

Journal of Science and Cycling

Breakthroughs in Cycling and Triathlon Sciences



Special number: World Congress of Cycling Science 2015, 1/2 July 2015, Utrecht

Editors: Mikel Zabala (PhD)
Greg Atkinson (PhD)



Science & Cycling
1 & 2 July 2015, Utrecht



OPEN ACCESS

www.jsc-journal.com

Modeling intermittent cycling performance in hypoxia using the critical power concept

Nathan Townsend^{1,2} Samantha Shearman² Philip Skiba³ Dan Dwyer²

Abstract

Purpose: Recently, a novel model derived from the critical power (CP) concept was developed to determine W' balance (W'_{BAL}) during variable intensity exercise. The purpose of this study was to investigate the effect of hypoxia on the efficacy of the W'_{BAL} model during high-intensity intermittent exercise.

Methods: Eleven trained, male cyclists (mean±SD; age 27±6.6 years, VO_{2peak} 4.79±0.56) completed a maximal incremental ramp test and a 3 min "all out" test to determine end power (EP) and work performed above EP (W'_{EP}). On another day an intermittent test to task failure was performed. All procedures were performed in normoxia (NORM) and hypoxia (HYPO; $FiO_2 \approx 0.155$). The experimental condition was single-blinded, randomized and counter-balanced, and the W'_{BAL} model was used to calculate the minimum W' (W'_{BALmin}) achieved during the intermittent test. W'_{BALmin} in HYPO was also calculated using model parameters derived in NORM (N+H).

Results: In HYPO there was a significant decline in VO_{2peak} (4.79±0.56 vs 3.93±0.47 L.min⁻¹; $P<0.001$) and EP (353±46 vs 319±49W; $P<0.001$), whereas no change occurred for W'_{EP} (12.6±4.1 vs 13.3±5.3kJ; $P=0.34$; NORM vs HYPO). The change in VO_{2peak} was significantly correlated with the change in EP ($r = 0.72$; $P<0.05$). There was no difference between NORM and HYPO for W'_{BALmin} (1.7±0.9kJ vs 1.3±0.8kJ). The N+H analysis revealed a gross overestimation of W'_{BALmin} (8.3±3.2kJ) and compared with HYPO ($P<0.001$). Figure 1 shows an example of modeled W'_{BAL} for a typical subject.

Conclusion: The W'_{BAL} model behaves similarly in hypoxic conditions equivalent to ≈2450m as previously reported for normoxia, but only when the model parameters (CP and W') are determined under the same environmental conditions as the performance task is completed. The practical application of the W'_{BAL} model for altitude training and performance monitoring, thus requires CP and W' to be measured at altitude.

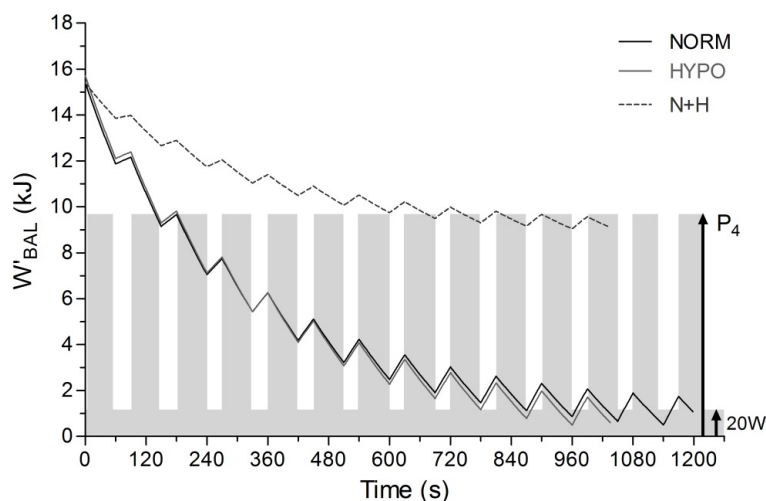


Figure 1. Modeled W'_{BAL} for a typical subject during intermittent high intensity exercise. Light grey bars indicate work intervals. P_4 refers to the power output predicted to result in task failure in 4 min. NORM: $FiO_2 = 0.2093$, HYPO: $FiO_2 = 0.155$, N+H: exercise in HYPO modeled with CP + W' measured in NORM.

✉ **Contact email:** nathan.townsend@aspetar.com (N. Townsend)

¹ Athlete Health & Performance Research Center, Aspetar Orthopaedic & Sports Medicine Hospital, Qatar

² School of Exercise and Nutrition Sciences, Deakin University, Australia

³ Department of Sports Medicine, Advocate Lutheran General Hospital, USA