Notice of the Final Oral Examination
for the Degree of Doctor of Philosophy
of

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BSc (Hons) (University of Western Ontario, 2002)

“Neuromechanical Measurement of the Effect of Carbohydrate Mouth Rinse on Human Performance in Strength and Elite Cycling Endurance”

School of Exercise Science, Physical and Health Education

Wednesday, April 25, 2018
1:00 p.m.
McKinnon Building
Room 179

Supervisory Committee:
Dr. Marc Klimstra, School of Exercise Science, Physical and Health Education, University of Victoria (Supervisor)
Dr. Trent Stellingwerf, School of Exercise Science, Physical and Health Education, UVic (Member)
Dr. James Wakeling, Department of Biomedical Physiology and Kinesiology, Simon Fraser University (Outside Member)

External Examiner:
Dr. Jim Martin, Department of Nutrition and Integrative Physiology, University of Utah

Chair of Oral Examination:
Dr. Michel Lefebvre, Department of Physics and Astronomy, UVic

Dr. David Capson, Dean, Faculty of Graduate Studies
Abstract

The overarching goal of this dissertation is to refine methods employed for assessing neuromuscular changes and associated power/force outputs during various perturbations of fatigue, direct or perceived, induced by either exercise or nutritional interventions, with associated performance outcomes.

To address this goal, we collected physiological and biomechanical data from subjects across a set of experiments designed to induce different levels of fatigue by the implementation of various exercise and nutritional interventions to cause various levels of fatigue in an ecologically valid manner. The data sets were collected during a single joint task and during cycling trials. During these experimental trials, we collected measures of kinetics (force and cycling power) as well as muscle activation (EMG) and physiological measures (heart rate, rating of perceived exertion, blood lactate, blood glucose, ventilation, oxygen uptake and carbon dioxide production) to investigate the overall performance, as well as potential mechanisms for improved performance related to the exercise and nutritional interventions.

In order to substantially enhance the collection of cycling kinetics and kinematics we have developed an innovative sensor that improved the measurement resolution (temporal and spatial) of a commercial research grade power meter. Using these improved measures alongside advanced muscle activity analysis, we could ameliorate an experimental framework that could be used to investigate changes in fatigue and coordination pattern associated with exercise and nutritional interventions.

Investigation of the effects of a CHO mouth rinse vs. placebo on force and muscle activity during a very short (<3 min) neuromuscular demanding fatiguing trial demonstrated a consistent change in EMG median frequency related to increased fatigue in both experimental conditions, providing little evidence of change in neuromuscular strategy associated with CHO mouth rinse.

Further investigation explored the effects of a CHO mouth rinse vs. placebo using fundamental physiological measures of neuromuscular activation and overall performance measures during an ecologically valid late endurance cycling time trial. Our results demonstrated that while there was no overall effect noticed for time to completion there was a significant decrease in performance in the time to complete various components of the time trial during the placebo trial only. Muscle activity of the lower leg (MG and SOL) demonstrated a modification in frequency only evident during the placebo condition.

Application of principal component analysis to power output and the EMG intensity profiles of the muscles of the lower leg during the pedal cycle revealed more detailed understanding of the effect of CHO mouth rinse on performance during cycling. The average power output profile in WASH showed an earlier onset in the pedal cycle, greater duration and higher amplitude versus PLA during the TT. Additionally, only the PLA condition showed a significant increase in muscle activation throughout the time trial, which could be evidence of fatigue. This dissertation shows for the first time that CHO mouth rinse may have a substantial effect on the maintenance of power while mitigating the impact of neuromuscular fatigue, in late endurance performance, further strengthen our assertion that CHO may in fact minimize the
changes in performance that are associated with fatigue during late endurance fatiguing events.