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Changes in oxygenation kinetics following training in normoxia and normobaric hypoxia.

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Introduction

Altitude camps are popular amongst elite endurance athletes seeking performance enhancement, however are not feasible for all. Subsequently, live-low-train-high protocols may be undertaken haphazardly in attempts to reap similar adaptations. The effects of exercise training in hypoxia on skeletal muscle oxygenation responses remain poorly understood (Bonetti & Hopkins, 2009). Near-infrared spectroscopy (NIRS) has been used reliably to monitor training-induced changes in forearm oxygenation kinetics (Ryan et al., 2013). Wrist flexors are commonly studied due to their typically untrained nature and low adiposity (Fryer et al., 2015).

The purpose of this study was to determine the effects of handgrip training in normobaric hypoxia and normoxia on the oxidative capacity index of the flexor digitorum profundus (FDP).

Methods

Nine recreationally trained, healthy males (mean ± SD, age: 20.7 ± 1.1 years; stature: 1.77 ± 0.08 m; body mass: 84.0 ± 14.2 kg) were studied. In a repeated measures, crossover design, participants completed 4 weeks of progressive endurance training of the wrist flexor muscles in normoxia and normobaric hypoxia (fraction of inspired oxygen = 14%). Training sessions comprised 30 min of continuous handgrip exercise. Contraction frequency increased from 0.3 Hz in week 1 to 1.2Hz in week four (~540 to ~2160 repetitions per session, respectively). Sessions ended with 60 s of 'sprint' contractions.

Changes in oxygenation kinetics of the FDP were assessed pre, post and 1, 2, 3, and 4 weeks post training. Briefly, participants were invited to lay supine for 20 min, before a tourniquet (Hokanson Inc, WA, USA) was utilised to sustain 5 min of brachial ischemia. Following rapid cuff deflation, time to half recovery ($t_{½rec}$) of the tissue saturation index was determined (McCully et al., 1994) using NIRS (Artinis Medical Systems BV, Ge, NL).

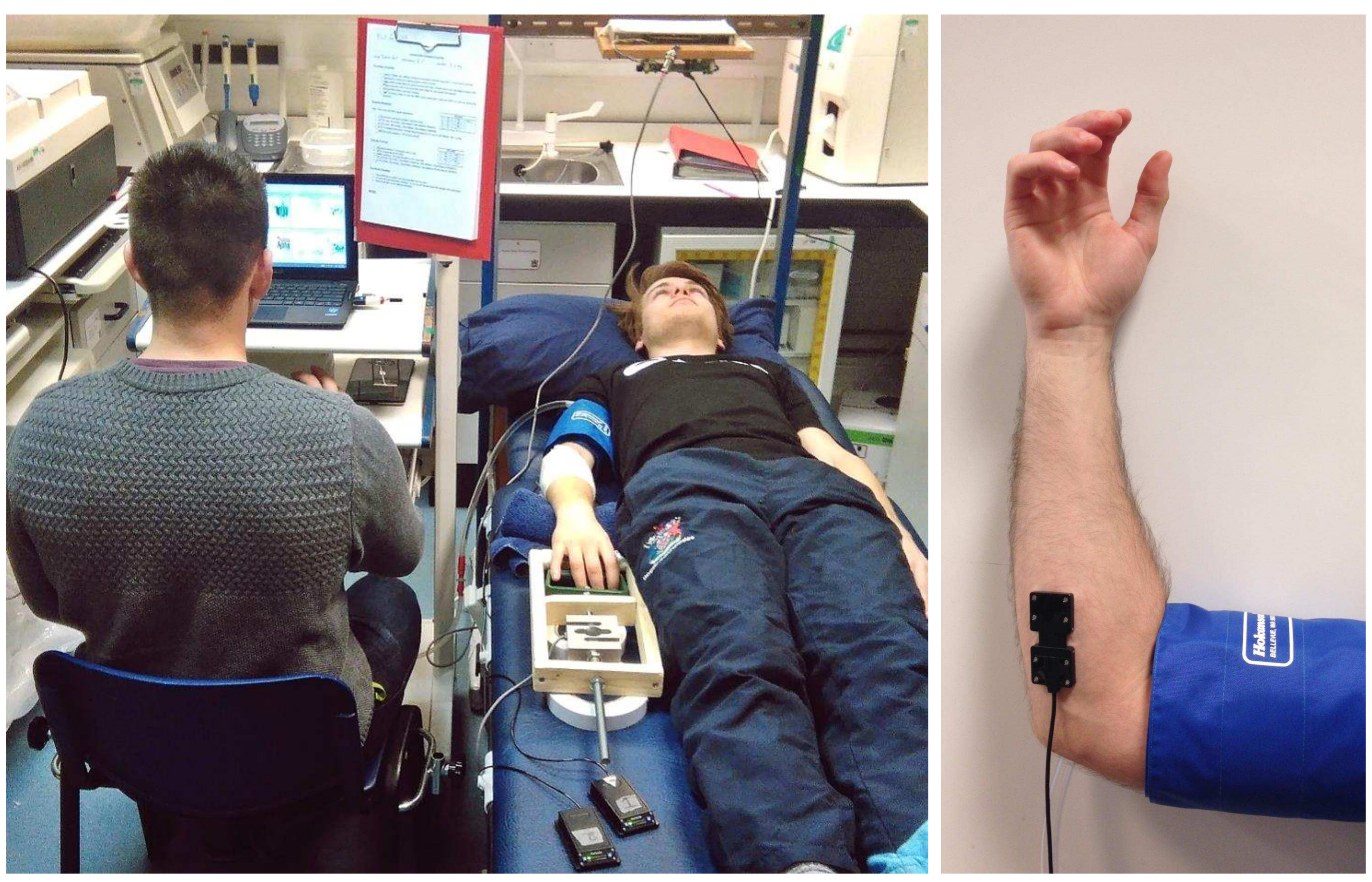

Figure 1. Assessment of oxygenation kinetics using near-infrared spectroscopy (left) and optode placement over the flexor digitorum profundus (right).

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Results

Two-way repeated measures ANOVA revealed a significant main effect for condition (P = 0.03, η_p^2 = 0.834). One-way ANOVAs revealed a significant difference across time in normoxia only (P = 0.01, η_p^2 = 0.305). Post $t_{½rec}$ (6.79 ± 2.18 s) was 27% quicker than pre (9.25 ± 3.41 s, P = 0.03). Post 2, 3, and 4 weeks were slower than post (all $P < 0.05$).

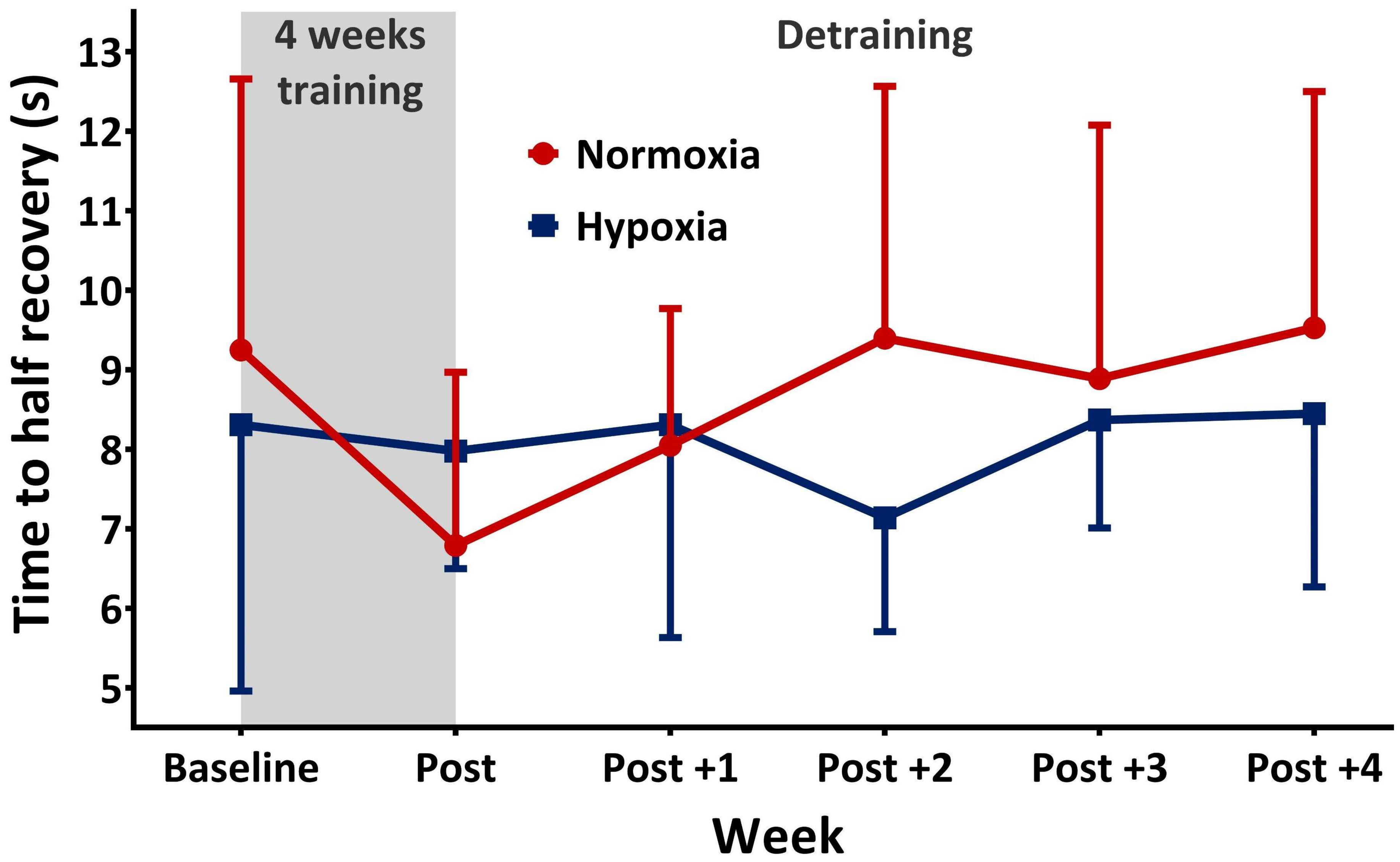

Figure 2. Time to half recovery of tissue saturation index of the flexor digitorum profundus following training and detraining in normoxia and normobaric hypoxia. Results are mean ± SD.

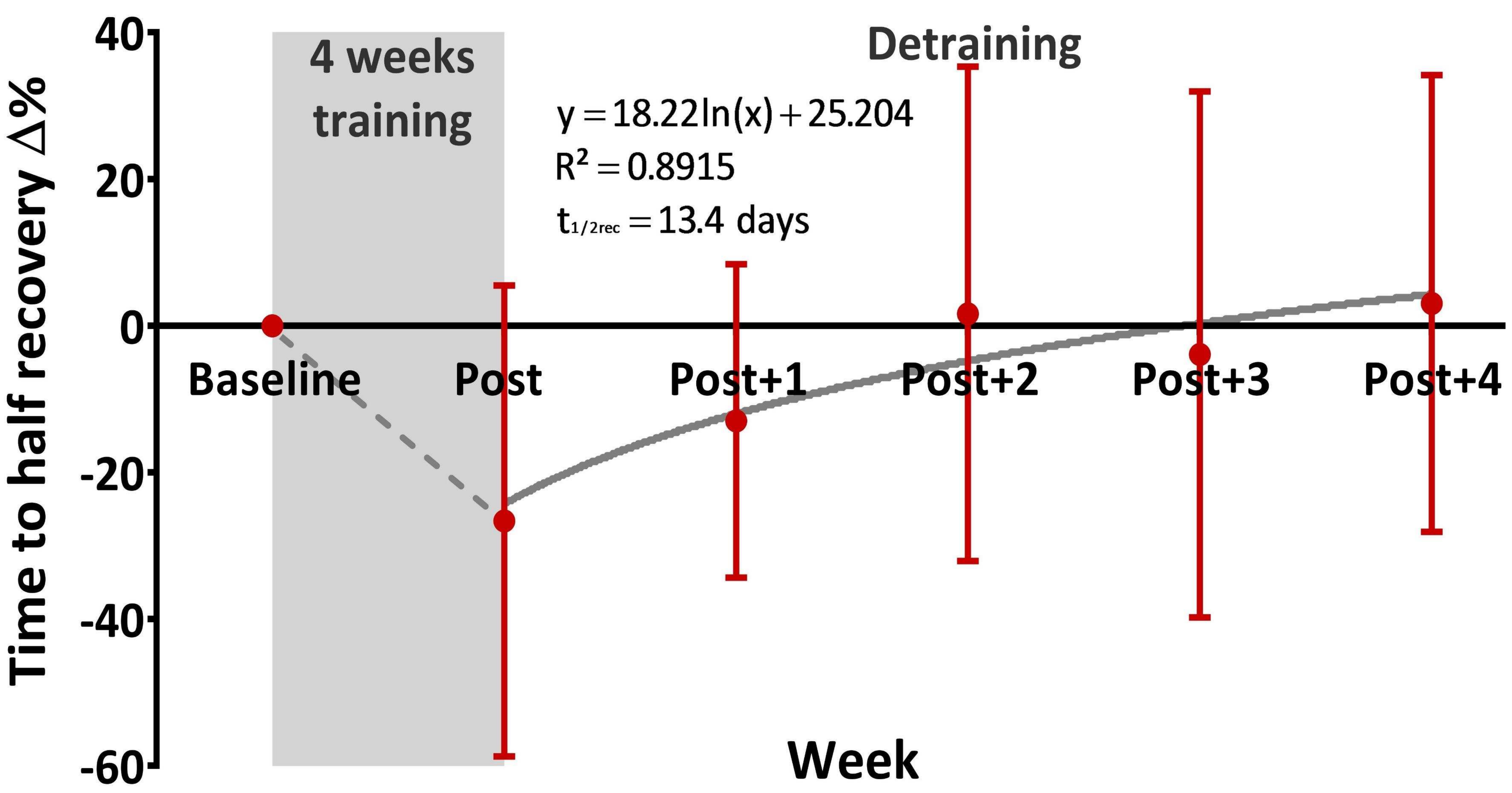

Figure 3. Percent change in time to half recovery of the flexor digitorum profundus following training in normoxia. A detraining half-time of 13.4 days was estimated using the regression equation of a logarithmic trend line fitted to the data. Results are mean ± SD.

Conclusions

- Oxygenation kinetics improved with 4 weeks of training in normoxia (27% faster $t_{1/2rec}$), but not in normobaric hypoxia.
- In normoxia, both the magnitude of change and the rate of decline were consistent with previous findings (Ryan et al., 2013).
- Endurance training in normobaric hypoxia may blunt physiological adaptations observed in normoxia.

References

Bonetti, D., & Hopkins, W. (2009). Sea-level exercise performance following adaptation to hypoxia. *Sports Medicine*, *39*(2), 107-127.

Fryer, S., Stoner, L., Scarrott, C., Lucero, A., Witter, T., Love, R., ... Draper, N. (2015). Forearm oxygenation and blood flow kinetics during a sustained contraction in multiple ability groups of rock climbers. *Journal of Sports Sciences*, *33*(5), 518-526.

McCully, K. K., Lotti, S., Kendrick, K., Wang, Z., Posner, J. D., Leigh, J., Jr., & Chance, B. (1994). Simultaneous in vivo measurements of HbO2 saturation and PCr kinetics after exercise in normal humans. *Journal of Applied Physiology*, *77*(1), 5-10.

Ryan, T. E., Southern, W. M., Brizendine, J. T., & McCully, K. K. (2013). Activity-induced changes in skeletal muscle metabolism measured with optical spectroscopy. *Medicine and Science in Sports and Exercise*, *45*(12), 2347-2352.