# The physiological and molecular response to repeated-sprints in male and female team-sport athletes

A thesis presented in partial fulfillment of the requirements for the degree of

Master of Science

In

Sport and Exercise Science

At Massey University, Palmerston North,

New Zealand

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2009

# Abstract

**Background:** Due to the unique demands of the sport, athletes playing football perform a variety of differing training methods to improve physiological performance. These include strength, endurance and sprint training. While the effects of strength and endurance training have been well researched, the effects of repeated-sprint training on blood and muscle variables in well trained males and females are not well known. An understanding of changes to the blood and muscle during and following an exercise bout are important, so to gain an understanding of the type of stress and resulting adaptations that may occur. Also, while a large volume of research in training adaptations has been performed on males; little has been done on females. To date, some research indicates metabolism during moderate-intensity exercise may differ between males and females; however, no study has compared repeated-sprint exercise. Therefore, it is unclear as to whether males and females would have a differing physiological response to repeated-sprint training.

**Purpose:** The purpose of this study was to determine the effects of a repeated-sprint bout on molecular signalling in muscle and blood measures and heart rate in well-trained footballers. Additionally, we compared running times and sprint decrement (%).

**Research Design:** Eight female senior University football players (Mean ± SD, age, 19 ± 1 y, $\dot{V}O_{2peak}$ 53.0 ± 5.1 ml·kg$^{-1}$min$^{-1}$) and seven male senior University football players (Mean ± SD, age, 19 ± 3 y, $\dot{V}O_{2peak}$ 59.0 ± 6.6 ml·kg$^{-1}$min$^{-1}$) volunteered to participate in this study. Participants performed four bouts of 6 x 30 m maximal sprints spread equally over a 40 min period. Sprint time was measured (at 30 m) for each sprint and sprint decrement was also calculated for all bouts. Muscle biopsies were taken from the vastus lateralis muscle at rest, 15 min following exercise and 2 h into recovery. Venous blood

samples were taken at the same time points as the biopsies while capillary blood lactate was measured at rest and 3 min following each sprint bout. Repeated measures ANOVA and *Post hoc* t-tests were performed to determine significant differences between the two groups (male vs. female) and time points.

**Findings:** Both groups had a significant ($P<0.05$) increase in blood lactate (mM) after the first bout of repeated sprints, with no differences between females (pre 0.9 ± 0.4 mM – post 10.0 ± 1.6 mM) and males (pre 0.8 ± 0.3 mM – post 10.0 ± 3.5 mM). Blood lactate remained elevated compared to rest ($P<0.05$) following bouts 2, 3 and 4 for both females (12.0 ± 3.6, 12.0 ± 3.3, 12.2 ± 3.8 mM respectively) and males (11.9 ± 2.9, 11.6 ± 2.3, 11.5 ± 4.0 mM respectively), with no differences between groups or time points ($P>0.05$). There were no differences ($P>0.05$) between the female and male athletes in mean heart rate attained at the end of each bout of repeated sprints (187 ± 2 v 190 ± 2 bpm respectively) or during recovery between sprints (140 ± 2 v 130 ± 2 bpm respectively). There were no differences between groups or time points in blood insulin ($P>0.05$). Fastest 30 m sprint time and mean 30 m sprint time during the repeated-sprint bout was faster for the males than females (4.58 ± 0.12 v 5.26 ± 0.27 s respectively; ($P>0.05$)). However, there were no differences in running velocity during the sprints between the males and females (165 ± 0.4 % vs. 155 ± 0.05 %; $P>0.05$) when expressed relative to velocity at $\dot{V}O_{2peak}$ ($v\dot{V}O_{2peak}$). Also, mean % decrement during the repeated-sprint bout was lower in the males then females (4.9 ± 1.3 v 7.1 ± 1.9 % respectively; $P<0.05$). No changes were observed in total or phosphorylated Akt at any time-point or between genders. However, while total 4E-BP1 was lower, the ratio of total to phosphoryalated 4E-BP1 at rest was greater in males than females ($P<0.05$). Finally, there was also a significant decrease in 4E-BP1 phosphorylation post-exercise in males ($P<0.05$), but not females.

**Conclusions:** There were no sex differences in blood lactate or heart rate throughout the repeated-sprint bout. These findings suggest that there were no cardio respiratory or lactate production/clearance differences in the response to a repeated-sprint-training bout between sexes. However, while males were faster than their female counterparts, the average relative speed was similar between sexes, suggesting a similar relative volume of work was performed during the sprint bouts. However, the females did have a greater decrement in sprint performance indicating a greater ability to recover sprint performance in the males. Sex differences in resting total and phosphorylated 4E-BP1 may indicate greater potential for muscle growth in the male athletes during basal conditions. However, differences could be due to factors other than sex, including previous training history. There was a lack of change in plasma insulin or Akt, but, similar to resistance exercise, a significant decrease in post-exercise 4E-BP1 phosphorylation for the males, but not females. The sex differences in the 4E-BP1 phosphorylation response post-exercise could be due to differences in the metabolic disturbance in the muscle during and following maximal sprints.

**Keywords: blood lactate, heart rate, muscle**

# Author's Publications

**Dent J**, Edge J, Mündel T, Hawke E, Short M, McMahon C, Coffey V (2008). The effects of sex on the physiological response to repeated sprints. Post Graduate Sport Research Conference, Massey University, Palmerston North (Oral Communication).

Hawke E., Edge J., **Dent J**., Mundel T., Short M.J., Mcmahon C., Coffey V., The effects of sex and repeated-sprints on muscle protein signalling. Coaching & Sport Science Journal (2008) 3, 2:37.

# Acknowledgements

Firstly, I would like to thank my supervisor Dr. Johann Edge, thank you for inspiring me to enter the world of research. The amount of time you invested into this research project is appreciated and my fountain of knowledge flows faster after my 3 years learning from you.

To Emma Hawke, Dr. David Simcock, Chris McMahon and Matt Barnes, thank you for sharing your time and experience in the lab with me. Your expertise and patience have not gone unappreciated.

To my research assistants Chelsea Aim and Warrick Raymond who ensured the smooth running of all exercise trials and made participants feel at ease. Good Attitude!

Next, I would like to thank my co-supervisor Dr. Toby Mundel. Thanks for always being there to push things along. Also to Associate Professor Hugh Morton, thank you for the time you spent reading over my literature review.

To those who without, this research could not have taken place, the participants and my friends. I wish you luck in soccer and life.

To Mum and Dad, thank you for always believing in me and inspiring me with your own work ethic.

Lastly, to the love of my life, Andy. Thank you for your unconditional love and support.

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# List of Abbreviations

| | |
|---|---|
| RSA | Repeated sprint ability |
| mRNA | Messenger Ribonucleic Acid |
| ATP | Adenosine Triphosphate |
| PDK1 | Pyruvate dehydrogenase kinase-1 |
| IGF | Insulin Like Growth Factor |
| P13K | Phosphatidylinositol- 3 Kinase |
| Akt | Serine/Threonine-specific protein-kinase 1 |
| mTOR | Mammalian Target of Rapamycin |
| 4E-BP1 | Eukaryotic translation-initiation factor 4E binding protein 1 |
| p70S6k | p70S6 Kinase |
| eIF4F | Eukaryotic initiation factor 4F complex |
| eIF4G | Eukaryotic initiation factor 4G |
| eIF4E | Eukaryotic initiation factor 4E |
| 5'TOP | 5'Terminal polypryrimidine tract |
| MEF2 | Myocyte enhancer factor 2 |
| AMPK | 5'AMP-activated protein kinase |
| AMP | Adenosine monophosphate |
| TSC2 | Tuberons sclerosis protein |
| FFM | Fat free mass |
| GH | Growth Hormone |
| FFA | Free fatty acids |
| IMCL | Intramyocellular lipid |
| Grb10 | Growth factor receptor bound-bound 10 |
| CHF | Chronic heart failure |
| CHO | Carbohydrate |