THE EFFECTS OF ACUTE ALCOHOL CONSUMPTION ON MUSCULAR PERFORMANCE AND RECOVERY AFTER EXERCISE

A thesis submitted in partial fulfilment
of the requirements for the degree of
Doctor of Philosophy
in
Sport and Exercise Science

at Massey University, Manawatu,
New Zealand

Matthew John Barnes

April 2012

ABSTRACT

The acute consumption of alcohol after sport, particularly team sport, is common place. Indeed, sportspeople regularly consume hazardous levels of alcohol at rates significantly higher than non-sportspeople during this period. Much focus is given to behaviours that may enhance the rate of recovery after sport/exercise however little attention has been given to behaviours that may have the opposite, negative effect such as alcohol consumption. Further, while it is widely recommended that alcohol consumption be avoided if damage/injury to skeletal muscle is present little direct evidence exists to support this recommendation. As acute post-eccentric exercise alcohol consumption has previously been shown to impact the magnitude of force loss associated with such exercise, the overall purpose of this thesis was to further investigate the interaction between acute alcohol consumption and damage to skeletal muscle. Within this thesis the consumption of 1 g, but not 0.5 g, of alcohol per kg bodyweight was found to magnify the force loss typically observed in the days after laboratory based, eccentrically biased exercise. This affect was shown to be due to a combination of decreased neural drive and alterations at the muscle level in the days following the damaging event. Investigation into the effect of alcohol on recovery from an ecologically valid game simulation found that acute alcohol consumption and the stresses induced by a rugby match may interact to reduce lower body power output in the days after the match. Other sports specific performance measures, testosterone and cortisol, and markers of immunoendocrine function were unaffected by this combination. In conclusion, the findings presented in this thesis provide evidence that the consumption of alcohol, even at volumes considerably less than those regularly consumed by sportspeople, has deleterious effects on muscle function when consumed soon after strenuous eccentric exercise. This affect is not seen with a lower dose of alcohol or with modest levels of muscle damage. Important to the wider sporting community, these data support the recommendation of limiting alcohol consumption when damage/injury to skeletal muscle has occurred.

ACKNOWLEDGEMENTS

The thesis presented here is the culmination of approximately three years' work in which juggling fulltime employment, study and family has proven a challenge, albeit an extremely rewarding one. Without the help and support of a number of important individuals this process would have been considerably more difficult and infinitely less enjoyable. Specifically, the guidance and knowledge provided by my supervisors, Associate Professor Stephen Stannard and Dr Toby Mündel, has allowed me to develop as a researcher over the course of the doctoral process. Their contribution as supervisors, and colleagues, has instilled in me a passion for further research and an appreciation of what quality research really is. I hope these qualities are evident in the work presented here. Thanks must also be given for the support I have received as an employee and student by the School of Sport and Exercise and the Institute of Food, Nutrition and Human Health at Massey University. I am greatly appreciative of the efforts so many subjects made during this series of studies, especially given the less than enjoyable nature of much of the research. I'm not sure that a few drinks after such exhausting and damaging exercise provided much reward. Finally, the support I have received from my family, in particular my wonderful wife Mel, has been invaluable. The many long days at work followed by, what felt like, even longer nights collecting data would simply not have been possible without this support. Mel's help in raising our two young children, Maia and Jayden, throughout this period has taken a considerable load off me and I hope I can repay the favour at some stage.

TABLE OF CONTENTS

LIST OF ABBREVIATIONS

A

ACh	Acetylcholine
ACSM	American College of Sports Medicine
ADP	Adenosine diphosphate
Ag/AgCl	Silver chloride
ATP	Adenosine triphosphate
ALAC	Alcohol Advisory Council of New Zealand
ALC	Alcohol
ANOVA	Analysis of variance

B

BAC	Blood alcohol concentration
BrAc	Breath alcohol concentration
BURST	Bath University Rugby Sprint Test
BW	Body weight

C

C°	Degrees centigrade
CAM	Cell adhesion molecule
CBF	Cerebral blood flow
CK	Creatine kinase
CL	Confidence limit
cm	Centimetre
CMJ	Counter movement jump
CNS	Central nervous system
CON	Concentric torque
CV	Coefficient of variation

D

DOMS	Delayed on set of muscle soreness

E

EC	Excitation-contraction
ECC	Eccentric torque
EIMD	Exercise induced muscle damage
EMG	Electromyography
ES	Electrical stimulation
EX	Exercising

G

g	Grams
g	Gravity
GABA	Gamma-Aminobutyric acid

H

h	Hour/s
HID	High intensity drill
HR	Heart rate
HR max	Heart rate maximum
Hz	Hertz

I

ICC	Intra-class coefficient
iEMG	Integrated electromyography
IGF-1	Insulin-like growth factor 1
IL.	Illinois
Inc.	Incorporated
ISO	Isometric tension

K

K_m	Michaelis constant
kg	Kilograms

L

L	Litre

La^-	Lactate
LFF	Low frequency fatigue

M

µm	Micrometer
µs	Micro second/s
mA	Milliamp
MEOS	Microsomal ethanol oxidising system
mmol	Millimole
MU	Motor unit
mV	Millivolt
MVIC	Maximum voluntary isometric contraction
MVC	Maximum voluntary contraction

N

n	Number of subjects
N	Newton
NAD^+	Nicotinamide adenine dinucleotide
NADH	Reduced form of nicotinamide adenine dinucleotide
NADPH	Reduced for of nicotinamide adenine dinucleotide phosphate
Nm	Newton meter
NX	Non-exercising

O

OJ	Orange juice

P

PES	Percutaneous electrical stimulation
P_i	Inorganic phosphate
PPO	Peak power output
PRE	Pre-exercise value

R

rad	Radians

RE	Running economy
RPE	Rating of perceived exertion

S

s	Second/s
SD	Standard deviation
SE	Standard error
SPSS	Statistical Package for the Social Sciences
SR	Sarcomplasmic reticulum
StD	Standard drink

T

TCA	Tricarboxylic acid
TMS	Transcranial magnetic stimulation

U

USA	United States of America

V

V	Volt
VA	Voluntary activation
VO2	Rate of oxygen consumption
VO2 max	Maximal rate of oxygen consumption
v/v	Volume/volume

W

W	Watts

LIST OF FIGURES

LIST OF TABLES