**Improvements in skeletal muscle can be detected using broadband NIRS in first-time marathon runners**

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**Abstract:** Introduction: Skeletal muscle metabolic function is known to respond positively to exercise interventions. Broadband near-infrared spectroscopy (NIRS) can quantify changes in oxygenated haemoglobin (oxyHb) and metabolism via the oxidation state of cytochrome-c-oxidase (oxCCO) within tissue.

Methods: Healthy, non-athletic adults (>30 years old) were enrolled in a study investigating physiological adaptations to endurance training for their first marathon. Before training commenced (baseline), participants underwent skeletal muscle measurements of oxyHb and oxCCO concentration changes using an in-house miniature broadband NIRS system during two 3-minute arterial occlusions. The first occlusion was carried out at rest; the second, following a maximal exertion exercise test. Cardio-pulmonary peakV̇O2 was measured by analysis of expired gases during exercise. All measurements were repeated within 3 weeks of participants completing the marathon (follow-up).

Analysis: The rate of change of oxyHb and oxCCO during cuff occlusions was determined. Normally distributed data are mean±SD, skewed data are median(IQR). Differences in mean and median values were determined using a paired student’s t-test or signed-rank test, respectively.

Results: 14 participants underwent baseline and follow-up measurements (n=8 male; 43±6 years old). Rates of decline of resting oxyHb and oxCCO during occlusion were higher at follow-up compared to baseline (oxyHb: -0.04±0.01 versus -0.03±0.007µM/s, p<0.001; oxCCO: -0.004±0.004 versus 0.0003±0.004µM/s, p=0.02). Rates of decline of exercise oxyHb and oxCCO were also higher at follow-up compared to baseline (oxyHb: -0.05(-0.04, -0.06) versus -0.04(-0.03, -0.04)µM/s, p=0.04; oxCCO: -0.006(-0.002, -0.01) versus -0.004(-0.002, -0.007)µM/s, p=0.04). There was no detectable difference in cardiopulmonary peakV̇O2 between baseline and follow-up (31.5±5.7 versus 31.0±4.9ml/min/kg, p=0.41).

Conclusion: In the gastrocnemius, muscle oxygenation and metabolism declines more rapidly during arterial occlusions after a period of endurance training. This suggests that NIRS can non-invasively detect improvements in skeletal muscle function despite an absence of change in cardio-pulmonary function.