.3	6.0 ± 1.7 5.0 - 8.0
Men (n=4)	24.7 ± 5.3 7.9 - 44.5	141.1 ± 16.9 87.0 - 181.0	73.4 ± 8.8 42.9 - 100	4.9 ± 3.2 1.9 - 8.5	4.3 ± 2.8 1.0 - 7.0

n.s. (Mann-Whitney U test)

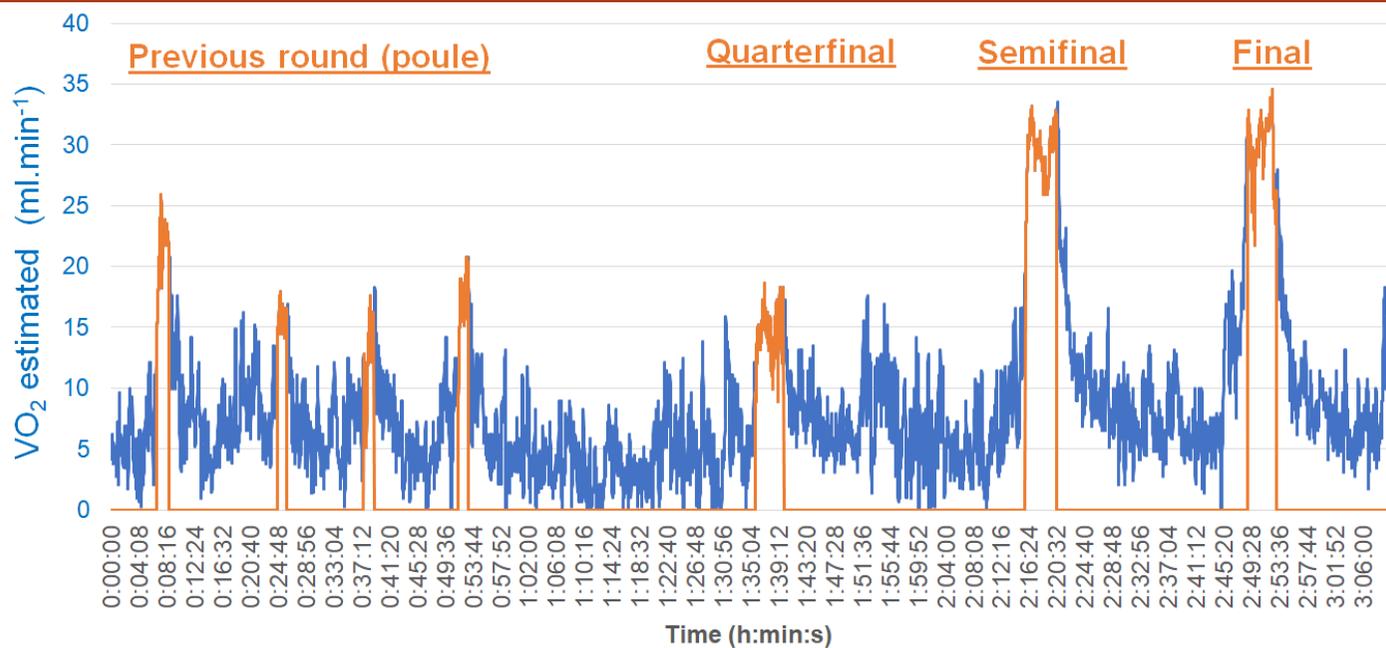


Figure 4. VO₂ estimated in a wheelchair épée fencing training competition

Discussion & Conclusions



- The physiological demands of wheelchair fencing are lower than those of standing fencing, but the demands on disabled people in wheelchair fencing bouts are similar to those of abled bodied people in the same conditions (wheelchair fencing).
- A sample size is too small to test differences between men and women. We resort to Mann-Whitney U test. No significant difference was found between women and men.
- We can use heart rate to estimate oxygen consumption in wheelchair fencing: the values are slightly underestimated (9.9%) but with good correlation indices ($r= 0.843$, $p < 0.001$).





Thank You



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