Nutrition Knowledge, Food Choice
Motives and Eating Behaviours of
Triathletes

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Triathlete, triathlon, athlete, food choice motives, nutrition knowledge, flexible restraint, rigid restraint, eating behaviours, factors, nutrition education, dietary restraint
Abstract

It is important for athletes to make sound food choices as optimal dietary intake is known to enhance sport performance. However, little is known about the factors important to athletes when making decisions about what to eat. Food choice and eating behaviours are a complex area to understand and research demonstrates there are many reasons behind individual food choice decisions. Using a quantitative research design this study explored nutrition knowledge, eating behaviours and factors important in the food choices of a sample of recreational triathletes (n = 164, males = 94, females = 70) compared to an age-matched group not currently participating in triathlon (n = 134, males = 58, females = 76) that included both active and non-active individuals. Three validated questionnaires were administered via the internet, including the General Nutrition Knowledge Questionnaire (GNKQ), an adapted version of the Food Choice Questionnaire (FCQ) and the rigid (RC) and flexible (FC) control subscales of the Three Factor Eating Questionnaire (TFEQ). The GNKQ assessed four areas including knowledge of dietary guidelines, food sources of key nutrients, skill in choosing healthy foods and the relationship between diet and disease. The FCQ measured the importance of 13 factors in food choice decisions and the RC and FC subscales measured two types of dietary restraint.

Overall nutrition knowledge scores did not differ between triathletes and non-triathletes. Scores on the knowledge subsections were also similar, but non-triathletes scored higher than triathletes on diet/disease relationships (47.8% vs. 41.1%; p=0.035). All females scored higher on knowledge of dietary guidelines (79.1% vs. 70.9%; p=0.011) and diet/disease relationships (47.8% vs. 41.1%; p=0.028). Both triathletes and non-triathletes scored best on choosing everyday foods and worst on diet/disease relationships. The five most important factors in food choice for all participants were health, performance, price, sensory appeal and natural content. The FCQ preferences indicated that triathletes placed greater importance on performance (p=0.019) and price (p=0.024), whereas non-triathletes placed more importance on environmental protection (p=0.024), political values (p=0.002) and animal welfare (p=0.007). Females placed more importance on weight control (p=0.043) and natural content (p=0.029) than males when selecting foods. There was a significant difference between male and female triathletes for scores on rigid and flexible control with females scoring significantly higher on both scales (p < 0.001). Scores
for RC and FC for males appeared higher than previous studies using the restraint subscales. Scores for female triathletes appeared higher only for FC. Overall, participants displayed a range of restraint levels from very low to very high with the only difference found for RC between female triathletes and non-triathletes with a higher proportion of female non-triathletes showing low RC ($p=0.039$). Both RC and FC scores were significantly correlated with the weight control motive of the FCQ across all groups ($p<0.001$).

These results show females have higher levels of nutrition knowledge than males and this is not influenced by being a triathlete. Triathletes’ food choices are influenced by factors similar to non-triathletes, but they are also influenced by performance. Finally, this study is the first to use the RC and FC subscales on an athlete population and results suggest athletes use both types of restraint, but may use higher levels of FC than non-athlete populations.
# Table of Contents

Keywords .................................................................................................................................................. i
Abstract .................................................................................................................................................... ii
Table of Contents .................................................................................................................................... iv
List of Figures .......................................................................................................................................... vi
List of Tables .......................................................................................................................................... vii
List of Abbreviations ............................................................................................................................. viii
Acknowledgments ..................................................................................................................................... x

## 1. **INTRODUCTION** ........................................................................................................................... 1
  1.1 Background ........................................................................................................................................ 1
  1.2 Context ........................................................................................................................................... 2
  1.3 Purpose .......................................................................................................................................... 2
  1.4 Significance .................................................................................................................................... 3
  1.5 Thesis Outline ................................................................................................................................. 4

## 2. **LITERATURE REVIEW** .................................................................................................................. 5
  2.1 Introduction .................................................................................................................................... 5
  2.2 Determinants of food choice ........................................................................................................ 6
    2.2.1 Sensory Appeal and food preferences .................................................................................. 6
    2.2.2 Price ...................................................................................................................................... 7
    2.2.3 Health and wellbeing ......................................................................................................... 7
    2.2.4 Weight control ................................................................................................................... 8
    2.2.5 Nutrition knowledge ......................................................................................................... 9
    2.2.6 Life stage .......................................................................................................................... 11
    2.2.7 Culture and religious beliefs ......................................................................................... 13
    2.2.8 Lifestyle choices ............................................................................................................. 14
    2.2.9 Habits, routines and past experiences ........................................................................... 15
    2.2.10 Hunger and appetite .................................................................................................... 15
  2.3 Factors impacting the food choices of athletes ........................................................................ 16
    2.3.1 Involvement in sport ........................................................................................................ 16
    2.3.2 Motives for participating in sport ................................................................................ 16
    2.3.3 Performance .................................................................................................................... 17
    2.3.4 Gastrointestinal issues ................................................................................................... 18
    2.3.5 Demanding schedules .................................................................................................... 19
  2.4 Approaches to understanding food choice ............................................................................. 20
  2.5 Conclusion .................................................................................................................................... 22
  2.6 Implications ................................................................................................................................... 22

## 3. **RESEARCH DESIGN** ..................................................................................................................... 23
  3.1 Methodology .................................................................................................................................. 23
  3.2 Participants .................................................................................................................................... 23
  3.3 Instruments .................................................................................................................................... 24
    3.3.1 Food Choice Questionnaire .......................................................................................... 24
    3.3.2 General Nutrition Knowledge Questionnaire .............................................................. 26
    3.3.3 Rigid and Flexible Control Subscales ........................................................................... 27
  3.4 Procedure and Timeline ............................................................................................................. 27
  3.5 Analysis ......................................................................................................................................... 28
3.6 Ethics and Limitations ............................................................................................................... 29

4. RESULTS ......................................................................................................................................... 30
  4.1 Participant Characteristics ......................................................................................................... 30
  4.2 Food Choice Questionnaire ....................................................................................................... 32
  4.3 General Nutrition Knowledge .................................................................................................... 36
  4.4 Rigid and Flexible Control ......................................................................................................... 39
  4.5 Nutrition Resources of Triathletes ............................................................................................. 43

5. DISCUSSION .................................................................................................................................... 45
  5.1 Food Choice Motives ................................................................................................................. 46
  5.2 Nutrition Knowledge ................................................................................................................. 48
    5.2.1 Nutrition knowledge and food choice motives ............................................................... 49
    5.2.2 Nutrition knowledge sources .......................................................................................... 51
  5.3 Rigid and Flexible Control ......................................................................................................... 51
    5.3.1 Male restraint scores ....................................................................................................... 52
    5.3.2 Female restraint scores ................................................................................................... 53
    5.3.3 Levels of flexible and rigid control ................................................................................. 53

6. CONCLUSIONS ................................................................................................................................... 55
  6.1 Strengths and limitations ............................................................................................................ 55
  6.2 Implications for practice ............................................................................................................. 58
  6.3 Future directions ........................................................................................................................ 58

7. REFERENCES ..................................................................................................................................... 60

8. APPENDICES ................................................................................................................................... 69
   APPENDIX A: PARTICIPANT QUESTIONNAIRE ............................................................................ 70
   APPENDIX B: ADAPTED FOOD CHOICE QUESTIONNAIRE .................................................... 73
   APPENDIX C: GENERAL NUTRITION KNOWLEDGE QUESTIONNAIRE .............................. 75
   APPENDIX D: THREE FACTOR EATING QUESTIONNAIRE FLEXIBLE AND RIGID
                  RESTRAINT SUBSCALES ........................................................................................................ 81
   APPENDIX F: NORMS FOR FLEXIBLE AND RIGID CONTROL ...................................................... 83
   APPENDIX G: RANGES OF BMI'S FOR MALE AND FEMALES ACCORDING TO
                  WEIGHT CLASSIFICATION. ..................................................................................................... 84
List of Figures

Figure 1  Mean scores for triathletes and non-triathletes on the food choice motives of the adapted Food Choice Questionnaire………..33

Figure 2  Differences in flexible and rigid control scores for male and female triathletes and non-triathletes……………………40

Figure 3  Distribution of flexible and rigid control between male and female triathletes and non-triathletes.........................42

Figure 4  Top five nutrition information sources used and not used by triathletes…………………………………………44
List of Tables

Table 1  Participant characteristics………………………………………………….31
Table 2  Scores for the food choice motives of the adapted Food Choice Questionnaire………………………………………………………..35
Table 3  Nutrition knowledge scores on the General Nutrition Knowledge Questionnaire for triathletes and non-triathletes………………….37
Table 4  Nutrition knowledge scores on the General Nutrition Questionnaire for groups……………………………………………………………..38
Table 5  Correlation analysis of General Nutrition Knowledge Questionnaire overall score with the Food Choice Questionnaire factor for health and performance/fitness………………………………………..........39
Table 6  Spearman’s correlation between level of flexible (FC) and rigid (RC) control, Body Mass Index (BMI) and the weight control motive of the Food Choice Questionnaire…………………………………..43
## List of Abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>BMI</td>
<td>body mass index (kg/m$^2$)</td>
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<td>FC</td>
<td>flexible control</td>
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<tr>
<td>FCQ</td>
<td>Food Choice Questionnaire</td>
</tr>
<tr>
<td>GI</td>
<td>gastrointestinal</td>
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<tr>
<td>GNKQ</td>
<td>General Nutrition Knowledge Questionnaire</td>
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<td>n</td>
<td>sample number</td>
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<tr>
<td>RC</td>
<td>rigid control</td>
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<td>SPSS</td>
<td>Statistical Package for Social Sciences</td>
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<td>TFEQ</td>
<td>Three Factor Eating Questionnaire</td>
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Statement of Original Authorship

The work contained in this thesis has not been previously submitted to meet requirements for an award at this or any other higher education institution. To the best of my knowledge and belief, the thesis contains no material previously published or written by another person except where due reference is made.

Signature: _________________________

Date: _________________
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1. Introduction

This chapter is presented in four sections. It begins with background information on the sport of triathlon which is intended to illustrate how the topics covered in this thesis evolved (Section 1.1). This is followed by the major focus of the study (Section 1.2) and, subsequently, the main purpose of the research (Section 1.3) and why it was important to carry out (Section 1.4). The final section (Section 1.5) provides an outline of the remaining chapters of the thesis.

1.1 BACKGROUND

The sport of triathlon first originated in 1974 (Dolan, Houston, & Martin, 2011) and had its inaugural debut at the Sydney Olympics in 2000 (Landers, Blanksby, Ackland, & Smith, 2000). The sport includes three disciplines of swimming, cycling and running performed consecutively over the course of a race. Triathlon is unique compared with single event sports as athletes must train and develop skills specific to each discipline (Knechtle, Knechtle, Rosemann, & Senn, 2011). Races are conducted over a range of distances from sprint (750m swim, 20 km bike, 5 km run) to Ironman (3.8 km swim, 180 km bike, 42.2 km run) and can last anywhere from 50 minutes to 17 hours (Cox, Snow, & Burke, 2010).

Participating in triathlon requires many hours of training to attain the skills and level of fitness necessary to compete well in three disciplines. Due to the intensity and demands of training and competition the energy requirements of triathletes are amongst the highest across sports (Van Erp-Baart, Saris, Binkhorst, Vos, & Elvers, 1989) and the food choices they make can influence performance goals and outcomes (Frentsos & Baer, 1997). However, despite substantial evidence supporting the benefits of sound nutrition for optimal sport performance and recovery (Rodriguez, Di Marco, & Langley, 2009), there is little known about triathletes’ dietary intakes and whether they meet recommendations. In addition, little is known about what motivates triathletes when they make food choices.

The role of sport nutrition professionals is to educate and guide athletes to make nutrition choices that support health and performance. However, nutrition education is only useful if the athlete adopts positive eating behaviours. A limited
understanding of what motivates athletes when selecting foods makes it a challenge for nutrition professionals to provide effective counselling. Exploring the food choice motives of triathletes provides the opportunity to study a diverse and varied group of athletes in a sport popular to both males and females. As well, research shows triathletes are interested in nutrition (Worme et al., 1990) which may suggest an increased motive to eat well. As triathlon continues to grow in popularity and participant numbers increase, it is important to better understand what triathletes eat as well as why they choose the foods they do. This will help direct and improve nutrition services provided to these athletes. Furthermore, to provide effective nutrition education and guidance it is important for nutrition professionals to appreciate the many factors, in addition to knowledge, that can influence dietary intake practices.

1.2 CONTEXT

The major focus of this study was to explore the factors important in the food and fluid choices of triathletes. This included an investigation of nutrition knowledge and dietary restraint and how these are associated with food choice motives. The study explored food choice from the perspective of a group of athletes who engage in a sport where food consumption patterns and frequency are different not only to the general population, but to other non-endurance athletes (Burke, Gollan, & Read, 1991). As a result, this study provides new information on food choice in a population where there is potential for eating to be influenced by factors unique to athletes.

1.3 PURPOSE

This research project had three main objectives related to food choice and eating behaviours of triathletes. The primary objective was to investigate the factors that influence the food choices of triathletes compared with a non-triathlete group. The second and third objectives included an exploration of nutrition knowledge and dietary restraint in order to establish how these influence decisions around food choice motivations. Understanding what motivates food choice is complex and can depend on many factors, such as age, gender, socioeconomic status and ethnicity (Furst, Connors, Bisogni, Sobal, & Falk, 1996). As well, physiological cues of hunger and fullness, social and psychological factors and nutrition knowledge may
influence food choices (Worsley, 2002). Athletes are also faced with choosing foods that support training, competition and recovery. Research has investigated the food choice motives of various populations, but few have explored this in athletes.

The purpose of this investigation was to explore the factors important to the food choice decisions of triathletes and if this differed from a group of non-triathletes. It was hypothesized that triathletes would be influenced by many of the same factors as the non-triathlete group, however, in this unique population it was anticipated performance would be an additional key factor driving food choice decisions. An exploration of the nutrition knowledge of triathletes also provided the opportunity to assess if this impacted on the importance placed on food decisions. Finally, this study aimed to add to the limited research on dietary restraint in triathletes by exploring two different types of dieting strategies (rigid and flexible control) and how they relate to food choice motives. Specifically, it was hypothesized triathletes would exhibit a high degree of dietary restraint, however, it was believed many would show a high level of flexible dietary restraint as a result of participating in triathlon. This was the first study to investigate these eating behaviours in triathletes compared with a non-triathlete group and, therefore, adds new findings to the field.

In conclusion, this research explored what is important to triathletes when they make dietary choices and how this is influenced by nutrition knowledge and eating behaviours (i.e. dietary restraint).

1.4 SIGNIFICANCE

Little is known about the factors important in the food choices of athletes. Even less information is available on the food choice motives of triathletes. To date, a review of the literature found only four investigations exploring the food choices of athletes and factors that influence these (Long, Perry, Unruh, Lewis, & Stanek-Krogstrand, 2011; Pelly, King, & O’Connor, 2006; Robins & Hetherington, 2005; Smart & Bisogni, 2001). Three of these investigations used qualitative research designs applying grounded theory methods through interviews or case studies. Studies indicate greater importance may be placed on high carbohydrate foods, hydration strategies and health, and eating patterns of triathletes suggest foods that are readily available and quick to prepare are important (Burke et al., 1991; Nogueira & Da Costa, 2004). The present study explored food choice using a quantitative
research design and, in contrast to qualitative research, involved a large group of participants. Furthermore, unlike previous studies, this investigation included a non-triathlete comparison group. The methodology provided a different approach to exploring the food choice motives of triathletes by making comparisons to a group not involved in triathlon, but included both active and non-active participants. Previous research exploring food choice has compared specific populations (Piggford, 2008; Share & Stewart-Knox, 2012) as well as made comparisons between consumer groups from different countries (Milošević, Žeželj, Gorton, & Barjolle, 2012). However, no research has compared differences between triathletes and non-triathletes and explored an association with nutrition knowledge and dietary restraint. Subsequently, this research provides insights into the nutrition knowledge of triathletes as well as dietary restraint by exploring flexible and rigid control. While this study involved triathletes, it is anticipated this information will benefit other athletes and the nutrition professionals who work with them. Furthermore, it was expected outcomes would stimulate opportunities for future research in the area.

1.5 THESIS OUTLINE

The remaining sections of this thesis are presented in four chapters. Chapter 2 presents a review of the current literature regarding food choice and eating behaviours, exploring both athlete and non-athlete populations. Chapter 3 outlines the design and methodology used in this study, including how this supported the aims and objectives of this research. Chapter 4 presents the results which are followed by the discussion and conclusions in Chapter 5.
2. Literature review

2.1 INTRODUCTION

Food choice is known to be influenced by many factors, including taste, convenience, price, and cultural and/or religious beliefs (Furst et al., 1996; Sobal & Bisogni, 2009). The literature also reports a strong influence of food availability and security (Mello et al., 2010). In addition to these factors, individual knowledge about food and nutrition as well as personal and/or family beliefs are also known to influence food choice (Worsley, 2002). In athletes, involvement in sport and the recognized importance of food and nutrition to sports performance also likely play an important role as well as the sport environment in which athletes are immersed (Rodriguez et al., 2009). Furthermore, athletes are likely influenced by coaches, the behaviours and practices of other athletes and the culture within sport (Ono, Kennedy, Reeves, & Cronin, 2012). Concerns about weight and body image are strong influences on food choice for general populations (Wardle et al., 2004) and have similar effects on athletes where attempts to achieve physique and body weight goals for performance and/or aesthetic reasons contribute added pressure on athletes (Byrne & McLean, 2002). The influence of the media promoting a range of weight loss and diet fads along with societal pressures, can have a strong influence on food choice (Bublitz, Peracchio, & Block, 2010). However, despite a large body of research with general populations, there are few studies examining the factors influencing the food choices and eating behaviours of athletes. This review of the literature explores factors influencing food choice, with emphasis on issues unique to sport. Due to the volume of research on the topic of food choice and eating behaviours, this review is unable to cover in depth all factors that may influence the food choice of athletes. Instead key areas are presented that were considered relevant to this study. Overall, this literature review illustrates the multidimensional nature of food choice and demonstrates our limited understanding of food choice motives within athlete populations. It remains to be investigated if athletes are influenced by factors similar to general populations.
2.2 DETERMINANTS OF FOOD CHOICE

2.2.1 SENSORY APPEAL AND FOOD PREFERENCES

Across all populations, from children, students, adults and within cultures, taste is an important determinant of food choice (Glanz, Basil, Maibach, Goldberg, & Snyder, 1998; Milošević et al., 2012; Shannon, Story, Fulkerson, & French, 2002). This is not surprising as the aroma, taste, texture and appearance of food provides pleasure and enjoyment making for a rich and varied sensory experience (Clark, 1998). In fact, in the absence of economic and availability issues, sensory appeal is thought to be the most important determinant of individual food choices (Eertmans, Baeyens, & Van den Bergh, 2001). In other words, if a food does not appeal to the senses, regardless of price, availability or nutrient content, it is unlikely to be eaten (Eertmans et al., 2001). However, the importance of taste when making food decisions is often balanced with other priorities, such as health or weight concerns (Sobal & Bisogni, 2009). Individuals living with chronic disease will emphasize health over taste when they avoid favourite high fat foods in favour of those they understand are healthier (Furst et al., 1996). Likewise, weight conscious individuals will select foods low in fat and calories over those they would like to eat, but do not support their weight specific goals (Connors, Bisogni, Sobal, & Devine, 2001). The importance of taste is influenced by demographic characteristics such as gender, income and age (Furst et al., 1996; Sobal & Bisogni, 2009). For example, those with lower incomes will balance taste over cost when making food choices (Furst et al., 1996). Athletes report the sensory aspects of food, such as taste and smell, are important in their food choices (Pelly et al., 2006; Smart & Bisogni, 2001). However, these become less important prior to an important game or event when foods that benefit performance are preferred (Smart & Bisogni, 2001). Athletes report foods they enjoy are not the best choice for performance as they believe palatable foods are associated with unhealthy options (Smart & Bisogni, 2001). Likewise, athletes will avoid preferred foods prior to competition in order to meet weight specific goals (Pettersson, Pipping Ekström, & Berg, 2012). Overall, taste is an important factor in food choice and varies with age, gender, personal characteristics and, for the athlete, is likely influenced by performance goals.
2.2.2 PRICE

Financial limitations and budget constraints can influence food choices, particularly for lower income individuals, students, and youth (Boek, Bianco-Simeral, Chan, & Goto, 2012; Glanz et al., 1998). Elite athletes on a limited budget report financial constraints interfere with making food choices that support a healthy diet (Heaney, O'Connor, Naughton, & Gifford, 2008). Indeed, those at the elite or professional level, who train full time, report financial issues are a major stress (Hanton, Fletcher, & Coughlan, 2005). Likewise, budget friendly food choices are a priority to the college athlete responsible for purchasing his or her own foods (Long et al., 2011). Although a large majority of triathletes are employed full time and work professional jobs, there are those who are students with limited income where price may be a factor in food selection (Arnott, 2008). Participation in triathlon is not without cost, not only with the time investment, but also the financial commitment. Equipment, race entry fees and a number of other expenses require a substantial monetary contribution (Arnott, 2008). However, it’s not known if these factors impact on the food choices of athletes. Overall, research suggests finances are a concern for some and, therefore, an important factor to include when assessing food choice determinants.

2.2.3 HEALTH AND WELLBEING

Healthy eating is important for general well-being, disease prevention and maintaining a healthy body weight. Sport nutrition guidelines emphasize the importance of a balanced diet not only to optimize athletic performance, but also to support health, immune function and prevent illness (Rodriguez et al., 2009). Health is an important factor in food choice for many individuals and is often associated with better dietary habits. For example, individuals who value health report greater intakes of fruits, vegetables and fibre (Glanz et al., 1998). These individuals also tend to make similar healthy lifestyle choices by not smoking and engaging in more physical activity. The importance of health is influenced by age, gender, education, nutrition knowledge and physical activity level (Ree, Riediger, & Moghadasian, 2008). Studies report males, younger individuals and those with lower incomes place less importance on the value of health (Honkanen & Frewer, 2009). However, this can be influenced by nutrition knowledge with research showing younger individuals
with greater knowledge value healthy eating and engage in more physical activity then their less active peers (Croll et al., 2006).

A greater importance on healthy food choices is not always related to well-being. Instead, weight concerns are the main reason for some people. Females consistently report a greater importance on nutritious food choices which may be driven by health or weight concerns (Boek et al., 2012; Glanz et al., 1998; Ree et al., 2008; Wardle et al., 2004). Foods commonly identified as healthy are also frequently low in calories and fat, and, therefore, important to those interested in weight control (Ree et al., 2008). Concerns about health and weight may be separate or combined factors influencing food choice. For example, adolescents report food choices are influenced by weight concerns with little emphasis on health (Ree et al., 2008). This is likely a reflection of age as younger individuals are often less worried about long term health issues (Share & Stewart-Knox, 2012). In contrast, older adults living with chronic disease identify both as important factors influencing food choices (Ree et al., 2008). Research with athletes suggests health is an important factor in food choice. For example, in a study by Long et al. (2011) a football player reported he chose to eat healthy foods due to a family history of heart disease and some triathletes compete to prevent or remove unhealthy habits, such as smoking and drinking (Lamont & Kennelly, 2012). Amongst athletes, the importance of health may vary over time with weight control and performance taking precedence during competition or practice and the opposite occurring in the off season. However, we do not know if the reported link observed in general populations between physical activity, healthy eating and the importance of health also applies to athletes as their exercise motives may be performance rather than health orientated. In other words, it remains to be investigated if the higher physical activity level of athletes means they place high importance on health when selecting foods.

2.2.4 WEIGHT CONTROL

Weight control is an important factor in food choice decisions for many, particularly those concerned with body shape and size (Steptoe, Pollard, & Wardle, 1995). Cognitive dietary restraint is referred to as the conscious restriction of food intake in order to control body weight (Stunkard & Messick, 1985). This may include ‘diet rules’ such as choosing products low in fat and calories or restricting selected food groups (Forestell, Spaeth, & Kane, 2012; Ward & Mann, 2000). Dietary
restraint has been researched extensively in non-athlete populations, particularly in the areas of weight loss, dieting and disordered eating (Ashikali & Dittmar, 2010; Bublitz et al., 2010). Similarly, amongst athlete populations dietary restraint has been explored in relation to disordered eating, bone health and ovulatory disturbances (Barrack, Rauh, Barkai, & Nichols, 2008; Byrne & McLean, 2002; Williams, Leidy, Flecker, & Galucci, 2006). Many athletes attempt to modify body weight and composition believing this will enhance performance (O'Connor, Olds, & Maughan, 2007). Likewise, many athletes are susceptible to pressures to modify body composition to achieve a lean, athletic look, particularly in sports where leanness and low body mass are emphasized (Byrne & McLean, 2002; Rodriguez et al., 2009). The sport of triathlon has evolved considerably over the last 15 years and changes in morphology have been reported with athletes becoming leaner with lower body fat levels (Landers et al., 2012). Indeed, body mass and physique have been shown to influence performance outcomes in triathlon (Landers et al., 2000) so it should not come as a surprise that physique goals may influence the food choices of triathletes. Results, however, have varied with less impact of physique traits on performance as race distance increases, which has been reported in the literature exploring body composition and race outcomes in ironman triathlon (Knechtle, Wirth, Baumann, Knechtle, & Rosemann, 2010; Rüst et al., 2012). Triathlon is a sport in which leanness is favoured with images of top athletes possessing ectomorphic, athletic builds often revealed through tight fitting lycra clothing. As such, participants may be influenced to achieve a similar appearance in order to enhance performance or for aesthetic reasons. Furthermore, triathlon is a sport where athletes, both male and female, are at increased risk for disordered eating (DeBate, Wethington, & Sargent, 2002). This may factor in food choice as athletes restrict food intake in an attempt to modify body weight. Overall, research suggests the food choices made by athletes may be influenced by body mass goals. However, importance may vary based on competitive level, personal goals and individual characteristics of the athlete.

2.2.5 NUTRITION KNOWLEDGE

Nutrition knowledge and beliefs can influence food choice (Furst et al., 1996). Knowledge is described as both an awareness of nutrition as well as the ability to practically apply this when choosing healthy foods (Worsley, 2002). As such, the athlete’s knowledge about nutrition, both general and sport specific, may
impact their food choices and subsequent dietary intake. Likewise, their beliefs about nutrition and level of knowledge may determine the importance placed on food choices as influenced by the athlete’s understanding of the role of nutrition on health and sport performance. Nutrition education is often used to help change human behaviours and is provided with the expectation that greater knowledge will lead to improved dietary practices and better food choices (Parmenter & Wardle, 1999). Research has shown an increase in fruit and vegetable consumption in adults with improved knowledge (Wardle, Parmenter, & Waller, 2000) and that college students with greater awareness of healthy eating guidelines make better food choices (Kolodinsky, Harvey-Berino, Berlin, Johnson, & Reynolds, 2007). Likewise, in athletes, research has found an association between greater knowledge and healthy habits, with a stronger relationship found in those at a non-elite level (Harrison, Hopkins, MacFarlane, & Worsley, 1991). A possible explanation may be that elite athletes, who compete at the top level, place performance factors above all else when making food choices. In other words, despite awareness of healthy choices, athletes may select foods they feel will maximize performance outcomes, whether healthy or not. The nutrition knowledge of triathletes has received little investigation. Furthermore, few studies have explored a relationship between knowledge, motivation to eat well and dietary intake in athlete populations. In other words, we do not know if an athlete’s knowledge of nutrition motivates them to eat well or if this is reflected in dietary intake. In addition, there is little information on where or how athletes acquire nutrition knowledge. Early research found newspapers, sport magazines and peers were a primary source of nutrition information for triathletes (Burke et al., 1991; Worme et al., 1990) while in other sports, despite easy access to a nutrition professional, few athletes utilize this reliable source of information (Nieper, 2005). At this point, studies suggest a greater awareness of nutrition will influence the athlete’s food choices. However, further investigation is needed exploring the nutrition knowledge, both health and sport specific, of athletes as well as the resources they use. This will help create a deeper understanding of the link between knowledge and food choice motives and help support the services provided by nutrition professionals.
2.2.6 LIFE STAGE

Throughout the lifespan food choices can be influenced by various factors associated with the different roles and responsibilities a person experiences through their life cycle. As individuals progress through life, factors important in food choice can vary and depend on existing priorities and circumstances of the current life situation.

Parents, children and adolescents

Parents are responsible not only for their own food choices, but also the choices of their children. As the primary food provider, parents decide what to purchase, prepare and offer children (Roos, Lehto, & Ray, 2012). They act as important role models and impact the food choices of children through their own eating preferences, beliefs and behaviours. As caregivers, it is not surprising that the factors important to the food choices of parents are frequently influenced by what is important to the health of their children (Contento et al., 1993). Factors important to parents include health, natural content and convenience (Roos et al., 2012). However, the importance placed on health can vary and may be influenced by nutrition knowledge (Contento et al., 1993). Mothers who rate health as important often have children who consume diets lower in sugar, saturated fat and calories (Contento et al., 1993).

For children, key factors influencing food choices are parental purchasing and preparation habits (Holsten, Deatrick, Kumanyika, Pinto-Martin, & Compher, 2012). Children exert control over food choices by indicating foods they like, but parental rules, family preferences and a host of other factors determine final food consumed (Holsten et al., 2012). Taste is an important factor for children, however, hunger and activities, such as playing with friends or sleeping, can have greater importance (Holsten et al., 2012). Parents factor in the food choices of their children through their presence or absence in the home. When parents are away, children have more freedom to choose and place importance on food likes and those quick and easy to prepare (Holsten et al., 2012).

During adolescence, teenagers face new challenges and food choices are influenced by peers, new environments and social pressures (Fitzgerald, Heary, Nixon, & Kelly, 2010). Adolescents rate taste, familiarity, health, dieting and filling food choices as important (Contento, Williams, Michela, & Franklin, 2006). Studies
show adolescents are aware of healthy eating and nutrition, but this is often not reflected in dietary intake practices or preferences (Brown, McIlveen, & Strugnell, 2000; Fitzgerald et al., 2010). As they get older, teenagers express greater control over their food choices as they experience a new found personal freedom. Food outlets, media, school and advertising can have a greater influence on food choice outside the home when parental control is reduced (Brown et al., 2000). With more independence, teenagers often report choosing unhealthy food which can be influenced by price, convenience and peers (Fitzgerald et al., 2010). Also, social pressures exist and teenagers may make food choices based on what peers are eating despite their own personal preferences (Contento et al., 2006).

**Older adults**

For the elderly, past experiences are important factors in food choice, with many choosing food based on memories formed during childhood (Winter Falk, Bisogni, & Sobal, 1996). The elderly often consider social situations when making food choices. Companionship and socializing are important in the lives of many older adults and food choice become dependent on the environment in which these take place. In other words, foods eaten are often based on what is being served (Winter Falk et al., 1996). Many also approach retirement where budget concerns arise, making price an important factor. The ageing process can lead to physical changes related to digestion or mobility and those with chewing difficulties or arthritis may favour food choices that are easy to digest, convenient or require little preparation (Winter Falk et al., 1996). With an increased risk of chronic disease, such as diabetes and heart disease, the elderly place greater importance on food choices that help in the management of issues related to high blood pressure, blood sugar or cholesterol (Ree et al., 2008).

**Students**

Many young college students have recently moved away from home where food is often prepared and freely available. Outside of the home, with the added pressures of study and school commitments, many rely on store-bought, prepared foods and rate convenience and price as important in food choice decisions (Boek et al., 2012). Consistent with previous reports in other populations, taste is a major factor important to students. However, other factors such as health play a role and this may be influenced by race and gender (Boek et al., 2012; Shannon et al., 2002).
Females are more likely than males to identify health and weight issues as important (Mooney & Walbourn, 2001; Shannon et al., 2002) and in high school getting the most for your money is a primary concern, particularly for males (Shannon et al., 2002). Athletes who participate in college meal plans indicate food choices are influenced by the abundance of options available in dining halls which can lead to overeating (Smart & Bisogni, 2001). These athletes also indicate their food choices are influenced by what peers are eating.

These studies support the importance of considering life stage when exploring the food choice motives of athletes. It is likely factors important to younger athletes still living at home will differ to older individuals living independently.

2.2.7 CULTURE AND RELIGIOUS BELIEFS

Different cultural groups have a range of beliefs and practices and these can influence food choice motives (Parraga, 1990). Customs are typically passed onto children and, therefore, transfer across generations. Cross cultural differences in food choice have been reported with consumers from Japan, Taiwan, Malaysia and New Zealand showing both similarities and differences on food choice motives (Prescott, Young, O'Neill, Yau, & Stevens, 2002). Within cultures, individuals vary with the importance they place on consuming traditional foods based on other factors they find important. For example, those who value health or weight control may avoid certain ethnic cuisines viewing them as higher in fat and calories (Pieniak, Verbeke, Vanhonacker, Guerrero, & Hersleth, 2009). Athletes from around the world participate in sport as evidenced by the over 200 countries that competed in the recent London Olympic games in 2012. Catering for athletes in Olympic villages demonstrates the challenge of feeding those of varying ethnicities (Pelly, O'Connor, Denyer, & Caterson, 2009) as food choices may be influenced by cultural beliefs, traditions and values (Nestle et al., 1998). For some athletes, family traditions and ethnic background have little importance on food choice (Long et al., 2011), while with others making food choices based on religious beliefs is of utmost importance (Burke & King, 2012). Overall, cultural influences on food choice are important determinants of food choice and may be an important factor to athletes.

2.2.8 LIFESTYLE CHOICES

Factors important in food choice can vary depending on the ideals or lifestyle preferences of an individual or group (Parraga, 1990). Food choice literature has explored a number of consumer segments grouped together based on similar characteristics related to lifestyle choices (Eertmans, Victoir, Vansant, & Van den Bergh, 2005; Glanz et al., 1998; Mai & Hoffmann, 2012). These segments range from the rational consumer more interested in food preparation and nutrition, to the conservative or uninvolved consumer who places more importance on convenience (Nie & Zepeda, 2011). For example, the health conscious consumer often places greater importance on nutrition and weight control (Glanz et al., 1998). This can be influenced by the degree of confidence the consumer has in making healthy choices (Mai & Hoffmann, 2012) which in turn can be influenced by their level of nutrition knowledge (Bisogni, Jastran, Shen, & Devine, 2005). Consumers who adopt healthy lifestyles emphasize the importance of the health related properties of food, such as the amount of fat, sugar or fibre (Mai & Hoffmann, 2012). Those less concerned about health, rate factors such as taste or cost as more important than nutrition (Glanz et al., 1998). Consumers who place greater importance on health and nutrition, often include more females, older adults and those with higher incomes and education levels (Steptoe & Wardle, 1999; Wardle et al., 2004).

More recently, a growing concern for the environment has led many to adopt lifestyles emphasizing foods that are organic, ethically produced and free of chemicals and preservatives (Lockie, Lyons, Lawrence, & Grice, 2004; Lockie, Lyons, Lawrence, & Mummery, 2002; Tobler, Visschers, & Siegrist, 2011). These individuals also base food choice decisions on their political values, animal welfare and religion and often include vegetarians (Lindeman & Väänänen, 2000). However, importance placed on food choice can vary depending on the type of vegetarianism. Studies report the flexible or ‘vegetarian oriented’ individual (those who occasionally includes meat and varying types of animal products), tends to place greater importance on weight concerns. The vegetarian, who does not include these foods, emphasizes ethical concerns as important in their food choices (Forestell et al., 2012).

Overall, research highlights the value of considering lifestyle choices when exploring food choice motives. Little is known about why people take part in sport, yet this may be a factor that impacts food choice. In other words, the decision to
participate in sport may be a lifestyle choice, yet reasons may differ amongst athletes. This is important to consider when working with athletes as some may not be open to nutrition advice if changes to a meal plan interfere with other factors they identify as important. The possible role of the athlete’s motive for participating in sport is discussed in a subsequent section of this review.

2.2.9 HABITS, ROUTINES AND PAST EXPERIENCES

Habitual behaviours can have a major role in food choice decisions. Habits are typical of behaviours that are repeated on a regular basis, such as eating meals and snacks. They help alleviate the need to make conscious and repeated decisions about food choices (van't Riet, Sijtsema, Dagevos, & De Bruijn, 2011). For many, a familiar food item provides a ‘safe’ food choice, where people are secure in knowing what they’re going to get (Parraga, 1990). With the busy schedule athletes face, many establish structured routines in order to meet their athletic goals and often rely on familiar foods, particularly before competition (Robins & Hetherington, 2005). In addition, collegiate football players frequently plan ahead in order to have foods available after practice. These routines, practiced on a regular basis, allow decisions to be made with minimal thought involved (Long et al., 2011). Habits are established through past experiences and, whether negative or positive, a food experience can influence future choices (Devine, Connors, Bisogni, & Sobal, 1998). For athletes, past experiences in the sport offer a learning opportunity to discover what foods work during training and competition (Robins & Hetherington, 2005). Although evidence is limited, as many athletes rely on routines or habits to manage a busy lifestyle, it is possible many would rate familiar foods as important when choosing what to eat.

2.2.10 HUNGER AND APPETITE

Early investigations into human eating behaviours regularly focused on biological factors, such as appetite and satiety, as primary reasons for food intake (Friedman & Stricker, 1976). However, as the growing worldwide epidemic of obesity demonstrates, people eat for numerous reasons beyond satisfying hunger (Bublitz et al., 2010; Franchi, 2012; Lowe & Butryn, 2007). The impact of exercise on appetite and energy intake has been extensively researched (Caudwell et al., 2011; Deighton, Zahra, & Stensel, 2012). Studies show these do not increase following an acute bout of intense exercise (King, Burley, & Blundell, 1994; King, Lluch, Stubbs,
& Blundell, 1997). While appetite suppression is generally for a short duration, this may impact the athlete who needs to replenish glycogen stores prior to the next training session. In these circumstances, hunger may not drive the athlete to eat and other factors, such as the recognized importance of recovery strategies, may be involved. In situations where hunger is a factor, the immediate availability of food is more important than taste and food preferences on food choice (Hoefling & Strack, 2010). This may be an example where the athlete chooses foods that are immediately available but less palatable over something that requires more time to prepare or access. Overall, the importance of hunger on food choice cannot be overlooked and is an important area for future research. Given the substantial energy demands of endurance sports such as triathlon, understanding how hunger and appetite influence the food choices of athletes is of utmost importance.

2.3  FACTORS IMPACTING THE FOOD CHOICES OF ATHLETES

2.3.1  INVOLVEMENT IN SPORT

Athletes, like the rest of the population, must eat and select foods to meet dietary needs. In doing so, they face many of the same food choice decisions of non-athlete populations, but are challenged with an additional set of demands that comes with participating in sport. Athletes need to consume enough food and fluids to meet the energy demands of exercise and this can vary considerably depending on the type of sport (Rodriguez et al., 2009). Triathlon is an endurance sport and includes three disciplines of swimming, cycling and running performed consecutively over the course of the race (Cox et al., 2010). Events include a range of distances from a sprint to Ironman triathlon and can last anywhere from 50 minutes to 17 hours. As a result, triathletes have high energy needs and meeting requirements can be a challenge particularly for those who engage in more than one workout a day (Cox et al., 2010). The training schedules and routines along with the demands of training and competition place a unique set of challenges on athletes and, therefore, this is expected to influence the food choices of those who participate in sport.

2.3.2  MOTIVES FOR PARTICIPATING IN SPORT

Individuals engage in physical activity for several reasons and for many these include health and weight loss (Vartanian, Wharton, & Green, 2012). Likewise, motives for participating in sport also include health and wellness benefits as well as
numerous other reasons (Lamont & Kennelly, 2012). As an example, triathlon includes those at the elite level who compete in the World Triathlon Series and World Cup events with the potential of winning prize money. However, triathlon attracts competitors of various ages, fitness levels and personal backgrounds who are often motivated by other reasons, such as health, friendship and personal gratification (Lamont & Kennelly, 2012). This is seen in other sports, such as cycling, where a large number of amateur/recreational athletes take part (Brown, O'Connor, & Barkatsas, 2009). Motives for participating in sport may influence the importance placed on food choices as personal goals and expectations may differ from one competitor to the next. For example, food choices may differ between those aiming to reach the podium versus those who simply wish to cross the finish line. The serious competitor may emphasize food choices that maximize performance over palatability, while the athlete involved for health and personal gratification may place more importance on sensory appeal and the enjoyment of eating. This has been reported in the literature as one triathlete sacrifices preferred foods in order to meet physique goals while another uses participation in triathlon as an opportunity to eat whatever she desired (Lamont & Kennelly, 2011, 2012). Although research is scarce, studies suggest motives for participating in sport may influence the importance athletes place on food choice.

2.3.3 PERFORMANCE

Competition and performing well is a reason many take part in sport (LaChausse, 2006; Lamont & Kennelly, 2012). Many athletes train hard, select the best equipment and modify diet in order to maximize their chances at success (Lamont, Kennelly, & Wilson, 2012). Results from the few studies that have explored factors important to athletes when making food decisions suggest performance is important. This is reported in both individual and team based sports (Long et al., 2011; Pelly et al., 2006; Robins & Hetherington, 2005; Smart & Bisogni, 2001). Collegiate ice hockey players emphasized sport performance, health and taste as most important influences on food choices. Athletes indicated playing hockey involved performing well on the ice and having a lean body composition which included feeling healthy and having enough energy to train and compete. This also included choosing foods low in fat and easy to digest. Taste was also important, however, this was less important prior to an upcoming game or practice (Smart &
Bisogni, 2001). Likewise, collegiate football players (Long et al., 2011) indicated performing at their best was important and this meant choosing healthy, nutritious foods that were low in fat and high in protein. These players also recognized the importance of hydration and many had established routines to ensure they were drinking sufficient fluid to maintain hydration status. Consistent with these findings, Robins and Hetherington (2005) found performance was a key factor influencing the food choices of non-elite triathletes before training or competition and this included avoiding foods that cause gastrointestinal upset.

Research suggests the importance athletes place on food choices varies with the phase of the season, the type of sport and competitive level (Pelly et al., 2006; Robins & Hetherington, 2005; Smart & Bisogni, 2001). For example, ice hockey players are more lenient during the off season when performance is not critical and the more competitive triathletes tend to favour foods that maximize performance more so than those less competitive (Robins & Hetherington, 2005; Smart & Bisogni, 2001). Likewise, athletes involved in power or skill based sports place less importance on factors that influence performance (such as the nutrient content of foods) than those in endurance sports (Pelly et al., 2006). This may relate to a belief that nutrition plays a minor role for those involved in these sports (Pelly et al., 2006).

When exploring food choice motives these issues must be considered as importance may vary depending on the level, training period and type of sport an athlete participates in. Overall, although evidence is limited, it appears that athletes are motivated by performance when choosing foods. However, more research is needed as it is unclear how this is influenced by athletic calibre, the type of sport and/or phase of the season.

2.3.4 GASTROINTESTINAL ISSUES

The food choices of athletes can be influenced by concerns associated with gastrointestinal (GI) issues. A common complaint for many endurance athletes includes intestinal discomforts such as heartburn, bloating, cramps, nausea and vomiting (Pfeiffer et al., 2012; Rehrer, van Kemenade, Meester, Brouns, & Saris, 1992; Worme et al., 1990). These issues tend to increase at greater race distances and are more common in those with a previous history of GI complaints (Pfeiffer et al., 2012). Depending on the severity of GI upset, this may impact performance and overall race outcome. Consequently, experience with GI issues may influence food
choices, not only during, but leading up to an event. Studies report triathletes will change their eating patterns and food choices prior to a race in order to avoid GI discomfort (Robins & Hetherington, 2005; Worme et al., 1990). Athletes appear to learn from experience and through a process of trial and error adopt nutrition strategies that work for them (Robins & Hetherington, 2005; Worme et al., 1990). These studies demonstrate GI issues are a common complaint experienced by athletes. It appears that many will choose or avoid certain foods to limit discomforts and, therefore, suggests this may be an important factor influencing food choices.

2.3.5 DEMANDING SCHEDULES

Hectic work and family schedules make convenient foods important in the lifestyles of many people, with preference placed on meals that are quick and easy to prepare (Fitzgerald et al., 2010; Glanz et al., 1998). A demanding training and competition schedule is common to many athletes, many of whom are responsible for purchasing, preparing and managing their dietary choices (Long et al., 2011). Research indicates athletes will adopt strategies that help them meet energy demands which include careful planning and preparation of food choices (Bentley, Cox, Green, & Laursen, 2008; Jeukendrup, Jentjens, & Moseley, 2005). For the endurance athlete this includes consuming frequent meals and snacks which appears necessary not only to meet energy needs, but also to fit within a hectic schedule (Burke & Read, 1987; Burke et al., 2003; Khoo, Rawson, Robinson, & Stevenson, 1987; Lindeman, 1990; Nogueira & Da Costa, 2004). This challenges the athlete to decide what to eat on many occasions throughout the day. As this is a characteristic eating behaviour, it is possible convenience may factor in the athlete’s food choices. In other words, as convenient foods are favoured by those with hectic schedules in the general population, it is possible athletes also value foods that are convenient and easy to prepare in order to fit meals and snacks within a busy routine. This is suggested by Robins and Hetherington (2005) who found the eating patterns of triathletes were influenced by convenience as they fit work and training into a busy schedule. Likewise, it is one of the reasons college football and hockey players report convenient food choices are important (Long et al., 2011; Smart & Bisogni, 2001). In summary, research demonstrates how the busy schedules of athletes can influence food decisions. However, it is uncertain how this impacts on food choice motives.
More research is needed exploring this area and how this may impact food choice as it will dictate what the athlete selects and, ultimately, consumes.

2.4 APPROACHES TO UNDERSTANDING FOOD CHOICE

Eating is a necessary part of life and food choice decisions are made multiple times each day. It is estimated that individuals make food choice decisions roughly 220 times a day (Wansink & Sobal, 2007) and these are influenced by a multitude of both external and internal factors (Sobal & Bisogni, 2009). A number of models have been used to explain the processes and underpinning motivations behind food choice. An example includes the food choice process described by Furst, Connors, Bisogni, Sobal, and Falk (1996). This model is based on the interaction of three main areas that lead to a final food choice. These consist of the ‘life course’ (includes past and personal experiences), ‘influences’ (includes ideals, personal factors and resources) and ‘personal systems’. The ‘personal food system’ is created to help inform food choices and individuals use this to decide what to eat. Individuals will weigh values, such as taste, health and price, against each other when making food choices. This includes developing strategies or rules that help make the decision making process easier and faster (Furst et al., 1996). The food choice process model has been used in research to explain the eating behaviours of older adults, families and a small number of athletes (Long et al., 2011; Smart & Bisogni, 2001; Travis, Bisogni, & Ranzenhofer, 2010; Winter Falk et al., 1996). This research illustrates how the model can be applied to different populations and supports other studies highlighting the multiple factors that influence individual food choice decisions.

Numerous other approaches have been used to describe individual behaviours in relation to food choice and dietary intake. These approaches provide different perspectives to understanding why people select foods and include factors such as, the environmental, social influences, personal beliefs and skills (Worsley, 2002). As an example, eating decisions have been described as dependent on the environment, location or situation in which the food choice is being made (Bisogni et al., 2007; Marshall & Bell, 2003). This may include what is available and whether the individual is alone or in the presence of others (Vartanian, Herman, & Wansink, 2008). If an eating occasion occurs in a location with limited selection, this can influence food choice. Eating in the presence of others, whether a stranger, acquaintance or friend, can influence the amount of food consumed and, depending
on the circumstances, may influence the type of food eaten (Herman, Roth, & Polivy, 2003). In the case of athletes, the presence of a coach or teammate can influence food choice. Pelly et al., (2006) found this was greater in athletes from Asia and Africa than America, perhaps suggesting cultural influences are involved. In situations where meals are frequently eaten with others, hockey players report food choices are often influenced by what teammates chose to eat (Smart & Bisogni, 2001). Personal identity or self-image may factor in food choice decisions (Bisogni, Connors, Devine, & Sobal, 2002; Jastran, Bisogni, Sobal, Blake, & Devine, 2009). Individuals may describe themselves as a certain ‘type of eater’, such as ‘not a breakfast eater’ or ‘meat and potatoes guy’. They may have multiple identities with some more important at certain times than others (Bisogni et al., 2002). For example, when children move away from home parental roles and responsibilities change and a mother may shift from family based food decisions to those based on her own preferences (Bisogni et al., 2002). Confidence in food management skills including the ability to prepare, purchase and buy food may influence food choice. The ability to choose foods considered the ‘best choice’ can be influenced by life or past experiences. Likewise, food management skills learned at an early age can help people meet their personal eating goals (Bisogni et al., 2005).

In contrast to a complex array of facts influencing food choice, it has been argued that most eating decisions are made quickly based on a small amount of information (Scheibehenne, Miesler, & Todd, 2007). Furthermore, it has also been suggested that a large number of food choices are based on habit or routine, requiring very little conscious thought (van't Riet et al., 2011). Eating environments today allow for endless opportunities to consume food as well as offer limitless choices. As such, many decisions become ‘automatic’ and unconscious prompted by contextual cues within the environment (Cohen & Babey, 2012).

Overall, the many approaches used to describe food choice behaviour show this is a challenging and complex area of study and that one style is not superior over another. Instead, research suggests exploring this area from different perspectives can provide new insights on food choice behaviours and, as such, help to enhance our understanding of why individuals eat what they eat.
2.5 CONCLUSION

This review of literature demonstrates the many factors that influence eating behaviours and highlights the limited research available on the food choice motives of athletes. Findings suggest factors important to the general population, such as taste, health and weight control are also important to athletes. In addition, despite limited research, it appears that performance is an important factor to athletes. However, despite the numerous factors known to influence the food choices of general populations, it is difficult to say if these factors apply to athletes. For example, it is unclear how an athlete’s calibre, type of sport or stage of training influences food choice. Likewise, if athletes place greater importance on weight specific goals or nutrient content of foods and if this translates into practice. Furthermore, it is unknown how the pressures associated with body shape and size common to many athletes influence food choice decisions. As such, this literature review demonstrates the lack of understanding of athletes’ food choice motives and the need to explore this area in more depth with this population. In view of the unique environments in which food choices are made and the impact of physical exercise on energy demands, this is an area worthy of further investigation.

2.6 IMPLICATIONS

This review of literature highlights the importance of understanding food choice and eating behaviours as the decisions individuals make about food are not only influenced by biological need, but a multitude of other factors. Furthermore, this review provides insight into how athletes may differ to other populations with respect to food choice motives. The limited research available on the food choices and eating behaviours of athlete populations highlights the importance of the present study and the value of considering numerous factors when assessing the athlete’s food choice motives. An improved understanding of what motivates athletes when selecting foods could impact approaches taken by nutrition professionals when educating this population. In addition, awareness of the current nutrition knowledge of triathletes will help nutrition professionals understand if and how knowledge motivates the athlete’s food choices. The present study contributes to the field by providing data on food choice motives from a large number of athletes and helps create a deeper understanding of what influences the final foods the athlete decides to eat.
3. Research design

This chapter discusses the research design, including the methodology, the instruments used and why these were selected, the timeline and statistical analysis. Finally, ethical considerations are discussed along with potential limitations.

3.1 METHODOLOGY

This study used quantitative methods designed to measure the nutrition knowledge, food choice motives and eating behaviours of triathletes. Data were collected using validated questionnaires and participant demographics, including age, height, weight, education, employment status and health or nutrition related qualifications, were also sought. Also, the questionnaire captured information specific to triathletes, such as competitive level and training hours (Appendix A). Finally, participants were encouraged to provide further comments or feedback.

3.2 PARTICIPANTS

This study included both male and female triathletes and an age-matched non-triathlete group, including both athletic and non-athletic individuals. Inclusion criteria consisted of those individuals 18 years of age and older who had completed high school. Participants who reported dietetic or nutrition related training were excluded from analysis of nutrition knowledge scores. Recruitment materials invited triathletes who were competing in the 2012 Noosa Triathlon\(^2\) to participate. However, those who compete in other distance triathlons were also included. Recruitment was carried out through various social media sites, including posts on Facebook, twitter, triathlon associated websites pages and in electronic newsletters. Several multisport coaches and over 120 triathlon clubs were contacted inviting triathletes to take part in the study. The non-triathlete group was recruited through the community of staff and students at the University of the Sunshine Coast. This was achieved by sending a study invite through email and a post on the university website. To increase

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\(^2\) The Noosa triathlon, one of the largest Olympic distance triathlons in the world, attracts over 8000 entrants annually.
recruitment numbers participants were offered the chance to win one of several entries to the Noosa triathlon in 2013 or a gift certificate.

3.3 INSTRUMENTS

Three previously validated questionnaires were used to collect data for this study. Food choice motives were assessed with an adapted version of the Food Choice Questionnaire (FCQ), nutrition knowledge with a revised version of the General Nutrition Knowledge Questionnaire (GNKQ), and eating behaviours with the Rigid (RC) and Flexible (FC) subscales of the Three Factor Eating Questionnaire (TFEQ) (Parmenter & Wardle, 1999; Steptoe et al., 1995; Westenhoefer, Stunkard, & Pudel, 1999).

3.3.1 FOOD CHOICE QUESTIONNAIRE

The Food Choice Questionnaire (FCQ) is a reliable and valid tool that measures participant motives related to food choice. The original version, developed in the United Kingdom, has 36 questions grouped into nine factors related to food choice (health, mood, convenience, sensory appeal, natural content, price, weight control, familiarity and ethical concern) (Steptoe et al., 1995). Since its development, the original FCQ has been enhanced to strengthen the ethical food choice dimension (Lindeman & Väänänen, 2000). This version added three new scales comprised of eight questions related to the influence of ecological welfare (which included both animal and environmental protection), religion and political values on food choice. Subsequently, modified versions of the FCQ have been used in several studies to measure the food choice motives of various populations, including consumers from around the world (Honkanen & Frewer, 2009; Milošević et al., 2012; Prescott et al., 2002). Modifications to the questionnaire involved increasing the original four point scale to include five to seven response options. The uneven scale was considered a better choice as it would help avoid the chance of a ‘forced’ response by providing a neutral option in which individuals could select neither important nor unimportant when responding to a question. Likewise, revised versions of the FCQ have been used to study the food choice motives of adolescents and dental students (Crossley & Nazir, 2002; Share & Stewart-Knox, 2012). In these studies revisions were made to make the questionnaire more relevant to the target population. A further modified version has been used on an Australian population studying the motives behind
organic food choices (Lockie et al., 2002). These revisions included changes to language to make it more understandable to Australian participants and the addition of two questions related to fitness. The scale was tested for validity (Cronbach’s alpha for the 13 food choice motives ranged from 0.54 to 0.86) and the final version included 47 questions grouped into 13 food choice motives (health, weight control, fitness, mood, convenience, sensory appeal, natural content, price, familiarity, animal welfare, environmental protection, political values and religion).

For the present study the revised version of the FCQ adapted by Lockie et al. (2002) was used. The revised scale has never been used with athletes, however, it was chosen as it had previously been adapted to use on an Australian population and included questions related to fitness. Consistent with previous studies, revisions were made to make the tool more specific to the target population. Additional questions were derived after reviewing research conducted with triathletes, specifically studies exploring dietary intake and eating patterns. This information, as well as discussions with the research team, resulted in the addition of six questions considered relevant to the food choices of triathletes and included:

- would not upset my stomach
- helped me stay hydrated
- was low in carbohydrate
- helped fill me up
- was prepared safely so I won’t get sick
- was a good source of carbohydrate

Previous studies that have conducted a factorial analysis on the FCQ have found ‘taste’ failed to load on any item and had poor correlation with the sensory appeal factor (Eertmans, Victoir, Notelaers, Vansant, & Van den Bergh, 2006; Share & Stewart-Knox, 2012). This may explain why ‘tasted good’ is missing from the version adapted by Lockie et al. (2002). However, taste is a relevant factor in food choice (Eertmans et al., 2001) and consumers report high scores for the importance of taste in studies using the food choice questionnaire (Carrillo, Varela, Salvador, & Fiszman, 2011; Milošević et al., 2012). In addition, informal discussions with triathletes suggested taste was important to these athletes. For these reasons it was considered a relevant factor in food choice and was included in the questionnaire used in the present study.
The combined questionnaires were pilot tested with a small group of triathletes (n=16) who were asked to provide feedback on whether they felt the survey was too long, the questions were understandable and, in particular, if relevant items were missing regarding factors important to them when making food selections. Triathletes indicated their responses would depend on when they were asked the question. In other words, what stage of training they were in, including whether they were training for an event in the near future or several months away. As a result, modifications were made that included adding a specific time period. Hence, whereas the original FCQ asks the question “it is important to me that the food I eat on a typical day is…” the revised version asks “over the past 3 months, it was important to me that the food I ate on a typical training day was…” The same time period (i.e. over the past 3 months) was asked of the non-triathlete group, however the original question was retained. The final version used in the study included 54 questions (Appendix B).

3.3.2 GENERAL NUTRITION KNOWLEDGE QUESTIONNAIRE

The GNKQ is a reliable and valid tool that addresses participant knowledge in four areas related to nutrition: dietary guidelines, sources of nutrients, choosing everyday foods and awareness of a diet-disease relationship (Parmenter & Wardle, 1999). It was originally developed in the United Kingdom to measure the general nutrition knowledge of adults. It has since been modified, validated and applied to measure nutrition knowledge and demographic variation within an Australian community sample (Hendrie, Coveney, & Cox, 2008; Hendrie, Cox, & Coveney, 2008). It was further revised and used to test the general nutrition knowledge of a group of elite Australian athletes. The revised version (Appendix C) was psychometrically evaluated and shown to have good internal consistency (Cronbach’s alpha was 0.55 for section A; 0.91 for section B; 0.40 for section C; 0.85 for section D and 0.94 for overall score) and test-retest reliability (Spearman’s rank correlation coefficient was 0.58 for section A; 0.89 for section B; 0.43 for section C; 0.90 for section D and 0.92 for overall score) (Spendlove et al., 2011). The revised version, reduced from 113 to 96 items, was found to be more sensitive in identifying significant differences than the original GNKQ. As this version was previously used on a group of Australian athletes it was selected for use in the present study.
3.3.3 RIGID AND FLEXIBLE CONTROL SUBSCALES

The final questions for the survey came from the rigid (RC) and flexible (FC) control subscales of the three factor eating questionnaire (TFEQ). It was considered important that these questions come at the end of the survey as they tend to move towards more sensitive issues around food and eating. Stunkard and Messick (1985) developed the original TFEQ which was designed to measure three dimensions of eating behaviour: cognitive dietary restraint, disinhibition and hunger. It is a validated tool that has been used in numerous studies to measure eating behaviours, including with athletes (Krempien & Barr, 2012). The restraint scale within the TFEQ was further subdivided into the rigid (RC) and flexible (FC) control dimensions based on the premise that there are different types of restrained eating. These subscales were previously validated and shown to have good internal consistency (Cronbach’s alpha for flexible and rigid control was 0.83 and 0.81, respectively) (Westenhoefer et al., 1999). The cognitive restraint rigid and flexible control subscales are comprised of 28 questions. These subscales measure RC, identified as an ‘all or none’ approach to eating and FC which includes a more ‘relaxed’ approach. These scales have not been applied to athletes, but it was felt they were a better choice for exploring dietary restraint for this population. It was believed triathletes would exhibit a moderately high to high amount of dietary restraint as a result of taking part in triathlon. However, given the often negative associations found with high levels of dietary restraint it was considered using these subscales would provide a better picture of restraint amongst these athletes. Finally, feedback from the pilot study indicated the three questionnaires created a lengthy survey and, therefore, the hunger and disinhibition subscales of the TFEQ were excluded in order to minimize respondent burden.

3.4 PROCEDURE AND TIMELINE

The three questionnaires used in this study were administered online. Participants were provided adequate time to respond as they were able to log back in over a period of three days to complete the questionnaires. Prior to agreeing to participate, details about the study were provided, including an online consent form.

3 The flexible (FC) control scale is comprised of 12 questions while the rigid (RC) control scale includes 16.
This research design provided the opportunity to gather a substantial amount of data as a large number of participants were involved. The online survey enhanced quality control as participant responses were directly recorded limiting the chance of human error through data entry from paper surveys. The online survey offered a convenient, accessible route for participants who could choose when, where and how long they took to complete the questionnaires.

Data was collected between September 2012 and February 2013. Triathletes were recruited during the three months prior to the Noosa Triathlon, from September to early November 2012. Non-triathletes were recruited from October 2012 to February 2013. The extended time period for non-triathletes was necessary as recruitment took place during exams and this was considered a busier time for both staff and students and, therefore, would limit the number of individuals able to participate.

3.5 ANALYSIS

Statistical analyses were performed using SPSS software version 21. Between group differences for categorical variables were assessed using chi squared analysis. Nutrition knowledge scores were analysed using ANOVA. A two way general linear model was used to determine if the main effects (i.e. age, athlete status (triathlete or non-triathlete), gender, education, employment, physical activity) were independent of nutrition knowledge. Likewise, a two way model was used to determine if these same main effects were independent of food choice motives with each of the 13 food choice variables fit into the model. Least squares means were tested using t tests. Spearman’s correlation was used to explore associations between nutrition knowledge scores and food choice factors for health and performance/fitness. Similarly, Spearman’s correlation was used to explore associations between rigid and flexible control levels and BMI as well as the food choice variable for weight control. Independent t-tests were used to assess differences in rigid and flexible scores between triathletes and non-triathletes. Finally, chi squared analysis was used to compare differences between athlete status for levels of rigid and flexible control. Significance was set at $p < 0.05$. 
3.6 ETHICS AND LIMITATIONS

This study was approved by the Human Research Ethics Committee of the University of the Sunshine Coast on September 9, 2012 (ethics approval number S/12/433). This research was identified as low risk causing negligible threat or impact to participants. Finally, threats did not arise that compromised the validity of the results.
4. Results

4.1 PARTICIPANT CHARACTERISTICS

An overview of demographic characteristics of triathlon and non-triathlon participants is shown in Table 1. A total of 317 surveys were completed (175 triathletes, 142 non-triathletes). Exploratory data analysis identified several participants for exclusion. From the triathlon group, five participants were excluded as they indicated they were not a triathlete and one male was removed as he was less than 18 years of age. Four triathletes were removed as they had not completed high school while another was removed for providing responses that were clearly spurious. From the non-triathlon group, six were excluded as they reported they were a triathlete or competing in triathlon and one was removed who had not completed high school. One non-triathlete was excluded due to duplicate responses. In total, 298 participants (164 triathletes and 134 non-triathletes) were included in analysis.
Table 1. Participant characteristics

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Participant total (n = 298)</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Triathletes (n = 164)</td>
<td>Non-triathletes (n = 134)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>55.0%</td>
<td>45.0%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>n (%)</td>
<td>n (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt; 35 years</td>
<td>52 (32.7)</td>
<td>61 (45.5)</td>
<td>0.014*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>≥ 35 years</td>
<td>112 (68.3)</td>
<td>73 (54.5)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sex</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>94 (57.3)</td>
<td>58 (43.3)</td>
<td>0.016*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>70 (42.7)</td>
<td>76 (56.7)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Education Level</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non tertiary</td>
<td>50 (30.5)</td>
<td>32 (23.9)</td>
<td>0.204</td>
<td></td>
<td></td>
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<tr>
<td>Tertiary</td>
<td>114 (69.5)</td>
<td>102 (76.1)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Physical Activity a</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less than 6 hours</td>
<td>17 (10.4)</td>
<td>96 (71.6)</td>
<td>&lt; 0.001*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>More than 6 hours</td>
<td>147 (89.6)</td>
<td>38 (28.4)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Employment</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Working b</td>
<td>149 (90.9)</td>
<td>92 (68.7)</td>
<td>&lt; 0.001*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Not working c</td>
<td>15 (9.1)</td>
<td>42 (31.3)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BMI d (Mean ± SD)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male (n = 94, 58)</td>
<td>25.0 ± 3.2</td>
<td>25.0 ± 2.4</td>
<td>0.943</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female (n = 70, 76)</td>
<td>21.7 ± 2.4</td>
<td>23.2 ± 3.8</td>
<td>0.004*</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Baseline categorical data analysed using χ². Significance set at P<0.05

a hours/week
b includes full and part time employment
c includes retired, unemployed and students
d body mass index (kg/m²) was analysed using t – tests. Includes mean and standard deviation.

Body Mass Index (BMI) ranged from 19.0 to 36.9 kg/m² and 16.2 to 29.1 kg/m² for male and female triathletes, respectively. For non-triathletes, BMI ranged from 18.6 to 32.4 kg/m² and 16.6 to 36.1 kg/m² for males and females, respectively. Triathletes included four males in the Clydesdale category and one female in the
Athena category\textsuperscript{4}. There was no significant difference in BMI ($p=0.311$) between triathletes (BMI = 23.6 $\pm$ 3.3) and non-triathletes (BMI = 24.0 $\pm$ 3.6). There was a significant difference ($p<0.001$), overall, in BMI between males (BMI = 25.0 $\pm$ 3.13 kg/m\textsuperscript{2}) and females (BMI = 22.5 $\pm$ 3.3 kg/m\textsuperscript{2}) which was observed for both non-triathletes (males = 25.0 $\pm$ 3.0; females = 23.3 $\pm$ 3.8; $p=0.006$) and triathletes (males = 25.0 $\pm$ 3.2; females = 21.7 $\pm$ 2.4; $p<0.001$).

4.2 FOOD CHOICE QUESTIONNAIRE

A total of 292 (164 triathletes and 128 non-triathletes) participants were included in analysis of food choice motives as six participants only completed the nutrition knowledge questionnaire (i.e. six did not complete the food choice or restraint questionnaires). Figure 1 presents mean scores for the food choice motives adjusted according to a five point likert scale (i.e. not at all important, a little important, neither important nor unimportant, moderately important, extremely important). The religion food choice motive was excluded from analysis as over 98\% of responses from all participants ranged from ‘not at all important’ to ‘neither important nor unimportant’. Triathletes had significantly lower scores for the importance of environmental protection ($p=0.024$), political values ($p=0.002$) and animal welfare ($p=0.007$) and significantly higher scores for the importance of performance ($p=0.019$) and price ($p=0.024$).

\textsuperscript{4}Athena and Clydesdale are weight categories in triathlon. Athenas are females over 75 kg. Clydesdales are males placed in one of two categories: 90 – 99 kg or over 100 kg.
Figure 1. Mean scores for triathletes and non-triathletes on the food choice motives of the adapted Food Choice Questionnaire. Scores are based on a 5 point Likert scale ranging from not at all important (1) to extremely important (5). Mean differences assessed using ANOVA and significance differences are indicated with a *. Significance set at $p < 0.05$.

Table 2 presents total mean scores (i.e. based on the number of questions in each factor) for sex, age and education as, in addition to athlete status, these groups showed the most significant differences on food choice motives. Scores for all groups (i.e. athlete status, sex, age, physical activity, employment and education) on the food choices motives can be found in Appendix E. Females scored higher than males on natural content and weight while those over the age of 35 identified natural content and political values as more important. Price and mood were more important to those individuals less than 35 years. Natural content was more important to non-tertiary educated individuals, who also identified environmental protection, health, performance and animal welfare as more important.

There was a significant interaction ($p = 0.024$) between education and employment on the importance of convenience with non-tertiary educated, employed individuals scoring higher (employed = 18.5 ± 0.8; unemployed = 15.5 ± 1.0). Natural content was more important ($p = 0.043$) for those over 35 years and unemployed (unemployed = 24.5 ± 1.6; employed 21.0 ± 0.7). Weight was more important ($p = 0.025$) to males who engaged in more than six hours of exercise per week (> 6 hrs = 10.6 ± 0.6; < 6 hrs = 8.8 ± 0.7). Familiarity was more important ($p$}
= 0.025) to non-triathletes without a tertiary education (not tertiary educated = 8.9 ± 0.6; tertiary educated = 7.3 ± 0.3). Females less than 35 years scored higher ($p = 0.025$) for health than males (females 25.4 ± 0.6; males 23.5 ± 0.7). Finally, there was a significant interaction for price ($p = 0.015$) with tertiary educated, unemployed individuals rating this as more important (unemployed = 8.4 ± 0.5; employed = 7.3 ± 0.2).
<table>
<thead>
<tr>
<th>Food choice motive (max score)**</th>
<th>Sex</th>
<th>Age Group</th>
<th>Education</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Male (n = 148)</td>
<td>Less than 35 yrs (n = 110)</td>
<td>Non Tertiary Educated (n = 79)</td>
</tr>
<tr>
<td></td>
<td>Female (n = 144)</td>
<td>35 years and older (n = 182)</td>
<td>Tertiary Educated (n = 213)</td>
</tr>
<tr>
<td>Mean (95 % CI) %</td>
<td>Mean (95 % CI) %</td>
<td>Mean (95 % CI) %</td>
<td>Mean (95 % CI) %</td>
</tr>
<tr>
<td>Convenience (25)</td>
<td>16.7 (15.3-18.0) 66.8</td>
<td>17.9 (16.8-19.0) 71.6</td>
<td>17.0 (15.8-18.2) 68.0</td>
</tr>
<tr>
<td></td>
<td>18.2 (17.2-19.2) 72.8</td>
<td>16.9 (15.7-18.2) 67.6</td>
<td>17.9 (16.8-18.9) 71.6</td>
</tr>
<tr>
<td>Natural Content (30)</td>
<td>20.4 (18.4-22.4) 68.0</td>
<td>20.5 (18.9-22.1) 68.3</td>
<td>23.3 (21.6-25.1) 77.7</td>
</tr>
<tr>
<td></td>
<td>22.9 (21.4-24.3) 76.3</td>
<td>22.8 (20.9-24.5) 76.0</td>
<td>19.9 (18.4-21.4) 66.3</td>
</tr>
<tr>
<td>Weight (15)</td>
<td>9.7 (8.7-10.8) 64.7</td>
<td>10.3 (9.5-11.2) 68.7</td>
<td>10.7 (9.8-11.6) 71.3</td>
</tr>
<tr>
<td></td>
<td>10.9 (10.2-11.7) 72.7</td>
<td>10.4 (9.4-11.3) 69.3</td>
<td>10.0 (9.2-10.8) 66.7</td>
</tr>
<tr>
<td>Sensory Appeal (20)</td>
<td>14.1 (12.9-15.2) 70.5</td>
<td>14.2 (13.2-15.1) 71.0</td>
<td>14.9 (13.8-16.0) 74.5</td>
</tr>
<tr>
<td></td>
<td>15.0 (14.1-15.8) 75.0</td>
<td>14.9 (13.8-15.9) 74.0</td>
<td>14.1 (13.2-15.0) 70.5</td>
</tr>
<tr>
<td>Environmental protection (20)</td>
<td>9.5 (8.0-11.0) 47.5</td>
<td>9.4 (8.2-10.6) 47.0</td>
<td>11.1 (9.7-12.5) 55.5</td>
</tr>
<tr>
<td></td>
<td>10.8 (9.7-12.0) 54.0</td>
<td>10.9 (9.5-12.3) 54.5</td>
<td>9.2 (8.1-10.4) 46.0</td>
</tr>
<tr>
<td>Political values (20)</td>
<td>9.0 (7.4-10.5) 45.0</td>
<td>8.3 (7.1-9.6) 41.5</td>
<td>10.5 (9.1-12.0) 52.5</td>
</tr>
<tr>
<td></td>
<td>9.9 (8.8-11.1) 49.5</td>
<td>10.6 (9.1-12.0) 53.0</td>
<td>8.4 (7.2-9.6) 42.0</td>
</tr>
<tr>
<td>Familiarity (15)</td>
<td>8.3 (7.9-9.3) 57.3</td>
<td>8.9 (8.1-9.6) 59.3</td>
<td>8.6 (7.8-9.4) 57.3</td>
</tr>
<tr>
<td></td>
<td>8.6 (7.9-9.3) 57.3</td>
<td>8.0 (7.2-8.9) 53.3</td>
<td>8.3 (7.6-9.0) 55.3</td>
</tr>
<tr>
<td>Health (30)</td>
<td>24.5 (23.2-25.7) 81.7</td>
<td>24.4 (23.4-25.4) 81.3</td>
<td>25.7 (24.6-26.8) 85.7</td>
</tr>
<tr>
<td></td>
<td>25.4 (24.5-26.3) 84.7</td>
<td>25.5 (24.3-26.6) 85.0</td>
<td>24.2 (23.3-25.1) 80.7</td>
</tr>
<tr>
<td>Performance (40)</td>
<td>31.3 (29.0-32.8) 78.2</td>
<td>31.1 (29.9-32.2) 77.7</td>
<td>32.4 (31.3-33.7) 81.0</td>
</tr>
<tr>
<td></td>
<td>31.0 (30.2-32.2) 77.7</td>
<td>31.4 (30.1-32.7) 78.5</td>
<td>30.1 (29.0-31.2) 75.2</td>
</tr>
<tr>
<td>Price (10)</td>
<td>7.8 (7.1-8.5) 78.0</td>
<td>8.2 (7.6-8.8) 82.0</td>
<td>7.6 (7.0-8.3) 76.0</td>
</tr>
<tr>
<td></td>
<td>7.7 (7.2-8.2) 77.0</td>
<td>7.3 (6.7-7.9) 73.0</td>
<td>7.9 (7.3-8.4) 79.0</td>
</tr>
<tr>
<td>Mood (25)</td>
<td>15.3 (13.8-16.9) 61.2</td>
<td>16.7 (15.5-17.9) 66.8</td>
<td>16.2 (14.9-17.6) 64.8</td>
</tr>
<tr>
<td></td>
<td>16.1 (15.0-17.2) 64.4</td>
<td>14.7 (13.3-16.1) 58.8</td>
<td>15.2 (14.0-16.4) 60.8</td>
</tr>
<tr>
<td>Animal welfare (10)</td>
<td>5.1 (4.2-6.0) 51.0</td>
<td>5.1 (4.3-5.8) 51.0</td>
<td>5.9 (5.1-6.7) 59.0</td>
</tr>
<tr>
<td></td>
<td>5.7 (5.0-6.4) 57.0</td>
<td>5.7 (4.9-6.6) 57.0</td>
<td>4.9 (4.2-5.6) 49.0</td>
</tr>
</tbody>
</table>

Mean differences assessed using ANOVA. *Indicates significant differences at p < 0.05.

** Maximum score obtained from sum of responses ranging from ‘not at all important’ (1 point) to ‘extremely important’ (5 points). The number of questions within each food choice motive varies (i.e. convenience has 5 questions (25 points); price has 2 questions (10 points). See Food Choice Questionnaire in appendix B for more information.

* hours per week

† Included full and part time employment

‡ Includes unemployed, full time homemakers, retired and students
4.3 GENERAL NUTRITION KNOWLEDGE

For nutrition knowledge scores, five triathletes and 18 non-triathletes were excluded as they reported dietetic or nutrition related training. Therefore, scores for 275 participants (159 triathletes and 116 non-triathletes) were included in analysis of nutrition knowledge. Table 3 compares nutrition knowledge scores of triathletes and non-triathletes. There was no significant difference between triathletes and non-triathletes in dietary guidelines and choosing everyday foods, although triathletes had lower scores for diet-disease relationships. There was a significant interaction between sex and athlete status (triathlete or non-triathlete) for overall score ($p = 0.008$) and sources of nutrients ($p = 0.04$) (section B). Female triathletes scored significantly higher (overall score $75.3 \pm 2.2$; section B $50.0 \pm 1.6$) than males (overall score $68.0 \pm 2.5$; section B $46.0 \pm 1.7$). Additional differences between groups (sex, age, physical activity, employment status and education) on nutrition knowledge scores are presented in Table 4. Females scored higher than males on dietary guidelines and diet-disease relationships. Participants over the age of 35 and not working scored significantly higher on sources of nutrients and overall nutrition knowledge. Individuals who were not working also scored significantly higher on diet-disease relationships. No differences were detected based on weekly hours of physical activity or education level. A significant interaction between education and sex ($p < 0.001$) was observed for diet/disease relationships with tertiary educated females scoring higher ($9.2 \pm 0.5$) than males ($7.2 \pm 0.5$).
Table 3. Nutrition knowledge scores on the General Nutrition Knowledge Questionnaire for triathletes and non-triathletes (Includes mean, 95% confidence intervals and percentage)

<table>
<thead>
<tr>
<th>Knowledge Domain (no. of points)</th>
<th>Triathletes (n = 159)</th>
<th>Non-triathletes (n = 116)</th>
<th>p difference between triathletes and non-triathletes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean 95%CI %</td>
<td>Mean 95%CI %</td>
<td></td>
</tr>
<tr>
<td>Section A: Dietary Guidelines (11)</td>
<td>8.1 7.5- 8.7 73.6</td>
<td>8.3 7.9-8.8 75.4</td>
<td>0.587</td>
</tr>
<tr>
<td>Section B: Sources of Nutrients (62)</td>
<td>48.0 45.3- 50.6 77.4</td>
<td>48.3 46.3-50.3 77.9</td>
<td>0.838</td>
</tr>
<tr>
<td>Section C: Choosing everyday foods (5)</td>
<td>4.5 4.2- 4.8 90.0</td>
<td>4.2 3.9-4.4 84.0</td>
<td>0.092</td>
</tr>
<tr>
<td>Section D: Diet-disease relationships (18)</td>
<td>7.4 6.5- 8.3 41.1</td>
<td>8.6 7.9-9.3 47.8</td>
<td>0.035*</td>
</tr>
<tr>
<td>Overall nutrition knowledge score (96)</td>
<td>71.6 67.9- 75.4 74.6</td>
<td>72.9 70.1-75.8 75.6</td>
<td>0.575</td>
</tr>
</tbody>
</table>

Mean differences assessed using ANOVA. *Indicates significant differences at p < 0.05.
Table 4. Nutrition knowledge scores on the General Nutrition Knowledge Questionnaire for groups (Includes mean, 95% confidence intervals and percentage)

<table>
<thead>
<tr>
<th>Knowledge Domain (no. of points)</th>
<th>Sex</th>
<th>Age</th>
<th>Physical Activity</th>
<th>Employment</th>
<th>Education</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<tr>
<td>Total number of participants n = 275</td>
<td></td>
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<tr>
<td></td>
<td>Male (n = 148)</td>
<td>Female (n = 127)</td>
<td>Mean (95 % CI)</td>
<td>%</td>
<td>Mean (95 % CI)</td>
</tr>
<tr>
<td>Section A: Dietary guidelines (11)</td>
<td>7.8 (7.2-8.4)</td>
<td>8.7 (8.2-9.1)</td>
<td>70.9</td>
<td>8.1 (7.7-8.6)</td>
<td>73.6</td>
</tr>
<tr>
<td></td>
<td>7.8 p = 0.011*</td>
<td>8.7 p = 0.651</td>
<td></td>
<td>8.1 p = 0.363</td>
<td></td>
</tr>
<tr>
<td></td>
<td>47.8 (45.3-50.4)</td>
<td>48.5 (46.5-50.5)</td>
<td>71.7</td>
<td>46.3 (44.3-48.4)</td>
<td>74.7</td>
</tr>
<tr>
<td></td>
<td>71.7 p = 0.013*</td>
<td>78.2 p = 0.013*</td>
<td></td>
<td>47.2 p = 0.214</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4.2 (3.9-4.5)</td>
<td>4.5 (4.2-4.7)</td>
<td>84.0</td>
<td>4.4 (4.1-4.6)</td>
<td>88.0</td>
</tr>
<tr>
<td></td>
<td>4.2 p = 0.170</td>
<td>4.3 p = 0.641</td>
<td></td>
<td>4.2 p = 0.174</td>
<td></td>
</tr>
<tr>
<td></td>
<td>7.4 (6.8-8.3)</td>
<td>8.6 (7.9-9.3)</td>
<td>41.1</td>
<td>7.8 (7.0-8.5)</td>
<td>43.3</td>
</tr>
<tr>
<td></td>
<td>7.4 p = 0.028*</td>
<td>8.6 p = 0.363</td>
<td></td>
<td>8.0 p = 0.881</td>
<td></td>
</tr>
<tr>
<td>Overall nutrition knowledge score (96)</td>
<td>70.7 (67.1-74.4)</td>
<td>73.8 (71.0-76.6)</td>
<td>73.6</td>
<td>70.0 (67.1-73.0)</td>
<td>72.9</td>
</tr>
<tr>
<td></td>
<td>70.7 p = 0.151</td>
<td>73.8 p = 0.028*</td>
<td></td>
<td>71.4 p = 0.397</td>
<td></td>
</tr>
<tr>
<td>Mean differences assessed using ANOVA. *Indicates significant differences at p &lt; 0.05.</td>
<td></td>
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</tbody>
</table>

\* Hours per week
\^ Included full and part time employment
\$ Includes unemployed, full time homemakers, retired and students
Table 5 summarizes Spearman’s correlations for overall nutrition knowledge scores and motives for food choice related to health and performance/fitness for all participants. Before pooling the six additional sport specific questions with the original two fitness questions, Spearman’s correlation was carried out. As the two scales were significantly correlated ($p<0.001; r_s = 0.715$), the questions were combined into a performance/fitness factor comprised of eight questions. The original two fitness questions and six additional performance questions are identified in Appendix B. There were no significant correlations between nutrition knowledge score and health for male participants, but a significant correlation was found for female non-triathletes. The health and performance/fitness factors were significantly correlated across athlete status.

| Table 5. Correlation analysis of General Nutrition Knowledge Questionnaire overall score with the Food Choice Questionnaire factor for health and performance/fitness |
|---------------------------------|-----------------|-----------------|
| Total (n) $^a$                  | GNKQ overall score and health | Health and performance/fitness |
|                                | $r$ ($p$ value)    | $r$ ($p$ value)  |
| Athlete status (292)           |                  |                  |
| Triathletes (164)              |                  |                  |
| Male (94)                      | 0.102 (0.328)    | 0.424** ($<$0.001) |
| Female (70)                    | 0.210 (0.081)    | 0.674** ($<$0.001) |
| Non-triathletes (128)          |                  |                  |
| Male (54)                      | 0.060 (0.668)    | 0.560** ($<$0.001) |
| Female (74)                    | 0.271* (0.019)   | 0.451** ($<$0.001) |

$^a$ Total number of participants who completed the Food Choice Questionnaire (FCQ). Spearman’s correlations with $p$ value $< 0.05$ were considered significant. $^* $ Indicates $p$ value $< 0.05$. **Indicates $p$ value $< 0.01$

### 4.4 RIGID AND FLEXIBLE CONTROL

A total of 35 participants chose not to complete the rigid and flexible control questionnaire. Therefore, analysis of eating behaviours included data from 264 participants (148 triathletes and 116 non-triathletes). Scores for rigid and flexible control are presented in figures 2a, b, c and d. There were no significant differences between groups for rigid and flexible control except for male and female triathletes. Females scored significantly higher on both scales ($p < 0.001$; males $RC = 4.74 \pm 2.7$; $FC = 5.08 \pm 2.4$ and females $RC = 6.57 \pm 3.1$; $FC = 6.82 \pm 2.7$).
Figure 2. Differences in flexible (FC) and rigid (RC) control scores for (a) male triathletes (n=87) and non-triathletes (n=48); (b) female triathletes (n=61) and non-triathletes (n=69); (c) male and female triathletes and (d) male and female non-triathletes. Values are mean scores with standard deviation shown via vertical bars. Scores range from 0 to 12 for FC and 0 - 18 for RC. Student t-test was used to compare difference between means and significance differences are indicated with a *. Significance set at p < 0.05.
Rigid and flexible control scores were converted to levels that range from 0 (very low) to 5 (very high) and were classified based on norms established by Timko (2007). These norms can be found in Appendix F. For chi squared analysis, very low flexible and rigid control scores were omitted as there were not enough participants at this level of restraint (i.e. minimum expected count for chi squared analysis is five). Figures 3a, b, c and d show the different distributions of rigid and flexible control levels between sex for triathletes and non-triathletes. There was no difference in the levels of flexible restraint between triathletes and non-triathletes. A significant difference was observed for rigid control amongst females with a higher proportion of non-triathletes showing low levels.
Figure 3. Distribution of flexible (a) and rigid (b) control between male triathletes and non-triathletes and flexible (c) and rigid (d) control between female triathletes and non- triathletes. Levels range from 0 (very low) to 5 (very high) calculated from raw scores and based on norms (male and female) for rigid and flexible control quintiles established by Timko (2007) and found in Appendix F. Chi squared analysis used to test for differences in distribution and significant differences are indicated with a *. Significance set at $p < 0.05$. 
Table 6 summarizes Spearman’s correlations between levels of rigid and flexible control and BMI and the weight control motive of the food choice questionnaire. Both levels of restraint were highly correlated with the food choice motive for weight control. The RC and FC subscales were also highly correlated with BMI in male triathletes, but not females. The two subscales were highly correlated ($p<0.001$; $r_s = 0.607$).

Table 3. Spearman’s correlation between level of flexible (FC) and rigid (RC) control, Body Mass Index (BMI) and weight control motive of the food choice questionnaire

<table>
<thead>
<tr>
<th>Total number of participants (n)</th>
<th>RC &amp; BMI ($r_s$ ($p$ value))</th>
<th>FC &amp; BMI ($r_s$ ($p$ value))</th>
<th>RC &amp; weight motive ($r_s$ ($p$ value))</th>
<th>FC &amp; weight motive ($r_s$ ($p$ value))</th>
<th>BMI &amp; weight motive ($r_s$ ($p$ value))</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Triathletes</strong> (n=148)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male (n =87)</td>
<td>0.375** (p&lt;0.001)</td>
<td>0.242* (0.024)</td>
<td>0.473** (&lt;0.001)</td>
<td>0.421** (&lt;0.001)</td>
<td>0.313** (0.003)</td>
</tr>
<tr>
<td>Female (n= 61)</td>
<td>0.157 (0.227)</td>
<td>0.036 (0.784)</td>
<td>0.515** (0.000)</td>
<td>0.409** (0.001)</td>
<td>0.112 (0.391)</td>
</tr>
<tr>
<td><strong>Non-triathletes</strong> (n =116)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male (n=47)</td>
<td>0.236 (0.111)</td>
<td>0.248 (0.093)</td>
<td>0.467** (0.001)</td>
<td>0.415** (0.004)</td>
<td>0.370* (0.010)</td>
</tr>
<tr>
<td>Female (n=69)</td>
<td>0.305* (0.011)</td>
<td>0.128 (0.295)</td>
<td>0.487** (&lt;0.001)</td>
<td>0.491** (&lt;0.001)</td>
<td>0.352** (0.003)</td>
</tr>
</tbody>
</table>

* Levels range from 0 (very low) to 5 (very high) calculated from raw scores and based on norms (male and female) for rigid and flexible control quintiles established by Timko (2007) and found in Appendix F.

** Spearman’s correlations with $p$ value < 0.05 were considered significant and marked with *.

* Indicates $p$ value < 0.05

** Indicates $p$ value < 0.01

4.5 NUTRITION RESOURCES OF TRIATHLETES

Figures 4a and b present the top five nutrition information sources (a) used by triathletes and top five sources (b) triathletes do not use. Other reported sources included magazines, journal articles, sports nutrition companies/suppliers, personal knowledge and responses to foods as well as the experience of others.
**Figure 4.** Top five nutrition information sources used (a) and not used (b) by triathletes
5. Discussion

This is the first study to explore nutrition knowledge, food choice motives and flexible and rigid eating behaviours of triathletes. This study found triathletes to have a high level of nutrition knowledge which was similar to a non-triathlete group. Nutrition knowledge was also higher for triathletes than previously reported for a group of elite athletes (74.6% vs. 61.3%) and a community sample (74.6% vs. 67.8%) (Spendlove et al., 2011). The most important factors in food choice for all participants were health, performance, price, sensory appeal and natural content. However, triathletes placed greater importance on performance and price than non-triathletes and although significantly more non-triathletes placed greater importance on ethical concerns (i.e. environmental protection, political values and animal welfare) this area was the least important for all participants when considering food choices. There was no difference between triathletes and non-triathletes on scores for flexible or rigid control. In contrast to previous studies with non-athlete populations (Provencher et al., 2004; Timko & Perone, 2005), there was no difference in restraint scores between male and female non-triathletes. However, a difference was observed amongst triathletes with females scoring higher on both scales. Compared with previous studies with non-athlete populations, male scores were higher for both rigid and flexible control, while females showed higher scores for flexible control. On the other hand, when translated to levels of rigid and flexible control, mean values were higher for males (i.e. males had middle RC to very high FC and females had middle RC to high FC levels). Participants showed a range of restraint levels, however, there was no difference based on athlete status on the distribution of rigid and flexible control. An association between restraint and food choice decisions related to weight control was found for both scales and is consistent with previous studies exploring food choice motives (Steptoe et al., 1995). Results of this investigation provide preliminary findings on the nutrition knowledge, food choice motives and flexible and rigid eating behaviours of triathletes and highlight many opportunities for future study. The following discussion provides a general description of the research findings.
5.1 FOOD CHOICE MOTIVES

The measurement of food choice motives of triathletes provides new information on factors important in food decisions amongst an athlete population. Results confirm the primary hypothesis of this study in which triathletes placed greater importance on performance factors than the non-triathlete group. This is similar to findings in other studies in which athletes report performance as important in food choice (Pelly et al., 2006; Robins & Hetherington, 2005). However, performance was rated important (>75%) by all participants and this may be related to the high number of active individuals in both groups. It is possible the active non-triathletes were involved in competitive sport where performance was also important. Similarly, although price was significantly more important to triathletes, overall, it was an important factor in food choice for all participants (>70%). This is consistent with previous studies that show price is important to the consumer, regardless of income and may be related to a desire to obtain value for money (Steenhuis, Waterlander, & De Mul, 2011). Some athletes at the elite level report financial status is an area of concern as many are unemployed and focus entirely on a full time athletic career (Hanton et al., 2005; Heaney et al., 2008). However, the athletes in the present study were not elite with the majority in full time employment, yet cost and value of food was still an important factor in food choice. It would be interesting to explore whether differences in the cost and value of food exists with those athletes of high calibre who experience limited income due to a full time athletic career. Studies also report students identify price as important in food choice (Shannon et al., 2002). In this study younger participants as well as those unemployed and tertiary educated placed more importance on price. The unemployed category included a large number of students who were also less than 35 years of age. This may explain the higher importance placed on price by these individuals whose income may be limited, making food costs more important (Pollard, Steptoe, & Wardle, 1998).

The five most important factors in food choice for all participants were health, performance, price, sensory appeal and natural content. Individuals who place high importance on health often score high on natural content as those who value nutritious foods also prefer those that are free of additives and are less processed (Pollard et al., 1998). Most participants in this study were active and knowledgeable about nutrition and the high scores are consistent with the literature showing these
areas are more important to the health focused, active individual (Glanz et al., 1998; Heinemann & Zerbes, 1989). Sensory appeal also received high scores which supports research that consistently rates sensory appeal, particularly taste, as an important determinant of food choice (Glanz et al., 1998; Honkanen & Frewer, 2009). Interestingly, a significant difference for sensory appeal was found for level of physical activity (Appendix E) with the more active individuals rating this as less important (68% vs. 77%). Again, this may be related to the high number of active individuals in this study which may have included those who were not triathletes, but involved in competitive sport. As studies report athletes will choose performance over palatability when selecting foods, particularly prior to important events, and this may have been the case for participants in this investigation (Pelly et al., 2006; Smart & Bisogni, 2001).

Numerous studies indicate females place greater concern on dieting and weight loss than males (Pollard et al., 1998; Wardle et al., 2004). This has been consistently reported regardless of age, income or country of origin (Januszewska, Pieniak, & Verbeke, 2011). However, in this study it was the more active male participants who identified weight control as more important than those less active. Amongst the females it is possible those with higher energy expenditures and healthy body weights (88% of female triathletes and 73% of non-triathletes were in a healthy weight range – Appendix G) were less concerned about controlling weight, therefore, did not identify this as important. In contrast, the more active male participants may have placed greater importance on weight control in order to achieve sport specific physique characteristics. Indeed studies report male athletes will control food intake to modify body weight to achieve performance goals (Pettersson et al., 2012). Overall, results support previous research that show health, price, sensory appeal and natural content are important factors in food choice and add new findings that identify performance as important to triathletes when choosing foods.

The three areas that received the lowest ratings with regards to food choice motives were political values, environmental protection and animal welfare (range from 35% – 62%). These three areas fall under the enhanced ethical food choice dimension (i.e. refer to research design under section 3.3.2). Although there was a significant difference between triathletes and non-triathletes, overall these areas were less important to the food choices of participants in this study. Many individuals who
choose a vegetarian lifestyle place greater importance on animal welfare when making food choices (Pollard et al., 1998). Interestingly, although this study did not specifically ask about vegetarian eating practices, when asked if following a special diet, only non-triathletes (n = 8) reported following a vegetarian, vegan or ‘no red meat’ diet. It is possible the differences observed for non-triathletes may be the result of characteristics not assessed, such as political beliefs or lifestyle choices. Overall, ethical concerns were not of primary importance to participants in this study.

These results demonstrate triathletes and other physically active individuals value health and performance when making food choices. Overall, the factor of most importance was health, followed closely by price, performance, sensory appeal and natural content. Although performance was significantly more important to triathletes, it was also important to the non-triathletes. It is unclear whether the greater importance triathletes place on performance is related to involvement in triathlon or simply the result of being physically active or involved in sport. Future studies exploring competitive level and motive for exercise would provide a better understanding of how these factors influence the food choice motives of various athlete populations.

5.2 NUTRITION KNOWLEDGE

This study used a previously revised and validated assessment tool to measure the nutrition knowledge of triathletes compared to a non-triathlete group. Both groups showed a high level of nutrition knowledge with higher scores than elite athletes and a community group in a study using the same instrument (Spendlove et al., 2011). In fact, triathletes scored higher than elite athletes on all sections of the tool except for diet/disease relationships (Section D). Furthermore, this was the only section where non-triathletes scored significantly higher than triathletes. However, scores for this section were generally poor for both groups (<50%) which are consistent with previous reports for both athletes and non-athletes (Dunn, Turner, & Denny, 2007; Hendrie, Cox, et al., 2008). The survey used in this study was long, incorporating three questionnaires. The section on diet/disease relationships falls at the end of the nutrition knowledge questionnaire (i.e. towards the end of 96 questions) and it is possible participant motivation was decreasing at this point (Burchell & Marsh, 1992). Higher scores for diet/disease relationships (section D) and dietary guidelines were observed for females which is not surprising as
numerous studies have reported the influence of sex on nutrition knowledge scores with females typically scoring higher than males (Hendrie, Coveney, et al., 2008). This is reported in both athlete (Dunn et al., 2007) and non-athlete populations (Wardle et al., 2000). A greater interest in nutrition and health as well as the female role as primary care providers may explain why nutrition knowledge is consistently higher than males (Wardle et al., 2004).

In contrast to elite athletes who scored highest on dietary guidelines (scored 73.6% on section A), participants in this study scored highest (triathletes 90%; non-triathletes 84%) on choosing everyday foods (section C). This section of the questionnaire explores capacity to apply knowledge when choosing healthy foods. The majority of participants in this study placed a high value on health, with less than 2% indicating this was not important. This may explain the overall higher scores on this section. Also, the higher scores for triathletes than elite athletes (90% vs. 68%) on choosing every day foods may be explained by age differences (Spendlove et al., 2011). Most of the triathletes (68%) were over the age of 35 and employed full time, therefore, likely living independently and responsible for making their own daily food choices. In contrast, the majority of elite athletes were under the age of 18 with many still living at home where food choice decisions are influenced by parents. Consistent with previous reports (Spendlove et al., 2011), knowledge of dietary guidelines was high (>73%) for both triathletes and non-triathletes. Most participants were sufficiently active according to Australian public health guidelines 5 (84%) and scores possibly reflect a greater interest in nutrition often seen in those more physically active (Glanz et al., 1998). Overall, these results are consistent with previous studies that report a high level of nutrition knowledge for triathletes (Worme et al., 1990).

5.2.1 NUTRITION KNOWLEDGE AND FOOD CHOICE MOTIVES

Prior to the current study, there were no reports exploring associations between knowledge and factors important in the food choices of triathletes. In this study a relationship between greater nutrition knowledge and health motive was observed for female non-triathletes. This supports female tendency to place greater importance on health (Pollard et al., 1998), particularly with increased knowledge (Contento et al., 1993). It is unclear why this relationship was not observed for

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5 Australian Institute of Health and Welfare (2003). Indicators of health risk factors, the AIHQ view.
female triathletes, however, it is possible this may have been influenced by the greater importance this group placed on performance \((p = 0.002; \text{triathletes } 32.0 \pm 3.9; \text{non-triathletes } 29.8 \pm 4.1; \text{data not shown})\). The strong correlation between motives for health and performance/fitness is not surprising as most study participants were physically active and scored high on the food choice motive for health (>80%). Individuals more physical active frequently place more importance on health when making food choices (Glanz et al., 1998). Although the observed relationship between knowledge and health in females is not surprising, it is important to recognize numerous confounding variables may have influenced the association between these variables. For example, in addition to sex, studies report income, age, dieting status and education as influencing the importance placed on health (Steptoe et al., 1995; Steptoe & Wardle, 1999; Wardle et al., 2004). Future research controlling for the effect of these variables will provide a better understanding of the impact of knowledge on food choice motives.

This study did not explore the relationship between nutrition knowledge and dietary intake, yet studies show athletes with greater knowledge have healthier eating habits (Harrison et al., 1991) and individuals with greater knowledge are more likely to meet public health nutrition guidelines (Wardle et al., 2000). It has been reported that even small increases in nutrition knowledge help support positive dietary change, however, many other factors play a role in food choice, such as personal beliefs and goals (Worsley, 2002). For the athlete, this may include those related to performance. Studies report athletes of higher calibre have better nutrition knowledge scores (Spendlove et al., 2011) which might be related to a greater interest in nutrition driven by a desire to maximize performance (Harrison et al., 1991). The non-elite triathletes in this study had a high level of nutrition knowledge which appeared greater than elite athletes mostly involved in team sports. It would be interesting to explore how these athletes compare to elite triathletes and how this relates to food choice motives. Furthermore, it is unknown whether the greater knowledge scores of triathletes translate into healthy dietary intakes and if this differs to those at the elite level. These areas could be explored in future research with triathletes and other athlete groups exploring the relationship between knowledge, dietary intake and food choice motives.
5.2.2 NUTRITION KNOWLEDGE SOURCES

There is little research on where triathletes access nutrition information. In this study, the most important source of nutrition information was other athletes (Figure 4a). This is similar to previous research which also identified books as important sources of nutrition information (Burke et al., 1991; Worme et al., 1990). Individuals who work closely with these athletes were identified as important sources, including coaches and personal trainers. However, studies report poor levels of knowledge for college level coaches (Torres-McGehee et al., 2012), a concern if athletes rely heavily on information they provide. Although the triathletes in this study had a good level of nutrition knowledge, the knowledge of the coaches who work with them is unknown. As dietitians are recognized experts in nutrition, it is unfortunate they were not a primary source of information (<52%). This may be related to the athlete’s beliefs and preference for information from those more experienced in the sport, such as fellow athletes and coaches. On the other hand, it may be that athletes have established nutrition strategies that work for them and are reluctant to change practices that have proven successful (Robins & Hetherington, 2005). This study did not explore sport specific nutrition knowledge and it is possible triathletes used coaches and other athletes for more of this type of information. Triathletes scored high on general nutrition knowledge, in particular choosing everyday foods (90%), and might not feel the need for expert advice on general healthy eating. As nutrition knowledge and beliefs may factor in food choice decisions, it is important to understand where athletes access information and recognize this as an important factor influencing food selection and dietary intake practices. Dietitians specialized in sport nutrition are in a position to offer additional sport specific advice, but it appears as if involvement in the sport would add credit to the information they provide.

5.3 RIGID AND FLEXIBLE CONTROL

This study is the first to report on flexible (FC) and rigid (RC) control of eating behaviours within an athlete population. The two scales of rigid and flexible control, designed to measure cognitive control over eating, were highly correlated which is consistent with previous research (Stewart, Williamson, & White, 2002; Westenhoefer et al., 1999). Similarly, both scales were correlated with the food choice questionnaire motive for weight control which has also been reported in
studies measuring dietary restraint (Steptoe et al., 1995). These results support research suggesting individuals use a combination of strategies when controlling or monitoring body weight (Smith, Williamson, Bray, & Ryan, 1999). The following discussion provides a general description of the research findings for the subscales of dietary restraint.

5.3.1 MALE RESTRAINT SCORES

Although this study found no difference between male triathletes and non-triathletes on the subscales for rigid and flexible control, scores for both groups appeared higher than previous reports with non-athlete populations where individuals ranged from underweight to obese (Timko & Perone, 2005). Of interest, the scores for female triathletes in the present study were higher than males, which is consistent with previous research that report females typically score higher than males on restraint (Provencher et al., 2004; Timko & Perone, 2005). However, this was not observed for non-triathletes which may be explained by the higher number of physically active males within this group. Indeed, higher dietary restraint scores for males have been found amongst elite athletes with a spinal cord injury (Krempien & Barr, 2012). Dietary restraint is a common practice for many athletes involved in sport and often related to achieving body weight or performance specific goals (Pettersson et al., 2012). As well, individuals will engage in restrained eating for purposes beyond modifying body mass, such as maintaining weight or follow a healthy diet (Timko & Perone, 2006). This study did not explore whether the physical activity practices of non-triathletes included competitive sport other than triathlon. Likewise, the dieting status of individuals in this study is not known. As such, it is possible some male participants were actively dieting or restricting food intake to meet weight goals, reduce body fat or gain muscle mass, particularly in comparison to a non-active male population. This is suggested by comments from a male non-triathlete who participated in a weight class sport and indicated dieting was a necessary part of competition. This individual scored high on flexible control and middle for rigid control. Of interest, males who report dieting tend to score higher on both flexible and rigid control (Provencher et al., 2004), supporting the idea that both strategies are used by males who control body weight. Furthermore, in non-athlete populations, men with a higher body mass index (BMI) who report a current or past history of dieting, show higher scores for rigid control (Provencher et al., 2004). The
BMI range was higher for male participants in this study with a greater percentage outside a healthy weight range (Appendix G). Altogether, these factors may explain the higher scores for the male participants in this study.

5.3.2 FEMALE RESTRAINT SCORES

The mean scores for rigid and flexible control of female participants were similar to earlier studies with non-athlete populations. However, female triathletes appeared to have higher flexible scores, where rigid scores are typically higher (Timko, 2007; Timko & Perone, 2005). However, overall the mean levels of restraint were not particularly high, ranging from middle to middle/high for rigid and flexible control, respectively. This may be explained by the fact that the majority of females were in a healthy weight range. High restraint scores, particularly rigid, are associated with higher BMI (Timko & Perone, 2005) and found in women who are currently dieting to lose weight (Provencher et al., 2004). Likewise, non-dieting, healthy weight individuals typically score lower on restraint (Provencher et al., 2004). These findings support the previous discussion on the food choice motive for weight control where the more active females in this study, including non-triathletes, may be less concerned with restricting food intake given their healthy weights and higher energy expenditures. Again, this is reflected by comments received from a female triathlete who indicated questions did not apply to her as she did not diet to control her weight. This participant scored low for both flexible and rigid control. Of interest, rigid control was correlated with BMI in female non-triathletes and not triathletes. This may be explained by the higher number of female non-triathletes (21 non-triathletes vs. 2 triathletes) outside a healthy range (26% of non-triathletes vs. 7% of triathletes - Appendix G).

5.3.3 LEVELS OF FLEXIBLE AND RIGID CONTROL

Up to this point this discussion has focused on mean scores and does not take into consideration those at the extremes of rigid or flexible control. Figures 3 illustrates participants in this study used both types of restraint over a range of levels. Results do not support the hypothesis that triathletes, as a group, score higher on restraint, or that a higher proportion show greater levels of flexible control. Instead results show some athletes practice high levels of restraint while others low. Earlier studies using dietary restraint scales often report negative associations with high levels of restraint, such as increased risk of disordered eating, stress fractures and
low bone mass (Barrack et al., 2008; Guest & Barr, 2005). In contrast, studies using
the flexible and rigid control subscales have found a greater association with
symptoms of disordered eating in those who used predominantly rigid dieting
strategies (Stewart et al., 2002). Also, in a study that explored methods used to
control weight, high rigid control was associated with a greater use of diuretics,
laxatives or vomiting, while those high in flexible control a greater use of exercise or
body building (Westenhoefer et al., 1999). Research suggests individuals with high
flexible control are able to plan and self-regulate calorie intake and allow for foods
outside of their ‘diet’ (Timko & Perone, 2005; Westenhoefer et al., 1999). This may
be the case for athletes who watch their diet for reasons other than weight loss.
Exploring different levels of rigid and flexible control would provide a more
powerful look at restrained eating and relationship to food choice motives, dieting
status, BMI and disordered eating practices. This is particularly important amongst
athlete populations where dietary intake is closely monitored and risk of eating
disorders is high (Sundgot-Borgen & Torstveit, 2004). Although this study did not
report a difference in dietary restraint scores between triathletes and non-triathletes,
the mean scores for flexible control for this active group of participants appeared to
be higher than previous reports with non-athlete populations. It is entirely
speculative, but this may suggest some athletes use a flexible dieting strategy and
monitor food intake in a positive way that benefits their sporting goals. Studies show
many triathletes restrict food choices in order to achieve physique or performance
goals (Lamont et al., 2012). These athletes also avoid certain foods prior to
competition, yet allow themselves these foods once an event has past (Lamont &
Kennelly, 2011). These results provide an initial exploration into rigid and flexible
control in an athlete population. They highlight the value of exploring this area in
more depth using the rigid and flexible subscales and how different types and levels
of restraint influence food choice motives. Likewise, results demonstrate the
importance of exploring dieting status and understanding the reasons for restrained
eating when investigating food choice motives.
6. Conclusions

This study provides preliminary findings on the factors important to triathletes when making food choices. As well, results provide new information on the level of nutrition knowledge and dietary restraint in triathletes. Triathletes have a high level of nutrition knowledge and higher than a previous study with elite athletes. These athletes placed high importance on performance and health when making food choices. Of less concern were factors related to ethical issues and, in particular, religion which was of little importance to the majority of participants in this study. Factors important in the food choices of triathletes were not substantially different than a non-triathlete group, a population that also included a large number of active individuals. The triathletes in this study showed a higher level of dietary restraint than previously reported in non-athlete populations. As well, consistent with other groups, triathletes use both types of restraint, but the levels varied within this population. These results support previous findings exploring food choice and eating behaviours and highlight the multiple, interacting factors that influence the final food decisions an individual makes. Furthermore, results reinforce the importance of recognizing sport specific characteristics that may influence the food choices and dietary practices of athletes. This study provides an initial look at the factors important to triathletes when selecting foods and demonstrates the vast potential and need for future research in the area. Given the substantial role of nutrition in sport performance it is critical to explore in more detail why athletes eat what they eat.

6.1 STRENGTHS AND LIMITATIONS

There are several strengths of this study which include the use of well validated research tools. Nutrition knowledge was assessed using a revised and validated version of the General Nutrition Knowledge Questionnaire which was previously used on athletes and adapted to include terms familiar to an Australian population. Likewise, the rigid and flexible control scales, though not used previously on an athlete population, have been shown to have acceptable validity and reliability. Use of these subscales provided a more powerful measure of dietary
restraint by distinguishing between different types of restrained eating behaviours. The likelihood that some athletes, particularly those in weight category and aesthetic sports, will demonstrate high levels of dietary restraint is high. As such, using these scales was considered a better choice for investigating dietary restraint and the relationship to food choice motives. Studies have questioned whether the food choice questionnaire (FCQ) is suitable for measuring food choice motives across populations (Januszewska et al., 2011). Instead, using a population specific research tool has been suggested (Share & Stewart-Knox, 2012). However, an athlete specific FCQ does not currently exist. Therefore use of a validated tool that had previously been used on an Australian population as well as inclusion of a non-triathlete group for comparison was considered appropriate for this study. This research is the first to provide reliable and valid data on the nutrition knowledge of triathletes and provides a more detailed look at dietary restraint. As well, this is the first large scale investigation exploring the factors important in the food choices of triathletes. Finally, the quantitative research design recruited a considerable sample size, thereby enhancing power of results with a large study population.

The study had several limitations. Although recruitment was focused on those competing in an Olympic distance triathlon (i.e. Noosa triathlon), several triathletes volunteered who were not competing in this particular race. However, this study did not ask about other triathlon distances athletes competed in. Therefore, it was highly possible the athletes in this study included those training for a range of triathlon distances which may have influenced responses to food choice questions. Unfortunately, a very small number of top athletes were represented (one elite and six open participants) and, therefore it was not possible to explore how athlete calibre influenced food choices. Finally, there is also potential for non-response bias whereas those individuals interested in nutrition are more likely to respond to a nutrition survey. Likewise, those who attend university may also be more likely and interested in participating in research.

Despite a goal to recruit an inactive group to compare with triathletes, the non-triathletes showed a high level of activity and, although this study explored hours of physical activity, we did not ask about involvement in competitive sport other than triathlon. As a result, responses may have been influenced by active individuals involved in a variety of competitive sports and differ to sedentary
individuals. Non-triathletes were recruited at a time when stress and lack of time may contribute to food choice decisions (Boek et al., 2012). Likewise, it is also recognized these individuals were recruited over a period of time where unusual eating habits are practiced (i.e. during the holiday season) and this may have factored in food choice motives and dieting behaviours.

The aim of this study was to explore the food choices motives of triathletes. However, the sample characteristics show the triathletes in this study were a relatively diverse and varied group who did not fall within a specific demographic. Therefore, despite the common characteristic of participation in the sport, it was difficult to make distinct comparisons regarding food choice motives, nutrition knowledge and eating behaviours in such a diverse group. Furthermore, several variables that can influence food choice were not included, such as income, ethnicity and living situation. Given the growing popularity of the sport, the varying characteristics of participants and the fact that this research approach had never been carried out with triathletes, limiting exclusion criteria was deemed necessary.

There were also limitations regarding dietary restraint and body mass index (BMI). BMI is widely used for assessing health risk associated with increased body fatness and chronic disease (Goacher, Lambert, & Moffatt, 2012). However, the use of BMI in athlete populations has limitations as it does not take into consideration differences in lean body mass and per cent fat (Lambert et al., 2012). It is possible some athletes may have had higher BMI’s that suggest increased health risk, with body fat levels suggesting otherwise. As such, a relationship between weight concerns, BMI and dieting strategies may not have the same meaning as those reported in non-active populations. Furthermore, although this study found a strong association between BMI and restraint scores, there are several studies that report otherwise, particularly for flexible control (Gallant et al., 2010; Williamson, 1995). Finally, the exclusion of the disinhibition and hunger subscales of the TFEQ is a limitation in this study. These were excluded to minimize participant burden. However, as highlighted in the literature review, hunger is a factor in food choice and, therefore, may influence food choice decisions.

Findings from this study are specific to triathlon, an endurance sport. They are not transferrable to other athletes, such as those involved in team, contact or weight category sports. Finally, this study did not explore dietary intake and,
therefore, cannot report how nutrition knowledge, food choice motives and eating behaviours influence dietary intake.

6.2 IMPLICATIONS FOR PRACTICE

As nutrition educators, dietitians are in a primary position to support and guide athletes towards healthy eating practices that support both sport and health goals. The triathletes in this study had a high level of nutrition knowledge and placed high importance on food choices that were healthy and benefit performance. A primary source of nutrition information for triathletes was other athletes and coaches. This has important implications for nutrition professionals and highlights opportunities to improve nutrition education they provide. Dietitians can use this information and work with triathletes and coaches ensuring they receive the most accurate and reliable nutrition information. As well, to recognize the importance triathletes place on performance when making food choices and ensure this is incorporated into nutrition education provided. Finally, the range of restraint scores displayed by triathlete’s demonstrates that some will control and restrict dietary intake and, therefore, need to be supported to ensure they use safe and effective dieting strategies.

6.3 FUTURE DIRECTIONS

Future research should explore the nutrition knowledge of elite triathletes and how this compares to the age group competitors who took part in this study. Likewise, it is important to investigate motives for participating in triathlon and other sports and how this impacts food choice motives and dietary restraint. Finally, future studies that include dietary intake would help to understand how this is influenced by food choice motives, nutrition knowledge and dietary restraint.

This is the first study using the expanded cognitive dietary restraint subscales, therefore, it is not possible to say how the levels of flexible and rigid control in triathletes compare to other athletes. However, the possibility that athletes may practice higher flexible control provides an exciting opportunity for further exploration in athlete populations where controlling and monitoring food intake is a common practice. Furthermore, the higher scores by male participants suggest involvement in triathlon, or other sports, may influence restraint levels and potentially not be associated with negative or harmful behaviours. This requires
further investigation, which could include investigating dieting status as well as sport specific or performance goals. Also, research should explore the use of the rigid and flexible subscales for identifying athletes at risk of disordered eating practices. Likewise, research should explore the characteristics of those athletes who exhibit a high level of flexible control and how self-regulation of dietary intake may have beneficial and positive outcomes. The high value placed on performance and health highlights the importance of exploring the dietary intake of triathletes and how this relates to food choice motives and nutrition knowledge. Future research could explore the development and validation of an athlete specific food choice questionnaire. Development of a tool specific to athletes would help explore aspects of food choice unique to this population. Finally, studies need to explore the nutrition knowledge and information sources of triathlon coaches.

This study was designed to explore the factors important in the food choices of triathletes and how this is influenced by nutrition knowledge and dietary restraint. Results show the food choice of these athletes are influenced by their involvement in triathlon and that decisions about what to eat may be influenced by their knowledge and personal beliefs. Results of this study present many opportunities for future investigations. It is important for dietitians, coaches, sports scientists and others who work with athletes to recognize the multitude of factors that shape food choice decisions and how this can influence dietary intake.
7. References


Devine, C. M., Connors, M., Bisogni, C. A., & Sobal, J. (1998). Life-course influences on fruit and vegetable trajectories: Qualitative analysis of food


8. Appendices
Appendix A: Participant Questionnaire

Part 1: We would like to begin by asking you a few details about yourself.

1. Are you competing in the Noosa Triathlon in November 2012?
   a. Yes □
      If yes, please indicate what level you compete at:
      Elite □
      Open □
      Individual □
      Athena □
      Clydesdale □
   b. No □

2. If you answered yes to the previous question, would you be willing to provide your name? As mentioned, we are asking for your name in order to connect race results with your questionnaire responses.
   a. Yes □
      ______________________             _____________________
                   Surname             Given name (s)
   b. No, I'd prefer not to give my name □

3. Are you male or female?
   a. Male □
   b. Female □

4. How old are you?
   a. Less than 18 □
   b. 18 – 24 □
   c. 25 -34 □
   d. 35-44 □
   e. 45-54 □
   f. 55-64 □
   g. 65-74 □
   h. 75 or more □

5. We have invited different groups to participate in these surveys. Please indicate which group you are a member of.
   a. Triathlete □
   b. University of the Sunshine Coast student □
   c. University of the Sunshine Coast staff □
   d. Both (a) and (b) □
   e. Both (a) and (c) □
   f. None of the above □
6. In a typical week, how many hours do you spend exercising or training?
   a. Less than 1 ½ hours per week □
   b. 1 ½ - 3 hours per week □
   c. 4 – 5 hours per week □
   d. 6 – 10 hours per week □
   e. 11 – 15 hours per week □
   f. 16 - 20 hours per week □
   g. 21 hours or more per week □
   If more than 21 hours per week, please specify the number of hours ____________

7. Over the past 3 months I have been using my diet to (please check all that apply):
   a. Help with recovery □
   b. Modify body fat □
   c. Modify muscle mass □
   d. Fuel my training □
   e. Other (please specify) ________________________________

8. What is your current height? (please provide a best estimate)
   __________feet__inches__ or
   __________________________centimetres

9. What is your current weight in kilograms (please provide a best estimate)?
   __________________________kg

10. What is the highest level of education you have completed?
    a. primary school □
    b. some high school □
    c. completed high school □
    d. tech or trade qualification □
    e. tertiary degree (not TAFE) □

11. Do you have any health or nutrition related qualifications?
    a. Yes □
        Please specify:
        __________________________________________
    b. No □

12. Please indicate how important each of the following sources of nutrition information is to you. Tick one box in each line.

<table>
<thead>
<tr>
<th>Source</th>
<th>Somewhat important</th>
<th>Very important</th>
<th>Most important</th>
<th>Do not use for information</th>
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</thead>
<tbody>
<tr>
<td>Partner/family</td>
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<tr>
<td>Friends</td>
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<tr>
<td>Other athletes</td>
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<tr>
<td>Coach</td>
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<td>Personal Trainer/Sports Conditioner</td>
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<td>Books</td>
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<td>Health food store</td>
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<tr>
<td>Naturopath</td>
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<tr>
<td>GP/local doctor</td>
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<tr>
<td>Dietitian</td>
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<tr>
<td>School</td>
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<tr>
<td>University</td>
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<tr>
<td>Nutrition session</td>
<td>arranged by my coach</td>
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<tr>
<td>Scientific research articles</td>
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<tr>
<td>Other health professionals, please specify</td>
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<tr>
<td>Other source, please specify</td>
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</tbody>
</table>

13. Are you currently:
   a. employed full time
   b. employed part time
   c. unemployed
   d. full time homemaker
   e. retired
   f. student
   g. disabled or too ill to work

14. Are you on a special diet?
   a. Yes
   b. No

Please specify:
## Appendix B: Adapted Food Choice Questionnaire

Several different factors influence our choice of food. For every person, there will be a different set of factors that are important. In the next set of questions, we are interested in finding out what factors influenced your choice of food over the past 3 months. Listed below are a series of factors that may be relevant to your choice of food. Read each item carefully and decide how important the item has been to you over the last 3 months. Put a tick in the box that best reflects your feelings. Remember, there are no right or wrong answers – we are interested in what is important to you.

<table>
<thead>
<tr>
<th>Factor</th>
<th>Over the past 3 months, it was important to me that the food I ate on a typical training day*:</th>
<th>Not at all important</th>
<th>A little important</th>
<th>Neither important nor unimportant</th>
<th>Moderately important</th>
<th>Extremely important</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>was quick and easy to prepare</td>
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<tr>
<td>1</td>
<td>was not messy to eat</td>
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<tr>
<td>1</td>
<td>could be bought in shops close to where I live</td>
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<tr>
<td>1</td>
<td>was easily available in shops and supermarkets</td>
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<tr>
<td>1</td>
<td>could be cooked very simply</td>
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<td>2</td>
<td>was high in fibre and roughage</td>
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<td>2</td>
<td>was high in protein</td>
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<td>2</td>
<td>was nutritious</td>
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<td>2</td>
<td>contained a lot of vitamins and minerals</td>
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<td>2</td>
<td>was good for my skin/teeth/hair/nails etc…</td>
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<td>2</td>
<td>kept me healthy</td>
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<td>3</td>
<td>helped me cope with stress</td>
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<td>3</td>
<td>cheered me up</td>
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<td>3</td>
<td>kept me awake/alert</td>
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<td>3</td>
<td>made me feel good</td>
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<td>3</td>
<td>helped me relax</td>
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<td>4</td>
<td>was a good source of carbohydrate</td>
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<td>4</td>
<td>would not upset my stomach</td>
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<td>4</td>
<td>was low in carbohydrate</td>
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<td>4</td>
<td>helped me stay hydrated</td>
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<td>4</td>
<td>helped fill me up</td>
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<td>4</td>
<td>was prepared safely so I won’t get sick</td>
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<td>4</td>
<td>provided enough energy to get through my physical exercise program</td>
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<td>4</td>
<td>did not compromise my sporting and exercise goals</td>
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<td>5</td>
<td>was low in fat</td>
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<td>5</td>
<td>was low in calories</td>
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<td>5</td>
<td>helped me control my weight</td>
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<td>6</td>
<td>was good value for money</td>
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<td>6</td>
<td>was not expensive</td>
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<td>7</td>
<td>was produced in a way that animals’ rights had been respected</td>
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<td>7</td>
<td>was produced in a way that animals have not experienced pain</td>
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<td>8</td>
<td>contained natural ingredients</td>
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<td>8</td>
<td>was certified free of chemical and hormone residues</td>
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<td>8</td>
<td>contained no additives</td>
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<td>8</td>
<td>contained no artificial ingredients</td>
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<td>8</td>
<td>was prepared in a way that preserves its natural goodness</td>
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<td>8</td>
<td>was as unprocessed as possible</td>
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<td>9</td>
<td>smelled nice</td>
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<td>9</td>
<td>tasted good</td>
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<td>9</td>
<td>had a pleasant texture</td>
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<td>9</td>
<td>looked nice</td>
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<td>10</td>
<td>had the country of origin clearly marked</td>
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<td>10</td>
<td>came from a country in which human rights are respected</td>
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<td>10</td>
<td>came from a country that I approved of politically</td>
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<td>10</td>
<td>was prepared in a way that does not conflict with my political values</td>
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<td>11</td>
<td>was produced in a way that has not shaken the balance of nature</td>
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<td>11</td>
<td>was grown locally to reduce transportation</td>
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<tr>
<td>11</td>
<td>was prepared in an environmentally friendly way</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>was packaged in an environmentally friendly way</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>was familiar</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>was what I usually eat</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>was like the food I ate when I was a child</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>was in harmony with my religious views</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>was not forbidden by my religion</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*For the non-triathlete group the word "training" was removed from the opening question (i.e. 'over the past 3 months, it was important to me that the food I ate on a typical day').

†Questions numbered according to the food choice factor in which they are grouped (i.e: 1 = convenience; 2 = health; 3 = Mood; 4 = fitness/performance; 5 = weight control; 6 = price; 7 = animal welfare; 8 = natural content; 9 = sensory appeal; 10 = political values; 11 = environmental protection; 12 = familiarity; 13 = religion).

*Additional question added for the performance factor.

†Original fitness questions added to food choice questionnaire by Lockie et al., (2002)
Appendix C: General Nutrition Knowledge Questionnaire

This is a survey, not a test. Your answers will help identify which dietary advice people find confusing.

- It is important that you complete it by yourself
- Your answers will remain confidential
- If you do not know the answer, mark “not sure” rather than guess.

The first few items are about what advice you think experts are giving us.

1. Do you think the Dietary Guidelines for Australians recommends that people should be eating more, the same amount, or less of these foods? (tick one box per food)

<table>
<thead>
<tr>
<th>Food</th>
<th>More</th>
<th>Same</th>
<th>Less</th>
<th>Not Sure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vegetables</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sugary foods</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Meat</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fatty foods</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High fibre foods</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fruit</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Salty foods</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2. How many servings of fruit and vegetables a day do you think experts recommend people eat? (Examples of one serve are a piece of fruit or 1 cup of salad vegetables)

<table>
<thead>
<tr>
<th>Fruit</th>
<th>Vegetables</th>
</tr>
</thead>
</table>

3. Which fat do experts say is most important for people to cut down on? (tick one)
   a) monounsaturated fat
   b) polyunsaturated fat
   c) saturated fat
   d) not sure

4. What version of dairy foods do experts say people should eat? (tick one)
   a) full fat
   b) low fat
   c) both full fat and lower fat
   d) none, dairy foods should be cut out
   e) not sure

Experts classify foods into groups. We are interested to see whether people are aware of what foods are in these groups.

1. Do you think these are high or low in added sugar? (tick one box per food).

<table>
<thead>
<tr>
<th>Food</th>
<th>High</th>
<th>Low</th>
<th>Not Sure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bananas</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unflavoured yoghurt</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ice-cream</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Orange 35% juice</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tomato Ketchup</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tinned fruit in natural juice</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
2. Do you think these are high or low in fat? *(tick one box per food).*

<table>
<thead>
<tr>
<th></th>
<th>High</th>
<th>Low</th>
<th>Not Sure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pasta (without sauce)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mayonnaise</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baked beans</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lunch/sandwich meat</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Honey</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vegetarian pastry</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nuts</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White bread</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cottage cheese</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Polyunsaturated margarine</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

3. Do you think these are starchy/high carbohydrate foods? *(tick one box per food).*

<table>
<thead>
<tr>
<th></th>
<th>High</th>
<th>Low</th>
<th>Not Sure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cheese</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pasta</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Butter</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nuts</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rice</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Porridge</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

4. Do you think these are high or low in salt? *(tick one box per food).*

<table>
<thead>
<tr>
<th></th>
<th>High</th>
<th>Low</th>
<th>Not Sure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sausages</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pasta</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anchovies</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Red meat</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Frozen vegetables</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cheese</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

5. Do you think these are high or low in protein? *(tick one box per food)*

<table>
<thead>
<tr>
<th></th>
<th>High</th>
<th>Low</th>
<th>Not Sure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chicken</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cheese</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fruit</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baked beans</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Butter</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cream</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

6. Do you think these are high or low in fibre/roughage? *(tick one box per food)*

<table>
<thead>
<tr>
<th></th>
<th>High</th>
<th>Low</th>
<th>Not Sure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cornflakes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bananas</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eggs</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Red meat</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Broccoli</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nuts</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fish</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baked potato with skin</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chicken</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baked beans</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
7. Do you think these fatty foods are high or low in saturated fat? *(tick one box per food)*

<table>
<thead>
<tr>
<th>Food</th>
<th>High</th>
<th>Low</th>
<th>Not Sure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tuna</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Whole milk</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Olive oil</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Red meat</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sunflower margarine</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chocolate</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

8. Some foods contain a lot of fat, but no cholesterol. *(tick one)*
   a) agree
   b) disagree
   c) not sure

9. Saturated fats are mainly found in: *(tick one)*
   a) vegetable oil
   b) dairy products
   c) both (a) and (b)
   d) Not sure

10. Brown sugar is a healthy alternative to white sugar. *(tick one)*
    a) agree
    b) disagree
    c) not sure

11. There is more protein in a glass of whole milk than a glass of skimmed milk. *(tick one)*
    a) agree
    b) disagree
    c) not sure

12. Polyunsaturated margarine contains less fat than butter. *(tick one)*
    a) agree
    b) disagree
    c) not sure

13. Which of these breads contains the most vitamins and minerals? *(tick one)*
    a) white bread
    b) wholemeal bread
    c) wholegrain bread
    d) not sure

14. Which do you think is higher in kilojoules: butter or regular margarine? *(tick one)*
    a) butter
    b) margarine
    c) both the same
    d) not sure
15. A type of oil which contains mostly monounsaturated fat is: (tick one)  
   a) coconut oil  
   b) sunflower oil  
   c) olive oil  
   d) palm oil  
   e) not sure  

16. There is more calcium in a glass of whole milk than a glass of skim milk. (tick one)  
   a) agree  
   b) disagree  
   c) not sure  

17. Which one of the following has the most kilojoules for the same weight? (tick one)  
   a) sugar  
   b) carbohydrate  
   c) fibre/roughage  
   d) fat  
   e) not sure  

18. Harder fats contain more: (tick one)  
   a) monounsaturated fat  
   b) polyunsaturated fat  
   c) saturated fat  
   d) not sure  

19. Polyunsaturated fats are mainly found in: (tick one)  
   a) vegetable oils  
   b) dairy products  
   c) both (a) and (b)  
   d) not sure  

The next few items are about choosing foods. Please answer what is being asked and not whether you like or dislike the food. For example, suppose you were asked…”if a person wanted to cut down on fat, which cheese would be best to eat?”  
(a) cheddar cheese  
(b) camembert  
(c) cream cheese  
(d) cottage cheese.  

If you didn’t like cottage cheese, but knew it was the right answer, you would still tick cottage cheese.  
1. Which would be the best choice for a low fat, high fibre light meal? (tick one)  
   a) grilled chicken  
   b) cheese on wholemeal toast  
   c) baked beans on wholemeal toast  
   d) quiche  

2. If a person wanted to reduce the amount of fat in their diet, which would be the best choice? (tick one)  
   a) steak, grilled  
   b) sausages, grilled  
   c) turkey, grilled  
   d) pork chop, grilled
3. If a person wanted to reduce the amount of fat in their diet, but didn’t want to give up chips, which one would be the best choice? (tick one)
   a) thick cut ‘chunky’ chips
   b) thin cut ‘french fries’
   c) crinkle cut chips

4. If a person felt like something sweet, but was trying to cut down on sugar, which would be the best choice? (tick one)
   a) honey on toast
   b) a cereal snack bar
   c) plain sweet biscuit
   d) banana with plain yoghurt

5. If a person wanted to reduce the amount of salt in their diet, which would be the best choice? (tick one)
   a) ready-made frozen shepherd’s pie
   b) ham steak with pineapple
   c) mushroom omelette
   d) stir fry vegetables with soy sauce

This section is about health problems or diseases

1. Are you aware of any major health problems or diseases that are related to a low intake of fruit and vegetables?
   a) Yes
   b) No
   c) Not sure

   If yes, what diseases or health problems do you think are related to a low intake of fruit and vegetables?

2. Are you aware of any major health problems or diseases that are related to a low intake of fibre?
   a) Yes
   b) No
   c) Not sure

   If yes, what diseases or health problems do you think are related to fibre?

3. Are you aware of any major health problems or diseases that are related to how much sugar people eat?
   a) Yes
   b) No
   c) Not sure

   If yes, what diseases or health problems do you think are related to sugar?

4. Are you aware of any major health problems or diseases that are related to how much salt or sodium people eat?
   a) Yes
   b) No
   c) Not sure

   If yes, what diseases or health problems do you think are related to salt?
5. Are you aware of any major health problems or diseases that are related to the amount of fat people eat?
   a) Yes
   b) No
   c) Not sure

If yes, what diseases or health problems do you think are related to fat?

6. Do you think these help to reduce the chances of getting certain kinds of cancer? (answer each one)

<table>
<thead>
<tr>
<th></th>
<th>yes</th>
<th>no</th>
<th>not sure</th>
</tr>
</thead>
<tbody>
<tr>
<td>eating more fibre</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>eating less fruit</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>eating more fruit and vegetables</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

7. Do you think these help prevent heart disease? (answer each one)

<table>
<thead>
<tr>
<th></th>
<th>yes</th>
<th>no</th>
<th>not sure</th>
</tr>
</thead>
<tbody>
<tr>
<td>eating less saturated fat</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>eating less salt</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>eating more fruit and vegetables</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

8. Which one of these is more likely to raise people’s blood cholesterol level? (tick one)

   a) antioxidants
   b) polyunsaturated fats
   c) saturated fats
   d) cholesterol in the diet
   e) not sure

9. Have you heard of antioxidant vitamins?

   a) Yes
   b) No

10. If YES to question 9, do you think these are antioxidant vitamins (answer each one)

<table>
<thead>
<tr>
<th></th>
<th>yes</th>
<th>no</th>
<th>not sure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vitamin A</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B Complex vitamins</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vitamin C</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vitamin D</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vitamin E</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vitamin K</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Appendix D: Three Factor Eating Questionnaire Flexible and Rigid Restraint Subscales

PART I: The following questions relate to eating behaviours. Please answer the following questions by circling True (T) or False (F) for the answer that is most appropriate to you.

1. When I have eaten my quota of calories, I am usually good about not eating any more ................................................................. T F
2. I deliberately take small helpings as a means of controlling my weight .......... T F
3. I have a pretty good idea of the number of calories in common foods .......... T F
4. While on a diet, if I eat food that is not allowed, I consciously eat less for a period of time to make up for it .............................................. T F
5. I consciously hold back at meals in order not to gain weight ...................... T F
6. I pay a great deal of attention to changes in my figure ................................ T F
7. If I eat a little bit more on one day, I make up for it the next day ................. T F
8. I pay attention to my figure, but I still enjoy a variety of foods .................. T F
9. I prefer light foods that are not fattening ............................................ T F
10. I count calories as a conscious means of controlling my weight .............. T F
11. If I eat a little bit more during one meal, I make up for it at the next meal .... T F
12. I eat diet foods, even if they do not taste very good ............................... T F
13. A diet would be too boring a way for me to lose weight .......................... T F
14. I would rather skip a meal than eating in the middle of one ................. T F
15. I alternate between times when I diet strictly and times when I don’t pay much attention to what and how much I eat .............................. T F
16. Sometimes I skip meals to avoid gaining weight .................................. T F
17. I avoid some foods on principle even though I like them ....................... T F
18. I try to stick to a plan when I lose weight ......................................... T F
19. Without a diet plan I wouldn’t know how to control my weight ............. T F
20. Quick success is most important to me during a diet ............................ T F

PART II: Please answer the following questions by circling the number above the response that is appropriate to you.

21. How often are you dieting in a conscious effort to control your weight?
   1 rarely  2 sometimes  3 usually  4 always

22. Would a weight fluctuation of 5 lbs (~ 2.3 kg) affect the way you live your life?
   1 not at all  2 slightly  3 moderately  4 very much

23. Do feelings of guilt about overeating help you to control your food intake?
   1 never  2 rarely  3 often  4 always

24. How conscious are you of what you are eating?
   1 not at all  2 slightly  3 moderately  4 extremely

25. How frequently do you avoid ‘stocking up’ on tempting foods?
   1 almost never  2 seldom  3 usually  4 almost always

26. How likely are you to shop for low calorie foods?
   1 unlikely  2 slightly unlikely  3 moderately likely  4 very likely

27. How likely are you to consciously eat less than you want?
   1 unlikely  2 slightly likely  3 moderately likely  4 very likely

28. Do you deliberately restrict your intake during meals even though you would like to eat more?
   1 never  2 rarely  3 often  4 always
### Appendix E: Scores on the food choice motives of the adapted Food Choice Questionnaire (includes mean, 95% confidence intervals, percentage and p values for each group).

<table>
<thead>
<tr>
<th>Food choice motive (max score)**</th>
<th>Athlete Status</th>
<th>Sex</th>
<th>Age Group</th>
<th>Physical Activity*</th>
<th>Employment</th>
<th>Education</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Triathlete (n = 164)</td>
<td>Control (n = 128)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mean (95% CI)</td>
<td>%</td>
<td>Mean (95% CI)</td>
<td>%</td>
<td>Mean (95% CI)</td>
<td>%</td>
</tr>
<tr>
<td>Convenience (25)</td>
<td>17.6 (16.1-19.0)</td>
<td>70.4</td>
<td>17.3 (16.2-18.4)</td>
<td>69.2</td>
<td>p = 0.076*</td>
<td></td>
</tr>
<tr>
<td></td>
<td>16.7 (15.3-18.0)</td>
<td>66.8</td>
<td>18.2 (17.2-19.2)</td>
<td>72.8</td>
<td>p = 0.051</td>
<td></td>
</tr>
<tr>
<td>Natural Content (30)</td>
<td>21.5 (19.4-23.3)</td>
<td>71.3</td>
<td>21.8 (20.2-23.3)</td>
<td>72.7</td>
<td>p = 0.805</td>
<td></td>
</tr>
<tr>
<td></td>
<td>20.4 (18.4-22.4)</td>
<td>68.0</td>
<td>22.9 (21.4-24.3)</td>
<td>76.3</td>
<td>p = 0.03*</td>
<td></td>
</tr>
<tr>
<td>Weight (15)</td>
<td>10.3 (9.2-11.3)</td>
<td>68.7</td>
<td>10.4 (9.6-11.2)</td>
<td>69.3</td>
<td>p = 0.834</td>
<td></td>
</tr>
<tr>
<td></td>
<td>9.7 (8.7-10.8)</td>
<td>64.7</td>
<td>10.9 (10.2-11.7)</td>
<td>72.7</td>
<td>p = 0.03*</td>
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<tr>
<td>Sensory Appeal (20)</td>
<td>14.7 (13.5-15.9)</td>
<td>73.5</td>
<td>14.3 (13.4-15.3)</td>
<td>71.2</td>
<td>p = 0.176</td>
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<td>14.1 (12.9-15.2)</td>
<td>70.5</td>
<td>15.0 (14.1-15.8)</td>
<td>75.0</td>
<td>p = 0.283</td>
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<td>Environmental protection (20)</td>
<td>9.1 (7.5-10.7)</td>
<td>35.5</td>
<td>11.3 (10.1-12.5)</td>
<td>56.5</td>
<td>p = 0.004*</td>
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<td>9.5 (8.0-11.0)</td>
<td>47.5</td>
<td>10.8 (9.7-12.0)</td>
<td>54.0</td>
<td>p = 0.122</td>
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<td>Political values (20)</td>
<td>7.9 (6.9-9.5)</td>
<td>39.5</td>
<td>11.0 (9.8-12.3)</td>
<td>55.0</td>
<td>p = 0.004*</td>
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<td>9.0 (7.4-10.5)</td>
<td>45.0</td>
<td>9.9 (8.8-11.1)</td>
<td>49.5</td>
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<td>Familiarity (15)</td>
<td>8.8 (7.8-9.7)</td>
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<td>8.1 (7.4-8.9)</td>
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<td>8.3 (7.4-9.2)</td>
<td>55.3</td>
<td>8.6 (7.9-9.3)</td>
<td>57.3</td>
<td>p = 0.550</td>
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<td>Health (30)</td>
<td>24.8 (23.5-26.1)</td>
<td>82.7</td>
<td>25.1 (24.1-26.1)</td>
<td>83.7</td>
<td>p = 0.068</td>
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<td>24.5 (23.2-25.7)</td>
<td>81.7</td>
<td>25.4 (24.5-26.4)</td>
<td>84.7</td>
<td>p = 0.180</td>
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<tr>
<td>Performance (40)</td>
<td>32.3 (30.8-33.8)</td>
<td>80.7</td>
<td>30.2 (29.0-31.3)</td>
<td>75.5</td>
<td>p = 0.019*</td>
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<td>31.3 (29.0-32.8)</td>
<td>78.2</td>
<td>31.1 (30.3-32.2)</td>
<td>77.7</td>
<td>p = 0.804</td>
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<tr>
<td>Price (10)</td>
<td>8.2 (7.5-9.0)</td>
<td>82.0</td>
<td>7.2 (6.7-7.8)</td>
<td>72.0</td>
<td>p = 0.024*</td>
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<td>7.8 (7.1-8.5)</td>
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<td>7.7 (7.2-8.2)</td>
<td>77.0</td>
<td>p = 0.024*</td>
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<tr>
<td>Mood (25)</td>
<td>15.8 (14.2-17.3)</td>
<td>63.2</td>
<td>15.7 (14.4-16.9)</td>
<td>62.8</td>
<td>p = 0.911</td>
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<tr>
<td></td>
<td>15.3 (13.8-16.9)</td>
<td>61.2</td>
<td>16.1 (15.0-17.2)</td>
<td>64.4</td>
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<td>Animal welfare (10)</td>
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<td>6.2 (5.5-6.9)</td>
<td>62.0</td>
<td>p = 0.007*</td>
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<tr>
<td></td>
<td>5.1 (4.2-6.0)</td>
<td>51.0</td>
<td>5.7 (5.0-6.4)</td>
<td>57.0</td>
<td>p = 0.218</td>
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</tbody>
</table>

Mean differences assessed using ANOVA. *Indicates significant differences at p < 0.05.
** Maximum score obtained from sum of responses ranging from 'not at all important’ (1 point) to ‘extremely important’ (5 points). The number of questions within each food choice motive varies (i.e. convenience has 5 questions (25 points); price has 2 questions (10 points). See Food Choice Questionnaire in appendix B for more information.
1 hours per week
2 Included full and part time employment
3 Includes unemployed, full time homemakers, retired and students

Total number of participants (n = 292)
Appendix F: Norms for flexible and rigid control

<table>
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<th>Level of restraint*</th>
<th>Rigid Control</th>
<th>Flexible Control</th>
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<tr>
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<td>Male</td>
<td>Female</td>
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<tr>
<td>Very low</td>
<td>0-1</td>
<td>0-2</td>
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<tr>
<td>Low</td>
<td>2</td>
<td>3-4</td>
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<tr>
<td>Middle</td>
<td>3-4</td>
<td>5-7</td>
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<tr>
<td>High</td>
<td>5-7</td>
<td>8-10</td>
</tr>
<tr>
<td>Very High</td>
<td>8-16</td>
<td>11-16</td>
</tr>
</tbody>
</table>

*norms established by Timko (2007)
Appendix G: Ranges of BMI’s for male and females according to weight classification.

a) Males

![Bar chart for males showing BMI weight classification]

b) Females

![Bar chart for females showing BMI weight classification]

Note: BMI weight classifications: <18.5 underweight; 18.5-25 normal weight; 25 overweight.

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