Cardiovascular response to intermittent high intensity double- and single-legged cycling

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This thesis is submitted as partial fulfilment of the requirements for the degree of Bachelor of Exercise Physiology (Honours) at Murdoch University, Perth, Western Australia.

I declare that this thesis is my own account of my research and contains as its main content work which has not previously been submitted for a degree at any tertiary education institution.

(Miss Nicole Gordon)

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ABTRACT

Although the benefits of high-intensity interval training can be similar or superior to moderate- or low-intensity continuous training, it is possible that not all individuals should undertake such exercise. While high-intensity interval training is currently accepted practice within the cardiovascular rehabilitation setting, some individuals may not be suited to this type of exercise due to their decreased exercise tolerance and diminished cardiovascular function. The use of smaller muscle mass training (e.g. single-legged cycling) can allow localised high-intensity muscle training but avoid cardiac limitations associated with high blood flow demands when training using a large muscle mass. **Purpose:** To examine the differences in cardiovascular stress imposed by double- and single-legged high-intensity interval cycling in order to better understand the physiological responses of such exercise and assist in future training prescription. **Methods:** In a randomised crossover design, ten young, healthy individuals (23 ± 5 years of age, 180 ± 7 cm height, 74 ± 13 kg body weight, 51 ± 9 $mL.kg^{-1}.min^{-1}$) performed six 1-minute double-legged 'all out' efforts interspersed with 1-minute active recovery and twelve 1-minute single-legged (six with each leg) 'all out' efforts interspersed with 1-minute active recovery in two experimental sessions. Power output, oxygen consumption and heart rate were measured throughout the interval sessions. Blood pressure, oxygen saturation, ratings of perceived exertion, pain in the quadriceps and effort were measured at baseline and immediately following each interval. All self-perceived measures were taken on a 0 - 10 scale, with 0 = no perception and 10 = maximum perception. While brain natriuretic peptide (BNP) and left ventricular function were measured pre- and post-exercise. **Results:** Significantly greater power

output (trial average: 340 ± 77 versus 301 ± 101 W, $p<0.01$) and workload (trial average: 916 ± 73 versus 743 ± 122 kJ, $p<0.01$) was observed during combined right and left single-legged cycling, when compared with double-legged cycling. Double-legged cycling resulted in greater physiological stress compared with single-legged cycling as shown by increased oxygen consumption (2.81 ± 0.69 versus 1.84 ± 0.43 $L.min^{-1}$, respectively; $p<0.01$). Additionally, greater cardiac stress was observed during and resulting from double-legged cycling when compared with single-legged cycling as shown by increased inter-interval heart rate (161 ± 7 versus 142 ± 7 bpm, respectively, $p<0.01$) and systolic blood pressure (180 ± 17 versus 166 ± 21 mmHg, respectively, $p<0.01$) as well as lower end-session left ventricular ejection fraction (pre-post change: 11.5 ± 1.8 versus 2.6 ± 1.3 %, respectively; $p<0.05$). BNP increased pre- to post-exercise (24 ± 8 versus 27 ± 8 $pg.mL^{-1}$), however, no differences were observed between conditions. Overall sessional perceived exertion was lower during single-legged, compared with double-legged cycling (7.2 ± 1.8 and 8.9 ± 0.7 units, respectively; $p<0.02$), even though inter-interval perceptions of exertion, pain and effort were similar between conditions. **Conclusion:** Single-legged cycling allows individuals to exercise at a greater overall power output; however, under reduced cardiovascular and physiological stress when compared with traditional double-legged cycling. Furthermore, single-legged cycling is perceived as easier, which could benefit compliance if used as a training stimulus. With increased attention placed on the use of high-intensity interval training in diseased populations, results of the present study indicate that single-legged cycling could provide an alternative approach to normal double-legged cycling giving

practitioners a method to quickly enhance metabolic function while allowing individual to exercise with less risk of experiencing an adverse cardiac event.