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Individualising training intensity to reduce inter-individual variability in training response in trained cyclists

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Abstract

Background: Training to improve endurance performance commonly results in large inter-individual variability (IIV) in response (Bouchard *et al.* [1998]. *Medicine and Science in Sports and Exercise, 30(2),* 252–258; Mann *et al.* [2014]. *Sports Medicine, 44,* 1113–1124). A novel perspective to this issue centers on the differences in physiological response at set percentages of maximal performances; commonly used to prescribe training (Coyle *et al.* [1988]. *Journal of Applied Physiology, 64(6)*, 2622–2630). By establishing individual profiles of performance using a Power Law (PL), training intensity could be prescribed on an individualised basis (García-Manso *et al.* [2012]. *Journal of Theoretical Biology, 300*, 324–329).

Purpose: This investigation sought to determine whether using a PL could reduce IIV in $\dot{V}O_{2max}$ response to training compared to using a standardised method.

Methods: Two groups of male cyclists completed 12 high intensity training (HIIT) sessions over 4 weeks. Training intensity was prescribed using PL models in the individualised group (IG; n=5, $\dot{V}O_{2max}$ = 57.50 ± 9.02 mL.kg.min^{-1}) and set percentages of $\dot{V}O_{2max}$ in the standardized group (SG; n=5, $\dot{V}O_{2max}$ = 62.17 ± 4.45 mL.kg.min^{-1}). A $\dot{V}O_{2max}$ test and performance time trial were completed pre- and post-training. PL's were established using maximal efforts of 12, 7, and 3 minutes (Galbraith *et al.* [2014]. *Journal of Sports Physiology and Performance, 9(6)*, 931–935). Training sessions consisted of 3 sets of 10 repetitions of 30 seconds work and 30 seconds recovery, with 5 minutes active recovery between sets. Statistical analyses were conducted using IBM SPSS Statistics 22, with between- and within-group comparisons completed using independent and paired samples t-tests, respectively. Variability was analysed using log-transformed coefficients of variation and Bland-Altman plots.

Results: $\dot{V}O_{2max}$ was shown to have significantly increased in IG from 57.50 ± 9.02 mL.kg.min^{-1} to 59.36 mL.kg.min^{-1} following 4 weeks of HIIT training prescribed using a PL ($P < 0.05$). $\dot{V}O_{2max}$ did not significantly improve in SG ($P > 0.05$; *Figure 1*). Intra-class correlation coefficients (ICC) showed that variability in $\dot{V}O_{2max}$ response in both IG and SG was low, but significantly stronger correlations were observed in IG ($P < 0.001$) than in SG ($P < 0.05$). Individual $\dot{V}O_{2max}$ response profiles (*Figure 2*) indicate wider variation in response in SG, with two participants showing reduced $\dot{V}O_{2max}$, and a more consistent positive response in IG. Bland-Altman plots identify variance in $\dot{V}O_{2max}$ response of + 4.39 ml.kg.min^{-1} to - 0.69 ml.kg.min^{-1} in IG and from + 8.86 ml.kg.min^{-1} to – 6.23 ml.kg.min^{-1} in SG (*Figure 3*).

Conclusion: The results of this study suggest that individualised HIIT training prescribed using a PL can reduce the IIV in $\dot{V}O_{2max}$ response to training when compared to a standardised approach. This indicated that prescribing training using a PL model can result in consistent and predictable responses, useful for research, clinical, and applied purposes.

Keywords: training, individualisation, high-intensity, cycling, individual variability.

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