Characteristics, training loads, injury patterns and stretching habits of Australian Ironman Triathletes

Warren H. Ansell
BAppSc(Phyt), PostGradDip(SportsPhysio)

A thesis submitted in fulfilment of the requirements for the degree of Master of Medical Science (Physiotherapy)

The University of Newcastle
New South Wales
Australia
February 2012
ACKNOWLEDGEMENTS

I would like to acknowledge the assistance provided by the following people, who made the completion of this project possible.

Professor Darren Rivett, Head of School of Health Sciences, who as principal supervisor used his academic knowledge and publishing experience to provide invaluable input throughout my candidature.

Professor Robin Callister, Discipline of Human Physiology, who as co-supervisor provided valuable feedback, advice and support throughout this study.

Ken Baggs, race director of the Australian Ironman Triathlon. Without his support I would never have had access to the athletes or the registration packs for distribution.

Finally my long suffering wife, family and friends who smiled and nodded while I bored them to tears with the nuances of stretching and Triathlon.
I hereby certify that the work embodied in this thesis is the result of original research and has not been submitted for a higher degree to any other University or Institution

________________________________________

Warren H. Ansell
### TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACKNOWLEDGEMENTS</td>
<td>I</td>
</tr>
<tr>
<td>TABLE OF CONTENTS</td>
<td>II</td>
</tr>
<tr>
<td>LIST OF TABLES</td>
<td>III</td>
</tr>
<tr>
<td>LIST OF FIGURES</td>
<td>IV</td>
</tr>
<tr>
<td>ABSTRACT</td>
<td>V</td>
</tr>
</tbody>
</table>

### CHAPTER 1 INTRODUCTION

1.1 Background 1

1.2 Aims and hypotheses 3

1.2.1 Aims 3

1.2.2 Hypotheses 3

1.2.3 Null hypotheses 4

1.3 Outline of thesis 4

### CHAPTER 2 LITERATURE REVIEW

2.0 Chapter overview 5

2.1 Triathlon sport 5

2.1.1 Short Course 5
2.1.2 Middle Course 6
2.1.3 Long Course 6
2.1.4 Triathlete anthropometrics 9

2.2 Injuries in ironman triathlon
2.2.1 Type, Incidence, Prevalence 10
2.2.2 Bike positioning and its effect on injury 11
2.2.3 Orthotics and injuries in Triathletes 12
2.2.4 Predictors of Triathlon Injuries 13
2.2.5 Injuries in Australian Ironman Triathletes 15
2.2.6 Gender Difference in Triathlon Injuries 16

2.3 Stretching 16
2.3.1 Definitions of Stretching 17
2.3.2 Different Stretching Techniques 20
2.3.3 Static Stretching 22
2.3.4 Contract Relax Stretching 28
2.3.5 Comparison of Different Stretching Methods 29
2.3.6 Electrical Activity of Muscles during Stretching 31
CHAPTER 3 METHOD

3.1 Study design

3.2 Participant recruitment

3.3 Human ethics and race organisers approval

3.4 Questionnaire development

3.5 Questionnaire structure

3.6 Data analysis

CHAPTER 4 RESULTS

4.0 Results introduction

4.1 Representative sample

4.2 Characteristics of race respondents

   4.2.1 Gender differences
4.2.2 Respondents’ competitive sport before triathlon

4.3 Respondent training characteristics

4.4 Stretching

4.5 Resources listed by respondents to learn stretches

4.6 Coaching

4.6.1 Triathlon coach

4.6.2 Swim coach

4.6.3 Cycle coach

4.6.4 Running coach

4.7 Training squads

4.7.1 Triathlon squad

4.7.2 Swim squad

4.7.3 Cycle squad

4.7.4 Running squad

4.7.5 Other squads
4.8 Bikefitting

4.9 Injuries

   4.9.1 Injured body areas

   4.9.2 Attributed causes of injury

4.10 Influence of time in previous Ironman triathlons on injury

4.11 Training loads and injuries

   4.11.1 Swimming hours

   4.11.2 Cycling hours

   4.11.3 Running hours

   4.11.4 Strength training hours

   4.11.5 Stretching hours

   4.11.6 Time in other sports and injury

   4.11.7 Unable to train due to injury

   4.11.8 Modified training due to injury

   4.11.9 Influence of coaching on injuries

   4.11.10 Influence of training in a squad on injuries
4.12 Influence of prevention strategies on injuries

4.12.1 Bikefit

4.12.2 Orthotics

4.13 Health professionals consulted

4.14 Management strategies for injuries

CHAPTER 5 DISCUSSION

5.1 Introduction

5.1.1 Discussion overview

5.2 Characteristics of race respondents

5.2.1 Gender, age and socioeconomic status

5.2.2 Height, weight and BMI

5.2.3 Respondent’s Competitive Sport before Triathlon
5.3 Training characteristics

5.3.1 Training loads

5.3.2 Differences between male and female training loads

5.3.3 Coaching

5.3.4 Triathlon coach

5.3.5 Swimming Coach

5.3.6 Cycling coach

5.3.7 Running coach

5.4 Training squads

5.4.1 Triathlon squad

5.4.2 Swimming squad

5.4.3 Cycling squad

5.4.4 Running squad

5.5 Injury incidence

5.5.1 Specific injured areas of the body

5.5.2 Gender differences in injury

5.5.3 Attributed causes of injury
5.5.4 Participant characteristics and injury

5.5.5 Time to complete the race

5.5.6 Training hours and injury

5.5.7 Strength and stretch training effects on injury

5.5.8 Coaching and injury

5.6 Prevention strategies and injury

5.6.1 Bikefit

5.6.2 Orthotics

5.7 Treatment sought

5.7.1 Health professionals

5.7.2 Injury management strategies

5.8 Stretching habits of Ironman triathletes

5.8.1 Pre and post exercise stretching

5.8.2 Duration and repetition of stretches

5.8.3 Body areas stretched

5.8.4 Resources respondents used to learn their stretches
5.9 Limitations of this study

CHAPTER 6 SUMMARY

6.1 Key research findings

6.2 Further research

REFERENCE LIST

APPENDICES

APPENDIX 1 Survey Questionnaire

APPENDIX 2 Letter of Invitation

APPENDIX 3 Ethics Approval

APPENDIX 4 Race organisers acceptance
The changes in angle have been measured at the hip joint with the knee extended or of the knee with the hip flexed at 90 degrees.
Table 4.12 Frequency of injured body areas

Table 4.13 Attributed causes of injury in various areas of the body

Table 4.14 Total injuries and time to complete race previously

Table 4.15 Strength training and stretch training relationships to injured body areas

Table 4.16 Days unable to train

Table 4.17 Days that athletes had to modify their training

Table 4.18 Orthotic wearers and injured parts of the body

Table 4.19 Use of orthotics and frequency of stretching after training

Table 4.20 Health professionals the respondents consulted for injured body areas

in order of frequency consulted

Table 4.21 Strategies respondents found best helped their injuries
Table 5.1 Mean Age

Table 5.2 Characteristics of Race Respondents

Table 5.3 Males and Females Training Loads

Table 5.4 Strength and Stretch Training

Table 5.5 Competitive sport prior to triathlon

Table 5.6 Orthotic wearers and injured parts of the body

Table 5.7 Orthotics and Stretching After Training

Table 5.8. Time to complete the race

Table 5.9 Total injuries and time to complete race.

Table 5.10 Unable to train

Table 5.11 Modify to train

Table 5.12 Strength training and stretch training relationship to injured body areas

Table 5.13 Injured Body Areas

Table 5.14 Attributed Causes to injured areas of the body

Table 5.15 Professionals respondents sought advice to injured body areas

Table 5.16 Strategies respondents found best helped their injuries

Table 5.17 The athletes that stretched before training
Table 5.18 The athletes that stretched after training

Table 5.19 Time respondents held their stretches

Table 5.20 The number of times respondents performed their stretches

Table 5.21 Areas Stretched by respondents

Table 5.22 Resources the respondents used to learn stretches

Table 6.1 Weekly Training Loads

Table 6.2 Strengthening and stretching loads

Table 6.3 Injured Body Areas
**LIST OF FIGURES**

| Figure 2.1 | Chrissie Wellington world ironman triathlete on aerodynamic bars | 8 |
| Figure 2.2 | Fuel Belt used by ironman triathletes in the run leg. | 9 |
| Figure 5.1 | Mean of athletes total injuries with athletes stretching after training | 73 |
ABSTRACT

The Ironman triathlon is an individual sport consisting of three disciplines – swimming, cycling and running. This endurance sport has grown in popularity with over 22 races annually worldwide and 24,000 participants. Despite this participation there are insufficient data concerning injuries in the Ironman triathlon and regarding athletes’ stretching and training habits, especially in Australia. The aim of this retrospective cross-sectional study was to investigate the incidence of overuse injuries in this sport according to anatomical site, and their relationships to gender, age, training hours, stretching habits and other factors.

Questionnaires were provided in the race packs of 1250 participants of the Australian Ironman Triathlon in 2006. Two hundred and ninety-six questionnaires were returned giving a low response rate of 24% (74.3% male, 25.7% female). In this sample, 86.1% reported suffering an overuse injury related to competition or training in the last year. The most common site of injury was the knee (35.1% of respondents), followed by the lower back (34.1%) and the ankle/foot (30.7%). There was no statistical relationship between incidence of injury and training load, gender or age, however triathletes with a triathlon coach had a lower injury rate. Participants reported stretching less before training (41.2%) than after training (67.2%). Among those participants who stretched, the most commonly stretched muscle groups were the hamstrings (88.9%), calves (88.5%) and quadriceps (86.1%). The lower back (61.5%), upper back (31.8%) and shoulder (53.4%) muscles were not stretched by as many participants. Lower back injuries had a significant association with cycling (n = 101, r = 0.256, p = 0.01). A strong positive trend was demonstrated between stretching after training and a reduction in total injuries (p=0.059). The health professional intervention most utilised by participants was physiotherapy. The overuse injuries in Ironman triathlons in other countries were reported to be most common in the knee, ankle/foot and lower back, which
was confirmed in this study of Australian Ironman triathletes. These areas injury need further investigation, to develop interventions to prevent or minimise injuries in this population.

There is a need to educate physiotherapists on the injury profile of these athletes, so they are better prepared to treat and design interventions to prevent these types of injuries.