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Abstract

Can Critical Power be Estimated for Mean Maximal Power Output Values

James Spragg [1], Peter Leo [2]

[1] University of Cape Town, Health Physical Activity Lifestyle Sport Research Centre (HPALS), Cape Town, South Africa
[2] University Innsbruck, Department Sport Science, Innsbruck, Austria

* Correspondence: (JS) james@spraggperformance..

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1. Introduction

The Critical Power (CP) represents an important threshold in exercise physiology (Poole, Burnley, Vanhatalo, Rossiter, & Jones, 2016) CP defines the border between the heavy and severe exercise domains (Burnley & Jones, 2018)and thus separates power outputs for which a physiological steady state can, and cannot, be achieved. It has been shown to have applicability to both stochastic and non-stochastic efforts within the severe exercise domain (Jones & Vanhatalo, 2017). CP is mathematically defined as the asymptote of the power- duration curve (Jones & Vanhatalo, 2017) . Traditionally, CP was estimated from 3-5 performance trials conducted on successive days (Moritani, Ata, Devries, & Muro, 1981) but it has recently been shown that CP can be estimated from a single exercise session(Simpson & Kordi, 2017). However, even this condensed approach may not always be feasible in-season in a professional cycling population due to the required volume of training (Metcalfe et al., 2017). Previous research (Pinot & Grappe, 2011) has shown that record power outputs (MMP) from training and racing can be used to derive a hyperbolic power-duration curve.

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2. Materials and Methods

Power meter data was collected from 11 professional cyclists (mean ± SD, age 21.3 ± 1.1y, body mass 70.8 ± 7kg, height 182.1 ± 5.4cm, VO2 max 74.2 ± 3.1 ml·kg·min-1) Data was sub-divided by mode of exercise: training or racing.

Participants performed 3 performance trials (2, 5 and 12 minutes). Critical Power (CPtest) and W′ (W′test) were interpolated from these performance trials

MMP values for the duration of 120-720s were collected from both racing and training in the subsequent 3 months. Critical Power and W′ estimates were interpolated exclusively from racing data (CPrace, W′race) or training data (CPtraining and W′training).

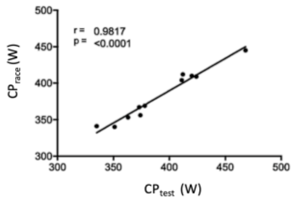
3. Results

There was a significant difference between CPtest and CPtraining values ($p < 0.01$). Correlation between CPtest and CPtraining were strong ($R = 0.728$, $p < 0.05$), mean bias was 3Kj (95% CI -4 – 10 Kj), percentage error 14.53% ± 17.02

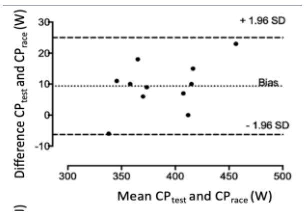
CPtest and CPrace were not significantly different ($p > 0.05$). Correlation between CPtest and CPrace was strong ($R= 0.982$, $p < 0.001$) (figure 1a), mean bias was 9w (95% CI 6 – 25w) (figure 1b) percentage error 2.34% ± 1.95.

W′test and W′race were not significantly different ($p > 0.05$). Correlation between W′test and W′race was was strong ($R= 0.904$, $p < 0.001$) (figure 1c) mean bias was 60w (95% CI 27 – 92w) (figure 1d) percentage error 15.2% ± 3.39. There was a significant difference between CPrace and CPtraining (figure 2a)

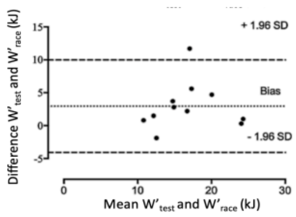
3.1. Figures



(a)



(b)



(c)

Figure 1. a) Correlation between CPrace and CPtest b)

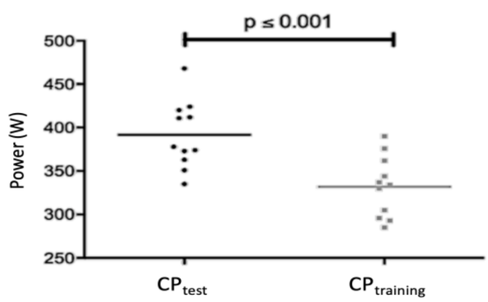


Figure 2. a) Comparison CPtraining and CPtest Bland-Altman plot of CPrace and CPtest c) Correlation between W′race and W′test d) Bland-Altman plot of W′race and W′test).

4. Conclusion

Valid CP estimates can be derived from MMP from racing. Accurate estimates for CP and W′ cannot be derived from MMP values achieved exclusively in training.

5. Practical Applications

Coaches and practitioners can use MMP values derived from races to accurately estimate the critical power.

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Conflicts of Interest: The authors declare no conflict of interest.

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