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Validity of the CycleOps Hammer direct drive trainer during sprint test when compared with an SRM powermeter – a preliminary study

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➢ Training or tests on smart trainers (Elite Directo, Taxc Neo 2, Wahoo Kickr, Bkool Smart, CycleOps Hammer…) can be performed with 2 user modes:

- Constant power mode (independent of pedalling cadence) → MAP test
- Constant resistant mode (dependent of pedalling cadence) → sprints test, TT

→ *measure PO and CAD <u>and</u> can direct drive the PO level*

- Accuracy and reliability of PO measure is major for success indoor training and tests

Smart trainer can be considered as valid if

relative PO bias
CV of PO bias
< 5% (< 2% for top athletes)

REVIEW ARTICLE
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Reliability of Power in Physical Performance Tests

Will G. Hopkins,[1] *Elske J. Schabort*[2] and *John A. Hawley*[3]

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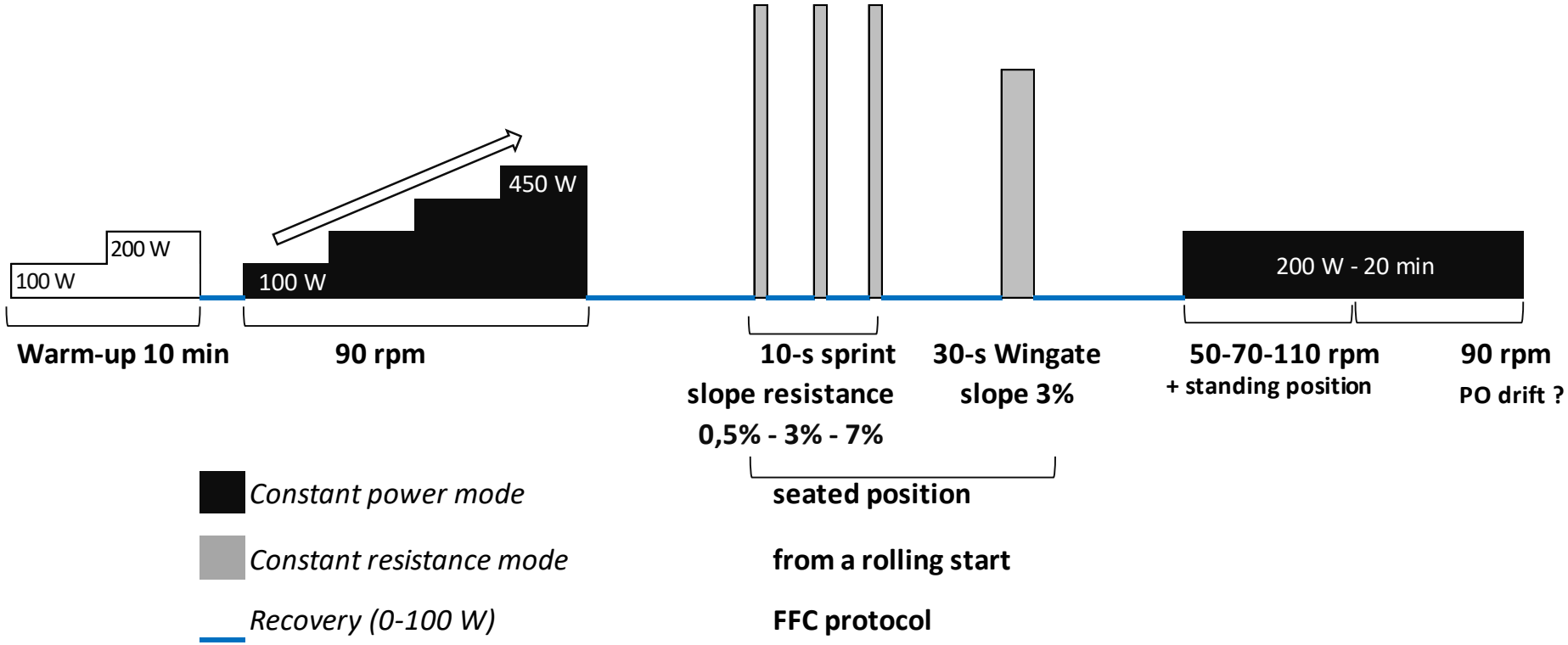
	 **Lemond revolution** *vs SRM* Novak et al. 2015	 **Wahoo Kirck** *vs dynamic calibration rig* Zadow et al. 2016	 **CycleOps Hammer** *Vs SRM* Lillo Bevia et al. 2018 Frémeaux et al., 2017
Incremental power test	100 - 400 W	250 - 700 W	100 - 500 W
TT tests (all out > 30s)			
Sprint tests	Peak PO		*Vs Powertap P1 pedals*

To evaluate the **accuracy** and the **reliability** of PO of **3 CycleOps Hammer direct trainer units** during **all-out sprints and time-trials** (constant resistance mode exercises) when compared to an **SRM powermeter**

- ✓ 5 trained male cyclists
- ✓ 2 test sessions per Hammer trainer unit

First test session (~ 1h30)



Second test session (~ 1H)

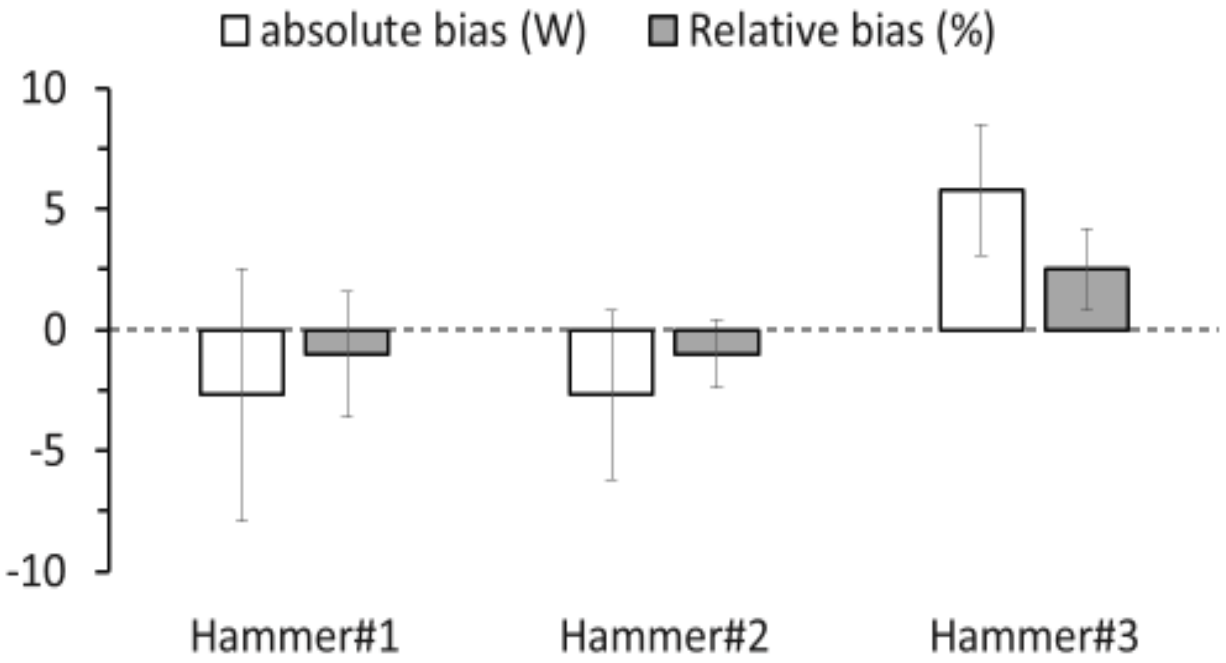
- ✓ 20-min Warm-up
- ✓ 16.8 km TT
- ✓ Time exercice : ~ 25-30 min

Average grade : 1 %
Max grade : 6%
Min grade : 5%

- ✓ PO and CAD were measured continuously and simultaneously at 1 Hz
- ✓ Data were stored in Rouvy software (CycleOps) and GPS bike Computer (Garmin Edge 520)

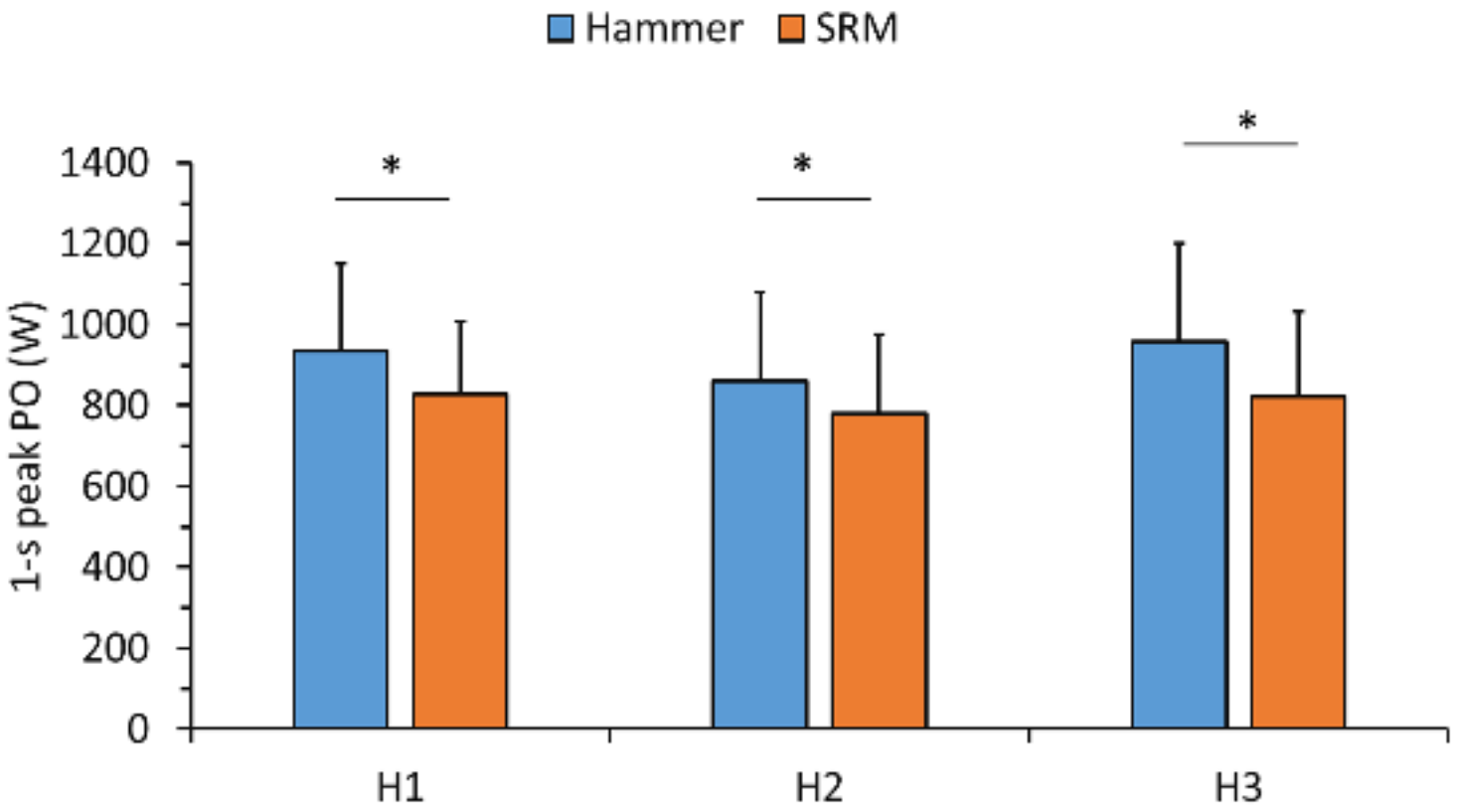
SRM slope was checked with a set of weight before the study
Calibration of SRM crankset and Hammer trainer before each test session

Constant power mode test → ***incremental test (100 to 450 W @ 90 rpm)***
→ ***rectangular test (200 W @ 50 to 110 rpm)***



- ✓ Mean bias = -1.0 to 2.7%
  - < Lillo Bevia et al. (2018): -5.5 to 3.8%
- ✓ CV of bias = 0.4 to 1.1%
- ✓ No effect of pedalling cadence and body position
- ✓ No PO drift with time

Constant resistance mode → 10-s all-out sprints → 1-s peak PO (up to ~1300 W)

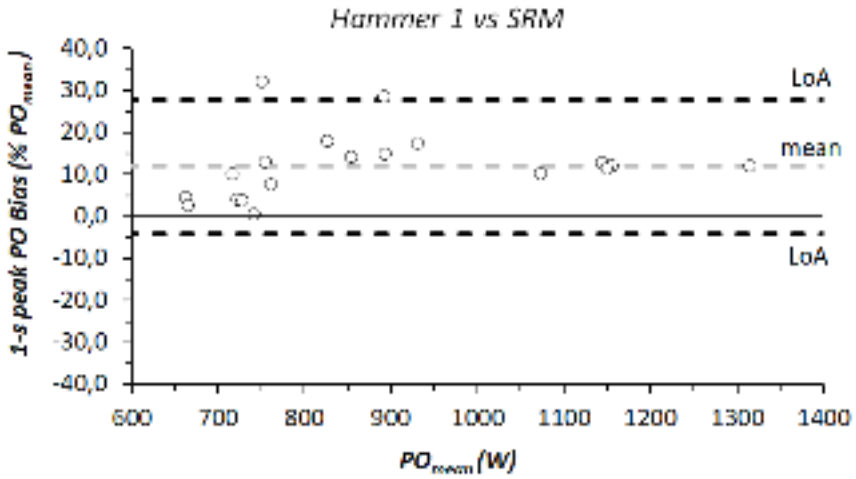


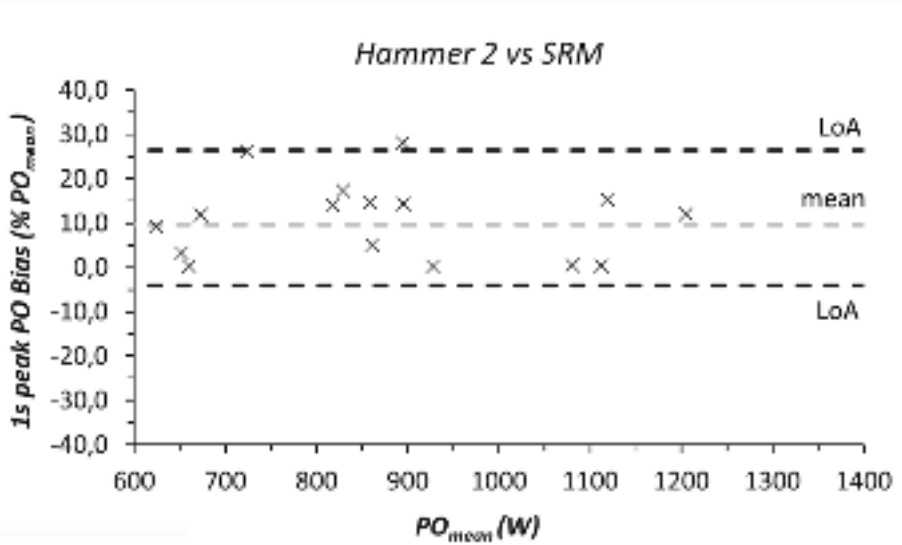
Wilcoxon test * $p < 0.05$

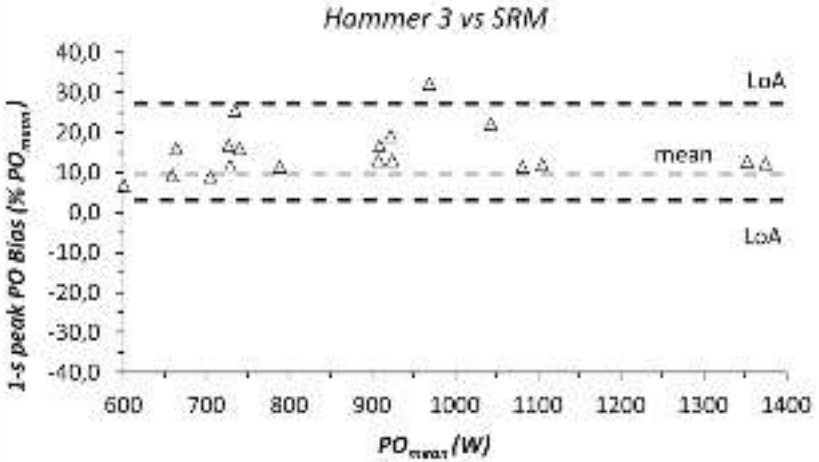
CV of bias

40.8 to 89.8%

Constant resistance mode → 10-s all-out sprints → 1-s peak PO







Constant resistance mode → 10-s all-out sprints → 1-s peak PO

Hammer unit	absolute difference (W)	relative bias (%)
H1 (n = 20)	105 ± 71	11.9 ± 8.1
CI95%	*[75 ; 141]*	*[8.1 ; 15.7]*
[min ; max]	[3 ; 254]	[0.4 ; 31.9]
H2 (n = 20)	81 ± 76	9.6 ± 8.6
CI95%	*[45 ; 117]*	*[5.6 ; 13.6]*
[min ; max]	[1 ; 251]	[0.1 ; 28]
H3 (n = 20)	136 ± 64	15.1 ± 6.2
CI95%	*[106 ; 166]*	*[12.2 ; 18.0]*
[min ; max]	[41 ; 312]	[6.8 ; 32.2]
All (n = 60)	**108 ± 73**	**12.2 ± 7.9**
CI95%	***[89 ; 127]***	***[10.2 ; 14.2]***

>> Frémeaux et al. (2017) : + 3.5%

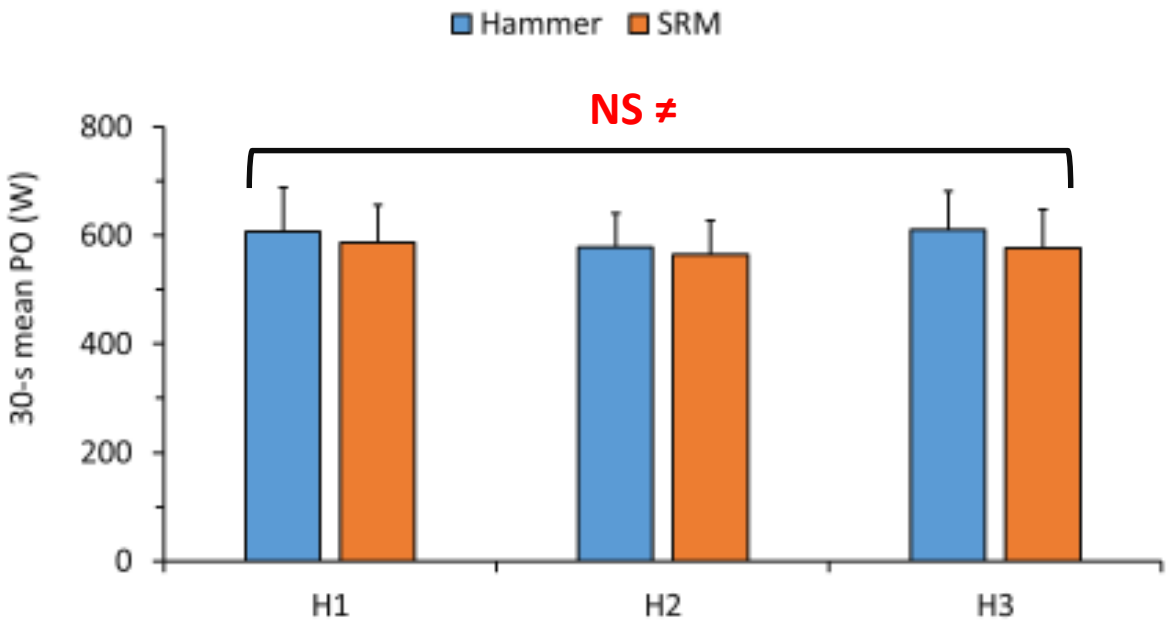
Hypotheses

Validity of Powertap P1 pedals ?

Error measure in optimal cadence ?

Absolute difference = 9 ± 11 rpm
% bias = 8.4 ± 10.2 %

Constant resistance mode → Wingate tests → 30s mean PO



CV of bias
19.9 to 114.%

Hammer unit	absolute difference (W) [min ; max]	relative bias (%) [min ; max]
H1 (n = 5)	21 ± 16	3.3 ± 2.4
[min ; max]	[3; 42]	[0.5; 6.0]
H2 (n = 5)	13 ± 15	2.2 ± 2.6
[min ; max]	[-2; 29]	[-0.5 ; 5.1]
H3 (n = 5)	32 ± 7	5.5 ± 1.1
[min ; max]	[24; 42]	[4.3; 6.9]
All (n = 15)	**22 ± 15**	**3.7 ± 2.4**
CI95%	***[14 ; 30]***	***[2.3 ; 5.0]***

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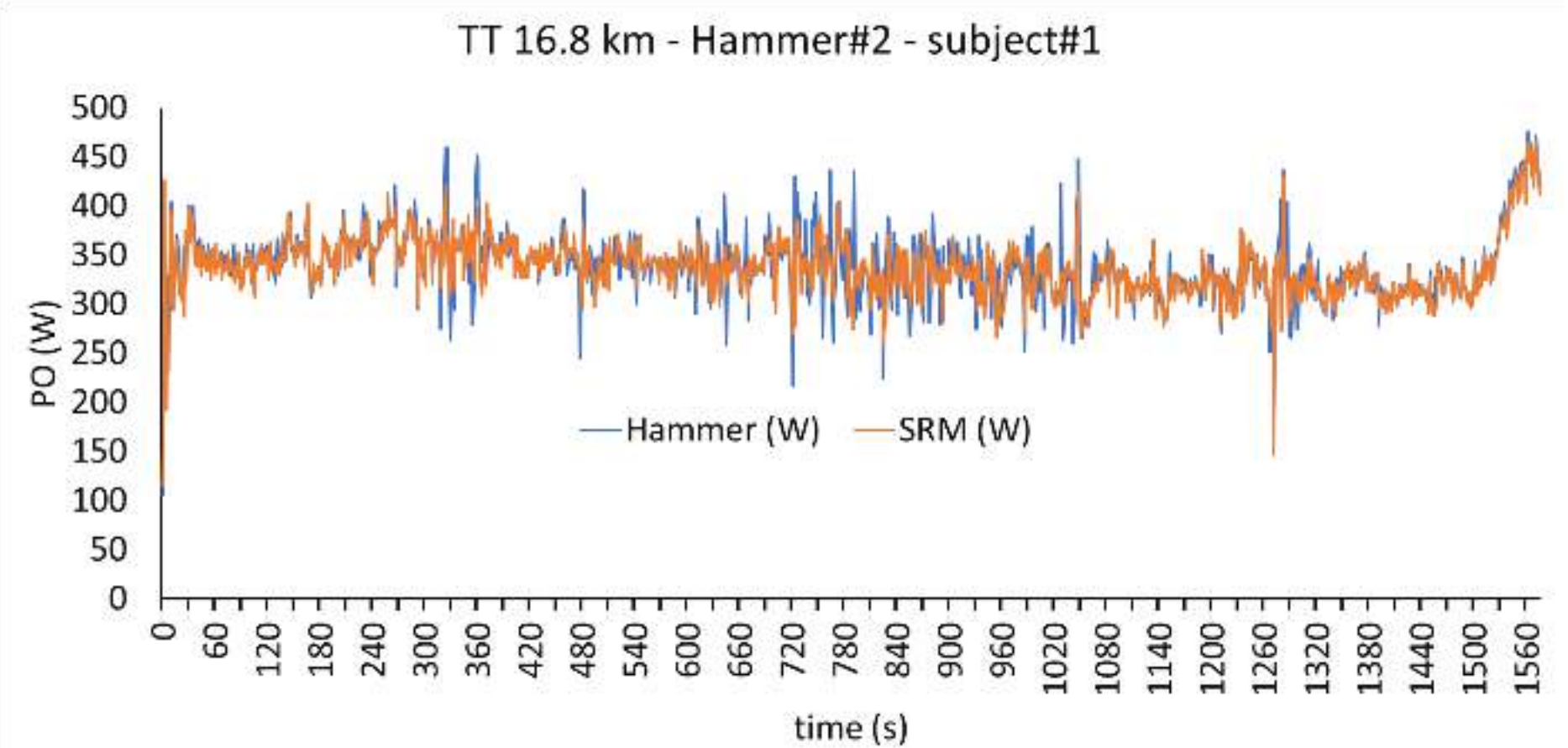
Time-trial tests



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Time-trial tests

Hammer	PO_{Hammer} (W)	PO_{SRM} (W)	relative bias (%)
#1	272 ± 49	270 ± 51	1.0 ± 0.7
#2	275 ± 45	269 ± 48	2.4 ± 3.1
#3	284 ± 46	278 ± 46	2.2 ± 0.8
All	277 ± 47	272 ± 48	1.8 ± 1.0

NS ≠

	 vs SRM	
	ACCURACY	***RELIABILITY***
Incremental power test (100 to 450 W) **Submaximal constant power test**	✓	✓
TT tests	✓	✓
Sprint tests **10 s – peak PO**	✗	✗
30s – mean PO	✓	✗

Next perspectives

→ increase the sample size of the current study

→ evaluate the accuracy and reliability of other smart trainers

Elite Direto

Tacx Neo

Bkool Smart Air