No differences in gross efficiency between dominant and non-dominant legs during one-legged counterweighted cycling

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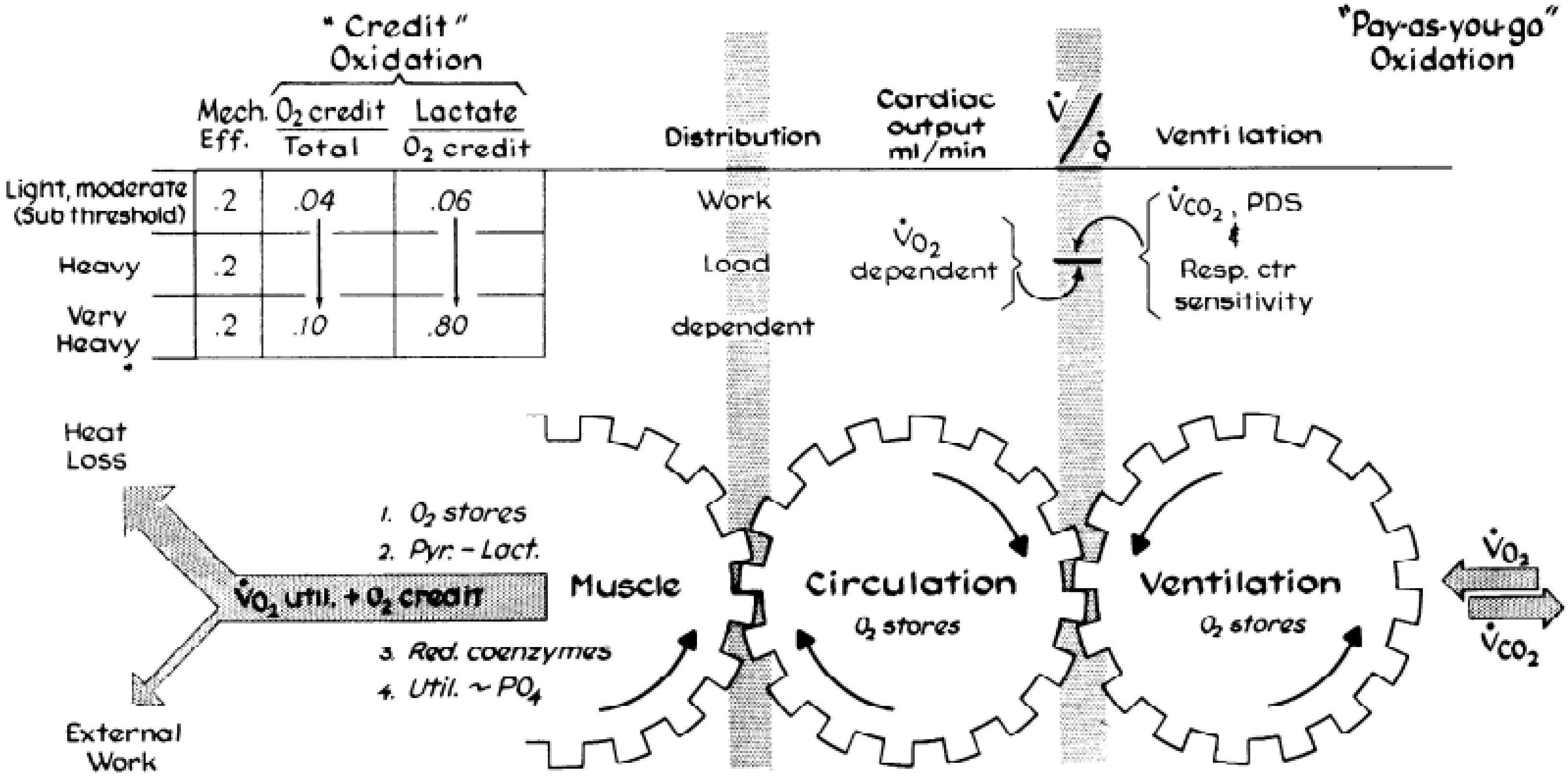
$$VO_2 = QO_2 \times C_{(a\text{-}v)}O_2$$

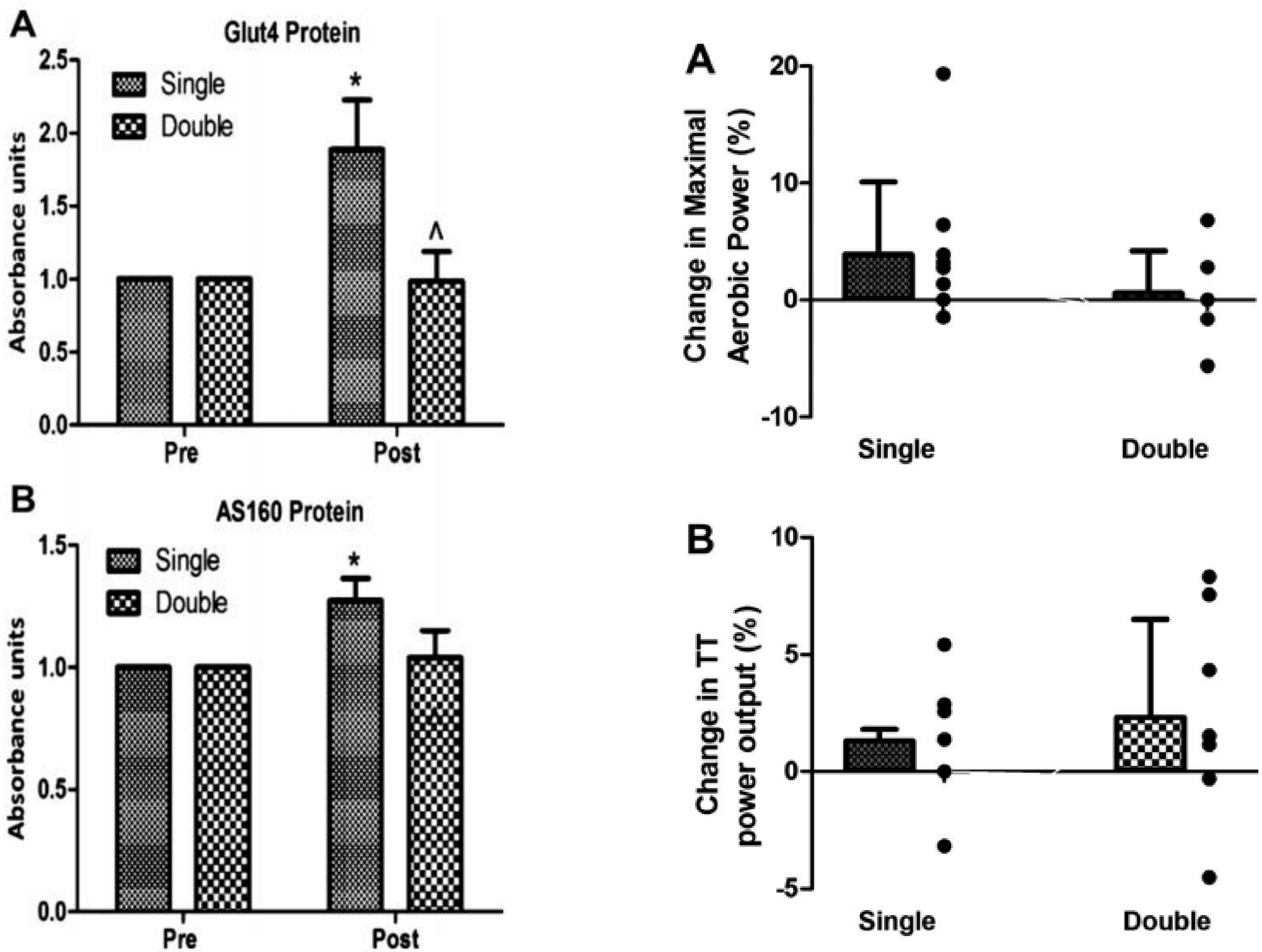


Wasserman et al. 1967

J Appl Physiol (1985). 2011 May;110(5):1248-55. doi: 10.1152/japplphysiol.01247.2010. Epub 2011 Feb 17.

Single-leg cycle training is superior to double-leg cycling in improving the oxidative potential and metabolic profile of trained skeletal muscle.

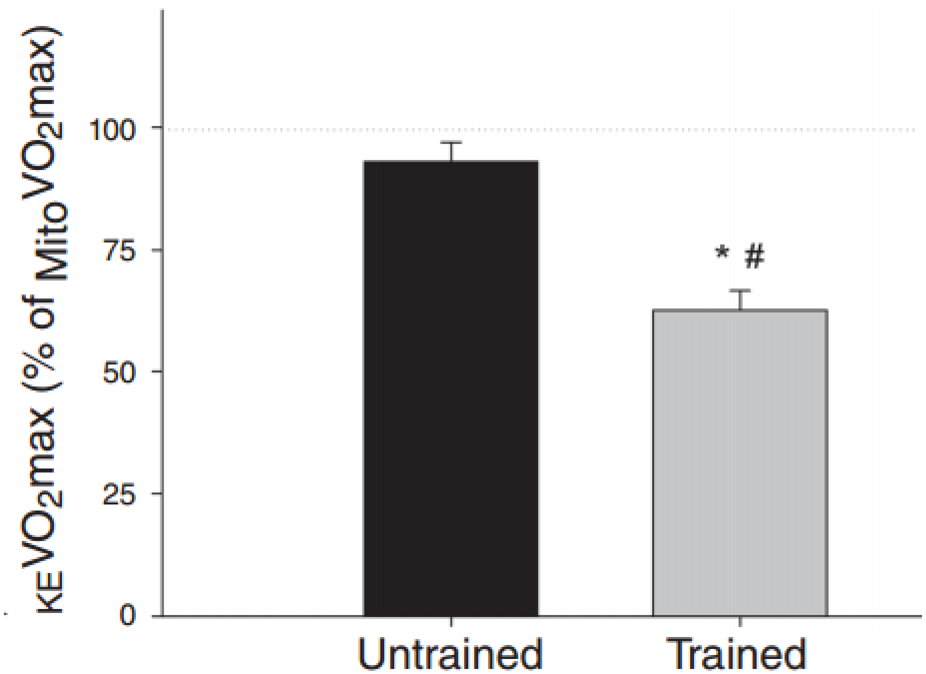
Abbiss CR[1], Karagounis LG, Laursen PB, Peiffer JJ, Martin DT, Hawley JA, Fatehee NN, Martin JC.

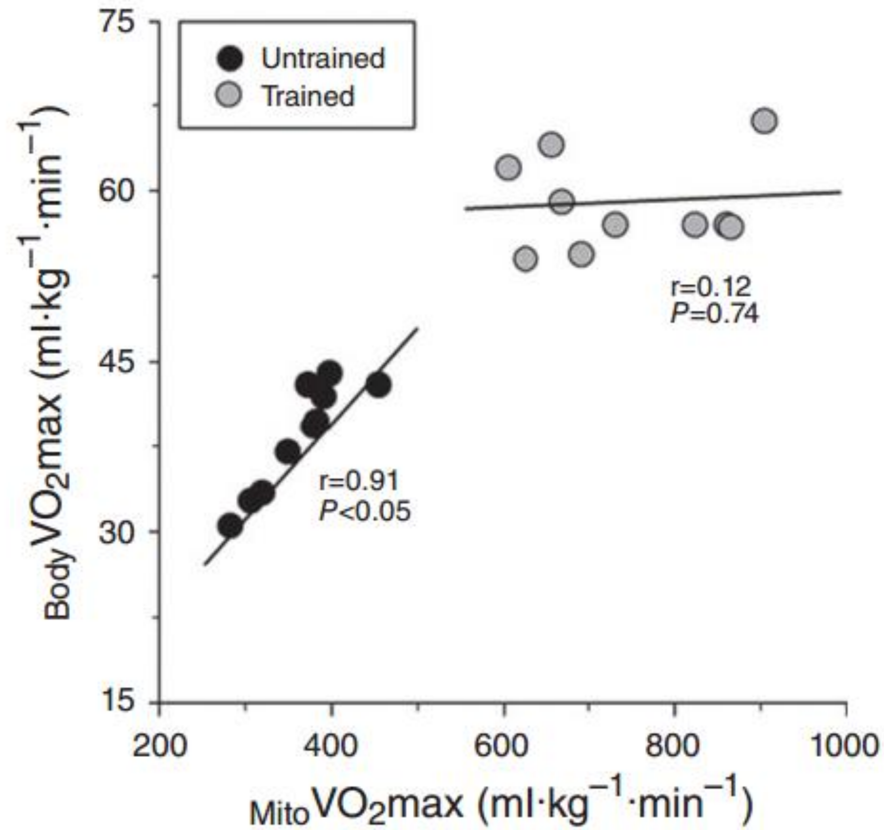


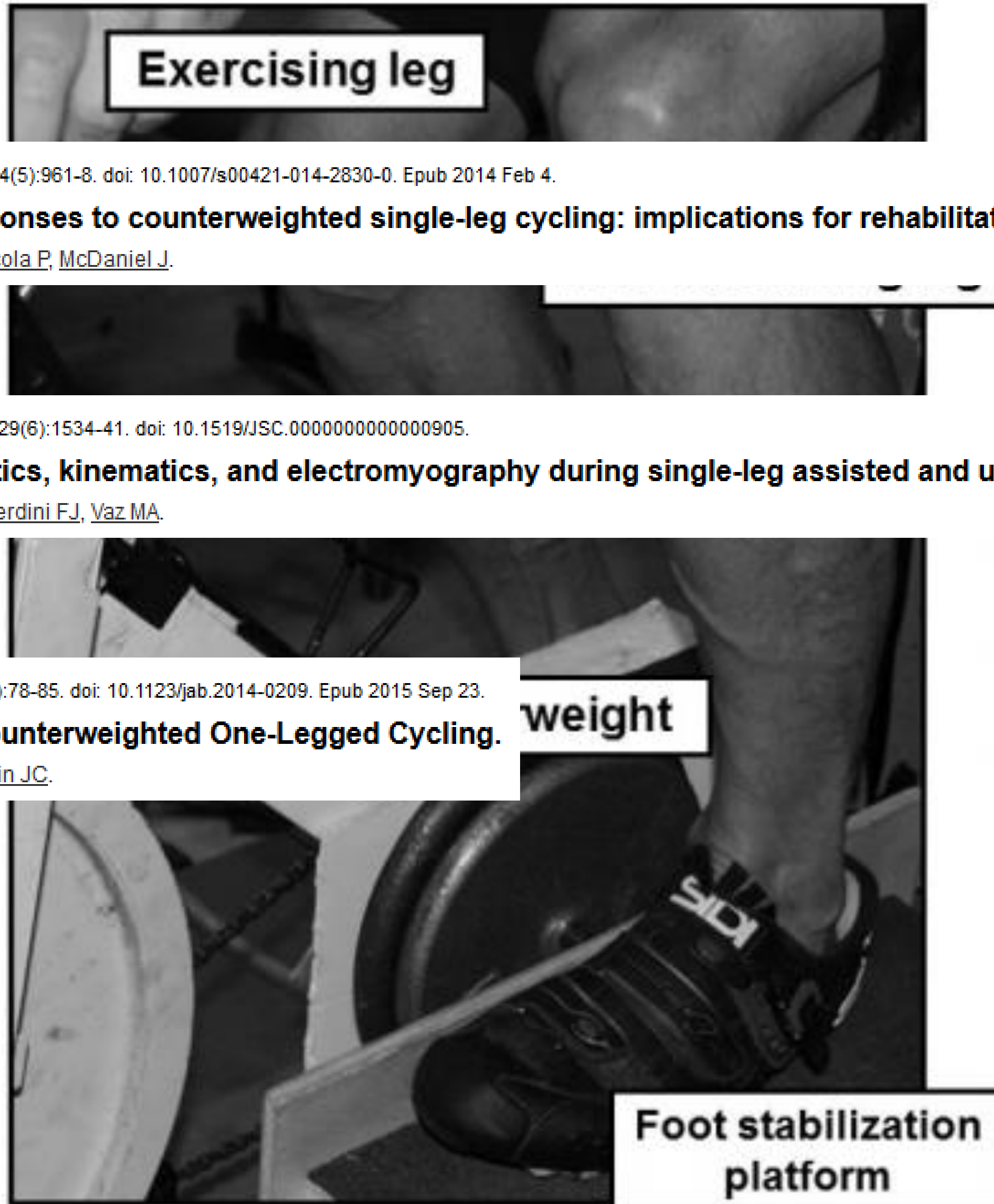
J Physiol. 2016 Mar 15;594(6):1741-51. doi: 10.1113/JP271229. Epub 2016 Jan 19.

Symmorphosis and skeletal muscle V̇O2 max : in vivo and in vitro measures reveal differing constraints in the exercise-trained and untrained human.

Gifford JR[1,2], Garten RS[1,3], Nelson AD[1,3], Trinity JD[1,3], Layec G[1,3], Witman MA[1,3], Weavil JC[1,2], Mangum T[1,2], Hart C[1,2], Etheredge C[1,2], Jessop J[4], Bledsoe A[4], Morgan DE[4], Wray DW[1,2,3], Rossman MJ[2], Richardson RS[1,2,3].







Eur J Appl Physiol. 2014 May;114(5):961-8. doi: 10.1007/s00421-014-2830-0. Epub 2014 Feb 4.

Cardiovascular responses to counterweighted single-leg cycling: implications for rehabilitation.

Burns KJ[1], Pollock BS, Lascola P, McDaniel J.

J Strength Cond Res. 2015 Jun;29(6):1534-41. doi: 10.1519/JSC.0000000000000905.

Comparison of kinetics, kinematics, and electromyography during single-leg assisted and unassisted cycling.

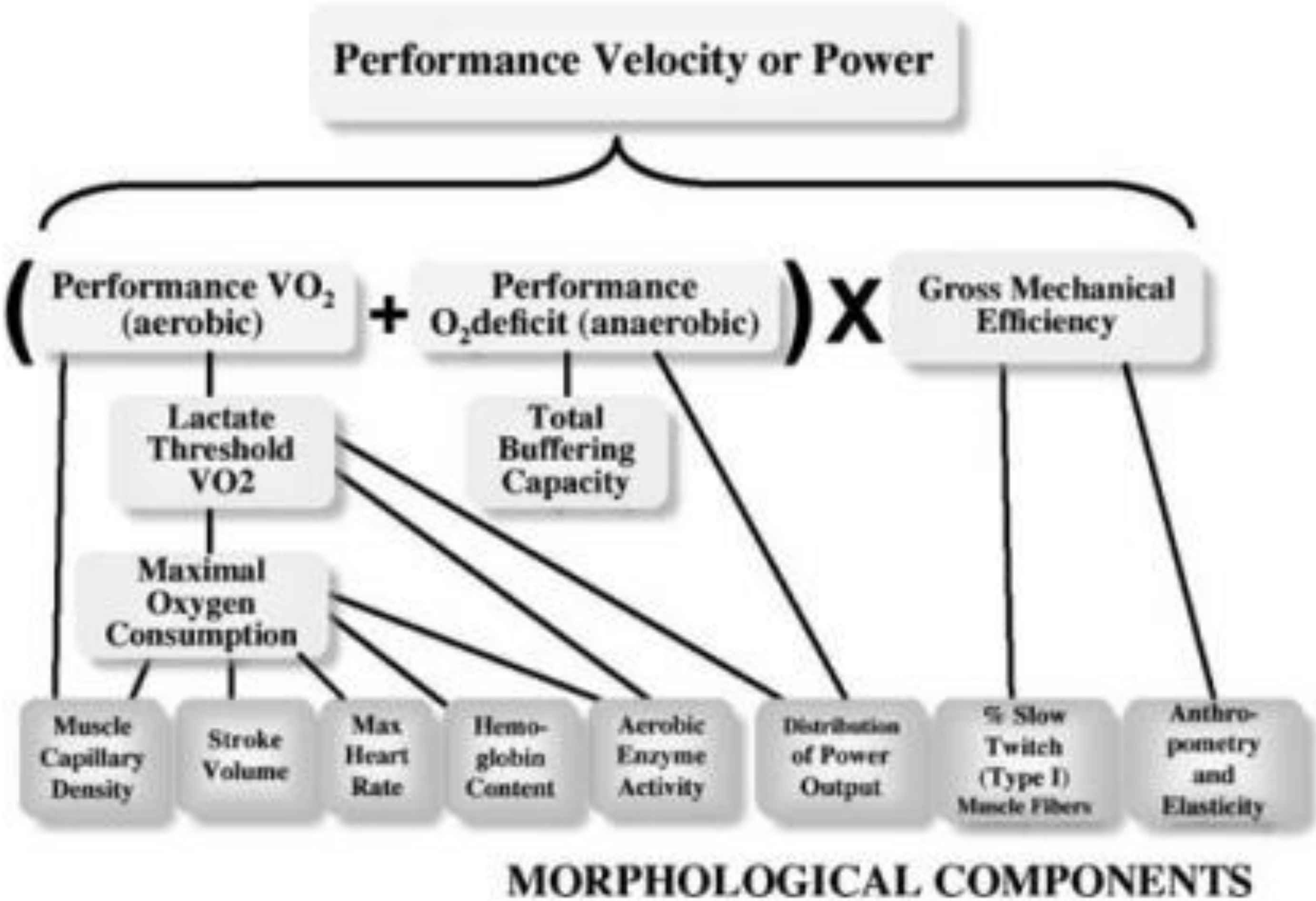
Bini RR[1], Jacques TC, Lanferdini FJ, Vaz MA.

J Appl Biomech. 2016 Feb;32(1):78-85. doi: 10.1123/jab.2014-0209. Epub 2015 Sep 23.

Biomechanics of Counterweighted One-Legged Cycling.

Elmer SJ[1], McDaniel J, Martin JC.

Gross Efficiency

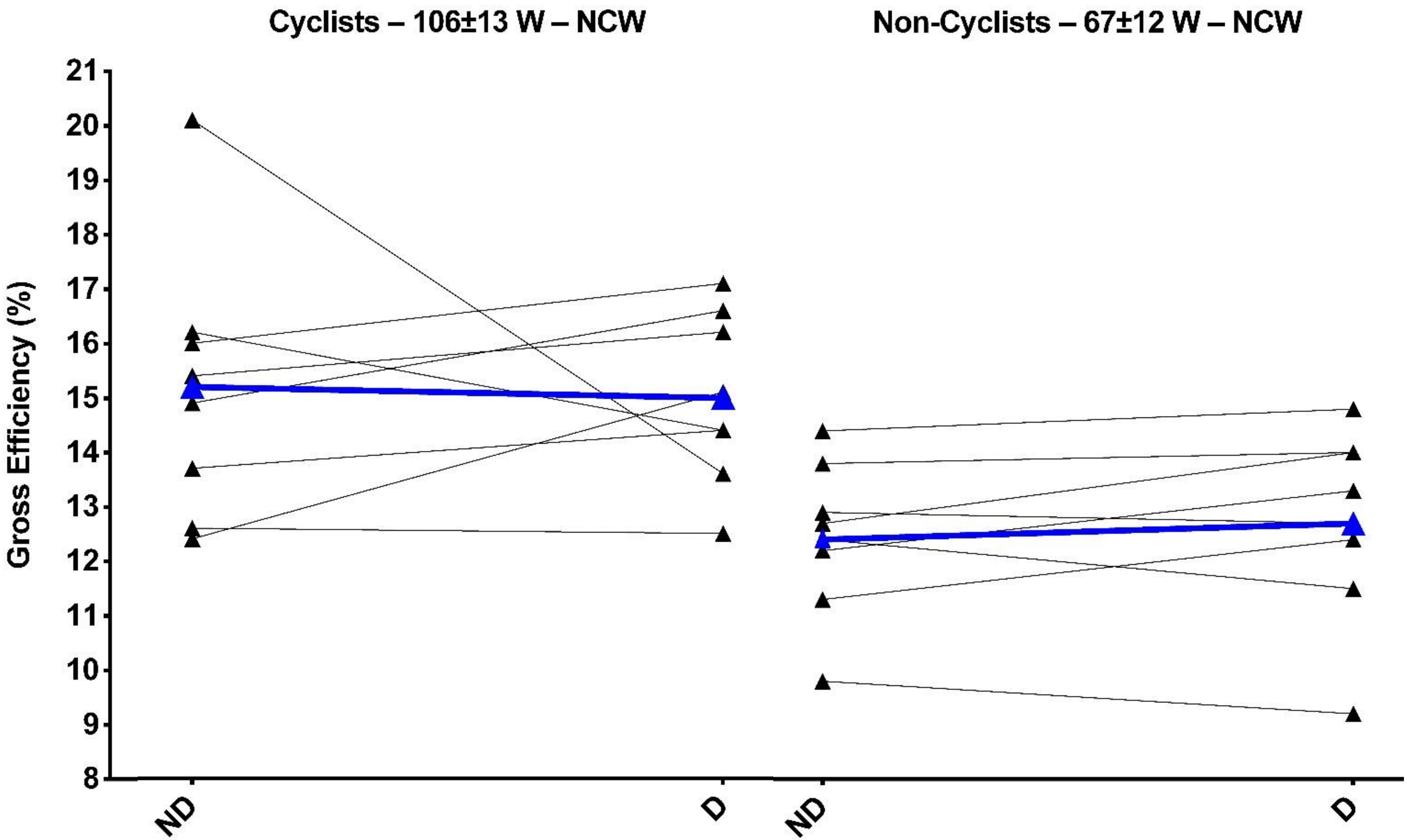


Joyner and Coyle 2008

J Electromyogr Kinesiol. 2010 Dec;20(6):1230-6. doi: 10.1016/j.jelekin.2010.07.013. Epub 2010 Aug 21.

Does leg preference affect muscle activation and efficiency?

Carpes FP[1], Diefenthaeler F, Bini RR, Stefanyshyn D, Faria IE, Mota CB.



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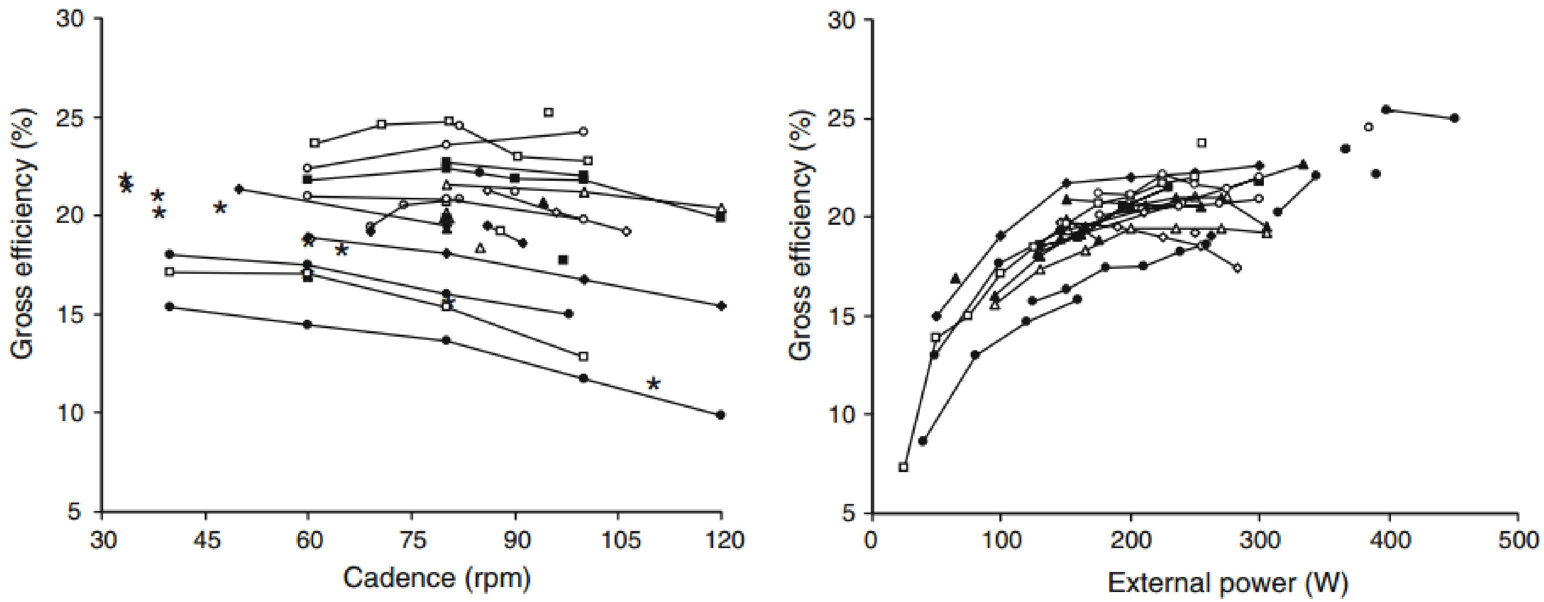


Ettema and Loras 2009

Study purpose

- To investigate whether cycling gross efficiency is affected by using either the dominant or the non-dominant leg during counterweighted cycling.

Methods

- 11 competitive cyclists
  31.0 ± 7.7 years – 70.6 ± 10.8 kg – 175.8 ± 8.1 cm
  64.0 ± 9.0 ml·kg^{-1}·min^{-1}

- 1st: Anthropometry – Waterloo Footedness Questionnaire – GXT
  2nd–7th: One-legged cycling

- D and ND legs
  60 and 100 W
  60, 75 and 90 rpm
  NCW, $CW_{2.5}$ and CW_5

- 18 min – each cadence for 6 min
  2 bouts per session (one for each leg) – 40-min rest
  Standard road bike + SRM + Computrainer

Data analysis

- Gas analysis: last 3 min (VO2000, Medgraphics, St. Paul, USA)

  GE% = (work accomplished/energy expenditure) × 100

- work accomplished(kcal.min-1) = power output(W) × 0.01433

  calorific equivalent of O_2 based on Peronnet and Massicotte (1991)

- Shapiro-Wilk – data normality

  3-way RM ANOVA, with Bonferroni pairwise comparisons if $P \leq 0.05$

Results

No significant main effect of the leg

- 60 W (F=0.024; P=0.879)

100 W (F=3.617; P=0.086)

Significant main effect of the cadence

- 60 W (F=40.213; P<0.001)

100 W (F=54.509; P<0.001)

90 × 60 rpm (P<0.001)
90 × 75 rpm (P<0.001)

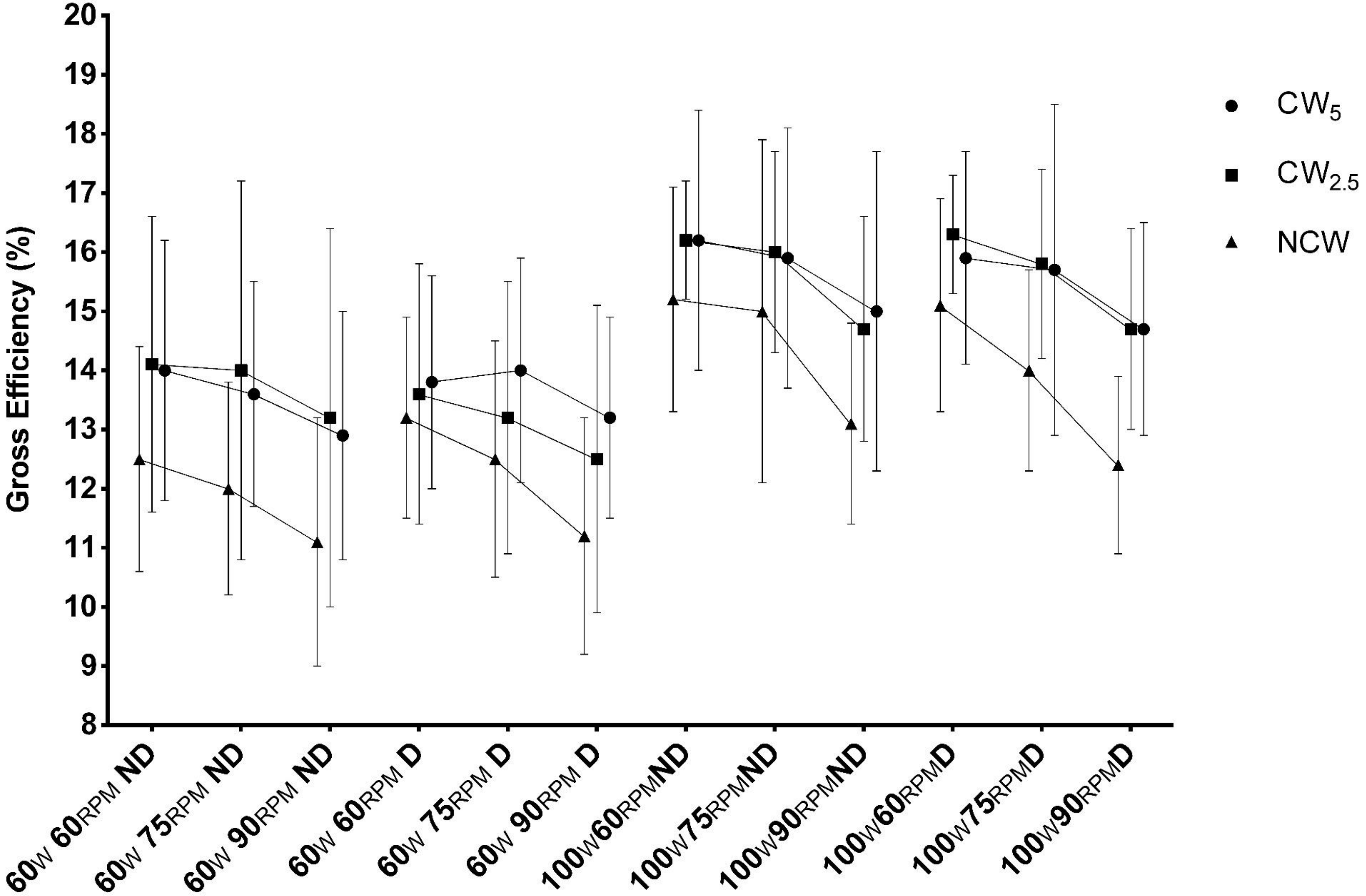
Significant main effect of the counterweight

- 100 W (F=3.879; P=0.038)

60 W (F=2.439; P=0.115)

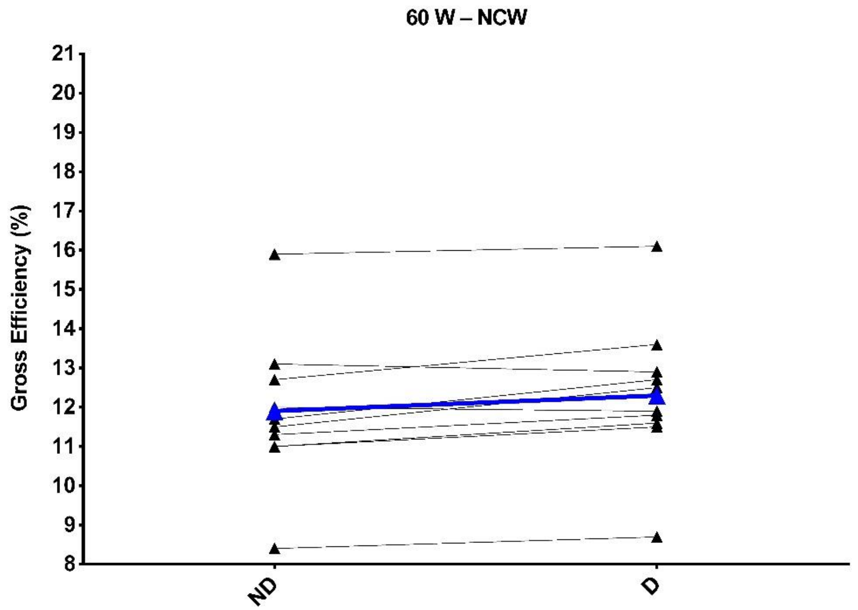
- Significant interaction counterweight × cadence
60 W (F=2.843; P=0.038)

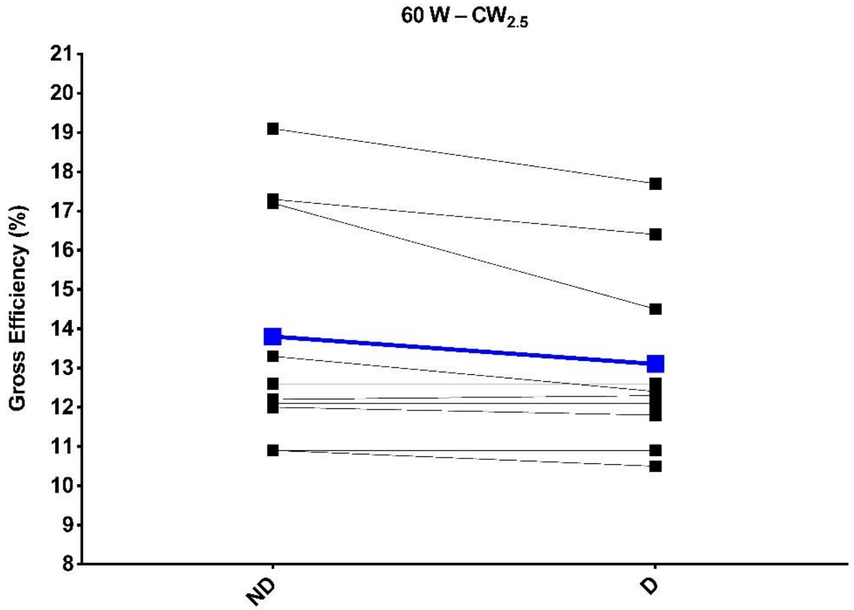
Results

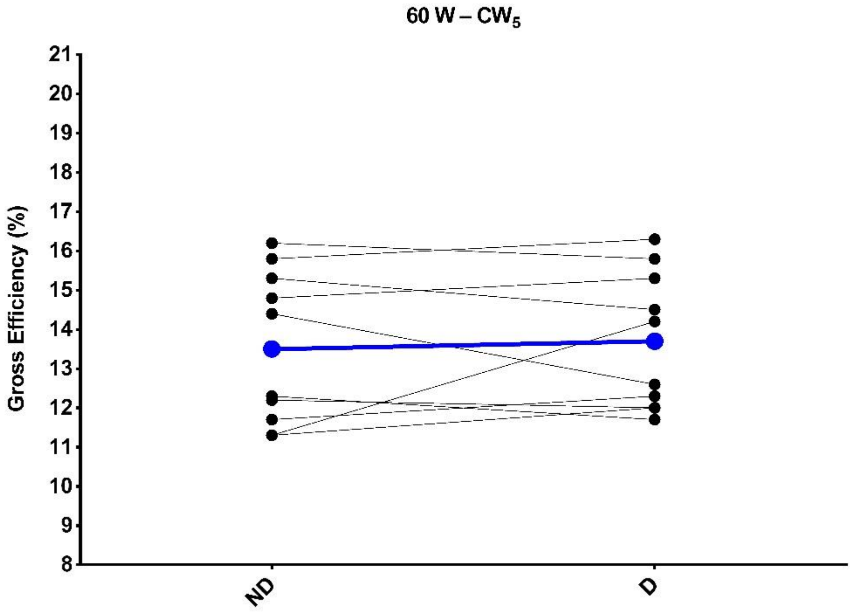


Gross Efficiency (%)
20
19
18
17
16
15
14
13
12
11
10
9
8
CW5
CW2.5
NCW
60W 60RPM ND
60W 75RPM ND
60W 90RPM ND
60W 60RPM D
60W 75RPM D
60W 90RPM D
100W60RPMND
100W75RPMND
100W90RPMND
100W60RPMD
100W75RPMD
100W90RPMD

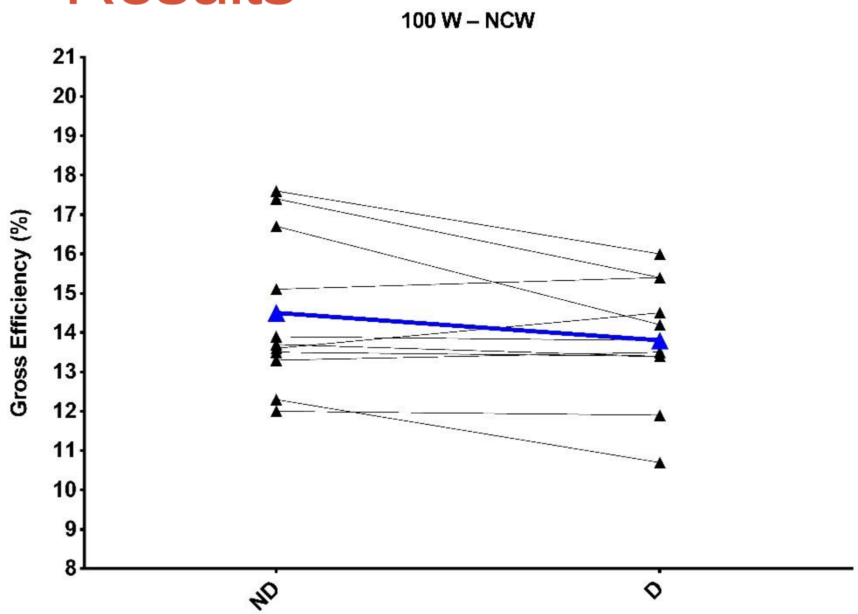
Results


60 W – NCW
Gross Efficiency (%)
21
20
19
18
17
16
15
14
13
12
11
10
9
8
ND
D

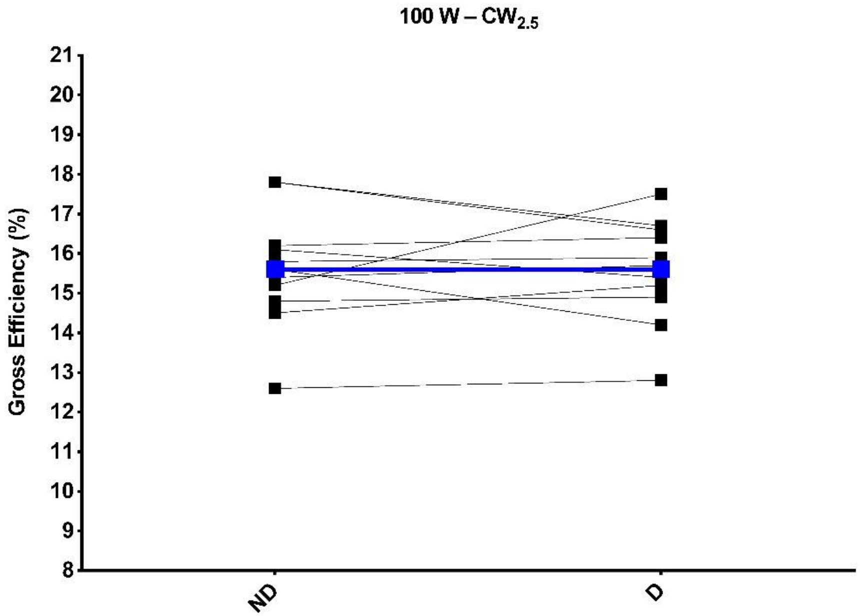

60 W – $CW_{2.5}$
Gross Efficiency (%)
21
20
19
18
17
16
15
14
13
12
11
10
9
8
ND
D


60 W – CW_5
Gross Efficiency (%)
21
20
19
18
17
16
15
14
13
12
11
10
9
8
ND
D

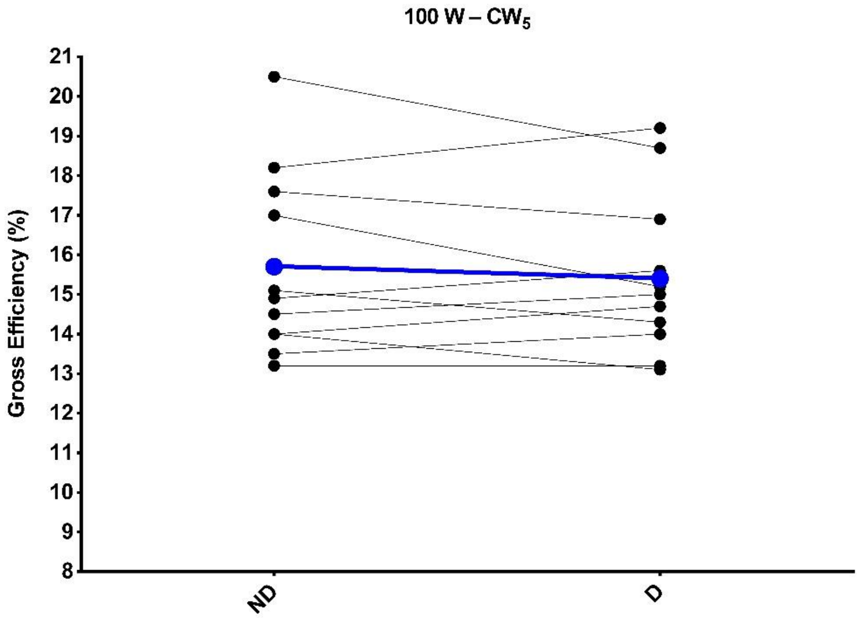
Results



100 W – NCW
Gross Efficiency (%)
21
20
19
18
17
16
15
14
13
12
11
10
9
8
ND
D



100 W – CW2.5
Gross Efficiency (%)
21
20
19
18
17
16
15
14
13
12
11
10
9
8
ND
D



100 W – CW5
Gross Efficiency (%)
21
20
19
18
17
16
15
14
13
12
11
10
9
8
ND
D

Summary

- The use of either the D or the ND leg during one-legged cycling does not systematically affect cycling GE
- Some individuals present wide variation in GE (>0.6%) between legs

Noordhof et al. 2010

- Higher cadences decrease GE
- The optimal counterweight for one-legged cycling might vary across conditions and subjects
- As power output increase, the counterweight size seems to be of lesser importance

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