An Evaluation of the Nutrition Support Provided to Athletes at a Major International Competition

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MSc., BSc.

A thesis submitted in fulfilment of the requirements for the degree of
Doctor of Philosophy

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2014
Abstract

Athletes competing at major international competitions such as the Olympic (OG) and Commonwealth (CG) Games live in a purpose built village environment where they may source all, or the majority of their meals and snacks from the main dining hall. As such, athletes are reliant on the event caterers to provide a range of high quality items to meet cultural, sporting and personal requirements. Currently athletes are supported in this environment through the provision of a menu and nutrition support services. Dietitians have played an important role in assisting caterers to develop suitable menus for previous OG and CG events and it is now mandatory for the menu for all OG events to be reviewed by a dietitian prior to the event. However, there is little published literature available to evaluate the suitability of the menu for the diverse group of athletes present at these events. Additionally, even if appropriate items are provided in the dining hall some athletes may require assistance in order to locate or choose suitable items in this unique environment. In order to assist athletes with food choice a range of nutrition support services have been provided at previous OG and CG events, with a nutrition kiosk and Point of Choice (POC) nutrition labels being used most often. In fact, it is now mandatory for caterers to provide a nutrition kiosk staffed by a dietitian and POC labels in the dining hall of all OG events. However, evaluation of these services and the specific role that the dietitian plays in providing support to athletes in this environment is limited. Therefore the objectives of this thesis are to evaluate the nutrition support (the menu, nutrition kiosk and POC labels) provided to athletes at a major international competition (The Delhi 2010 Commonwealth Games), to investigate the role of the dietitian in providing these services, and to identify if these services are appropriate for the diversity of athletes present at this event.

The research objectives of this thesis were investigated through three publications. Publication one investigated athletes opinions of the food provision at the Delhi 2010 Commonwealth Games from a cultural and sporting perspective through the use of a dining hall questionnaire (n = 351). Overall the menu at this event appeared to be successful with the majority of athletes rating the qualities and availability highly.
However, athletes from Western regions and those competing in power/sprint sports were more critical of the menu. Requests were received for culturally suitable items, sports foods and snack items, suggesting that improvements could be made to the menu. The results of this study may assist caterers when preparing for similar events in the future.

Publication two also used data collected with the dining hall questionnaire to investigate athletes’ opinions and use of the Point of Choice (POC) nutrition labels provided in the main dining hall at this event. The majority of athletes surveyed reported that it was important/very important to provide POC labels with 59% rating the POC labels as useful/very useful in this environment. However, only 14% of athletes reported using the POC labels all of the time, with athletes from Africa and India and Sri Lanka reporting more frequent use. Athletes believed that the POC labels could be improved and provided suggestions based on improvements to the information provided, positioning in the dining hall and aesthetic qualities. The results of this study provide support for previous recommendations for the development and evaluation of a standardised POC label for OG and CG events.

Publication three investigated the services provided by dietitians at the Delhi 2010 Commonwealth Games main dining hall nutrition kiosk and the skills likely to be required to work in this environment through records of occasions of service from this event (n = 443). Data collected with the dining hall questionnaire on athletes’ opinions of the kiosk service was also in this publication to evaluate the use of the kiosk at this event, as well as data collected on previous source of nutrition information. Athletes from non-Western regions (particularly Africa, India and Sri Lanka, and the Caribbean), and those competing in weight category sports were more likely to request a consultation and advice regarding sports nutrition, while athletes from Western regions were more likely to have an enquiry regarding food service and special/therapeutic dietary requirements. Approximately one third of athletes reported no previous source of nutrition information. The results from this study suggest that dietitians working in this environment require knowledge and experience in sports and clinical nutrition, an understanding of cultural eating styles, food customs and beliefs, and of local food availability and large scale food service. The results of this study may assist both
dietitians and caterers to design more comprehensive nutrition kiosk services for similar events in the future.

While the menu and nutrition support services (both the nutrition kiosk and POC labels) were rated highly, and appeared to meet the requirements of the majority of athletes who took part in this research, there is scope to make improvements to both of these services. Dietitians play an important role in assisting caterers to design an adequate menu for OG and CG events. While a menu review process is mandatory for all OG events, a review of the menu for CG events is at the discretion of the event caterers. While the menu for the Delhi 2010 CG was reviewed prior to the start of the event, dietitians based at the kiosk were also able to provide feedback to the caterers during the competition. Menu qualities (e.g. variety, taste, temperature) appear to be rated highly at the events for which an evaluation is available, however it appears that caterers still need to focus on providing specific staple items to meet cultural requirements, particularly for athletes from Africa, the Caribbean, and South-East Asia and the Pacific Islands. Additionally, a larger variety of sports foods (e.g. energy bars and recovery foods), special dietary items (e.g. gluten free breads), snacks and desserts need to be considered when planning for future events.

It is evident that the nutrition support services (kiosk and POC labels) provided in the main dining hall of a major international competition are of value to athletes and officials, particularly those from non-Western regions, and that dietitians play an important role in assisting individuals within this environment. This research highlights the importance of providing these services, and that kiosk dietitians require a wide range of skills in order to assist athletes in this environment. This thesis also provides a number of recommendations that may be of use to caterers and dietitians involved in the food provision and nutrition support services at not only future OG and CG events, but other sporting events where large scale food provision is required. These recommendations include; the development of a comprehensive catering manual, development of a ‘nutrition support services welcome pack’, design and evaluation of a standardised POC label, development of culturally suitable resources for use at the nutrition kiosk and investigation into the potential use of technology (e.g. ‘apps’) to support athletes with food choice. Dietitians may also play an important role in promoting environmental sustainability at events in the future. Further research on the
dietary regimens followed by elite athletes, as well as athletes’ previous source of nutrition information and level of nutrition knowledge, may also assist caterers and dietitians with preparations for future events, particularly those that are scheduled to be held in non-Western regions. While the menu and nutrition support services have evolved at major international competitions, potential exists for dietitians to play an integral role in developing a more comprehensive menu and diverse forms of nutrition support, as well as addressing environmental sustainability in the future.
Declaration of originality

This Thesis is composed of my original work, and contains no material previously written or published by any other person except where due and proper reference has been made in the text. The content of my Thesis has not been submitted for a higher degree at any other university or institution.

I have clearly stated the contribution of others to my Thesis. Each publication is preceded by a statement disclosing the contribution of each author.

Sarah Burkhart

7th March, 2014
Acknowledgements

There are a number of people that I would like to thank for their assistance with this PhD. Firstly, my supervisor Dr. Fiona Pelly, thank you not only for the opportunity to travel to the Delhi CG and undertake my PhD in this unique area, but for the amazing support you have provided me over the past three years. Thank you for your optimism, enthusiasm and patience which made doing this PhD so enjoyable and rewarding.

Thank you also to the Delhi CG nutrition kiosk team of; Lydia Sutakowsky, Kerry Leech, Emilie Isles and Jasmine Ahuja for diligently collecting data at this event, and for making the trip to Delhi so memorable. I’m sure this is one trip that we will never forget! Of course this research would not be possible without all of the athletes who took the time to participate in this research. I would also like to thank the Delaware North Companies team, along with the team from TajSATS, who supported this research.

I would also like to thank the rest of the USC Nutrition and Dietetics team for your support and many laughs along the way. My fellow PhD students, thank you for always having an answer to my questions and making our room a great place to work. I would also like to thank the University of the Sunshine Coast, and the Australian Government for the scholarships that have allowed me to concentrate on this thesis.

Most importantly, I’d also like to thank my family. Mum and Dad, thank you for teaching me that anything is possible with a little hard work and for all of your support and encouragement, not only throughout this PhD but all of the education that came before this. Katie and Simon, and Jess and Reuben, thanks for always taking an interest in my research and reminding me that I was ‘almost there’. Lastly, I would also like to thank my husband Glenn, who not only was happy to pack up and shift countries so that I could do this PhD, but for all of your support, encouragement and enthusiasm along the way. I couldn’t have done it without you.
Table of Contents

Abstract ........................................................................................................................................... I
Declaration of originality ..................................................................................................................... V
Acknowledgements ............................................................................................................................. VII
Table of Contents ............................................................................................................................... IX
Lists of tables, illustrations and figures .......................................................................................... XIII
List of original publications ............................................................................................................... XV
Conference presentations ................................................................................................................... XVII
List of acronyms and abbreviations .................................................................................................. XIX

Chapter 1: Introduction .................................................................................................................... 1
  1.1. Literature review ..................................................................................................................... 1
  1.1.1. The role of nutrition in sports performance ...................................................................... 2
  1.1.2. Major international competitions ....................................................................................... 5
  1.1.3. The role of the dietitian in assisting with food provision .................................................. 11
  1.1.4. The requirement for nutrition support ............................................................................... 15
    1.1.4.1. The nutrition kiosk ....................................................................................................... 18
    1.1.4.2. Point of Choice nutrition labelling .............................................................................. 20
    1.1.4.3. Other forms of nutrition support used at OG and CG events .................................... 23
  1.1.5. Overall summary and conclusions ..................................................................................... 24
  1.2. Research objectives ............................................................................................................... 26
  1.3. Research methodology ........................................................................................................... 28
    1.3.1. Research methodology ................................................................................................... 28
    1.3.2. The event ......................................................................................................................... 28
    1.3.3. The three stages of methods ............................................................................................ 31
      1.3.3.1. Stage One: Preparation for the event ...................................................................... 31
      1.3.3.2. Stage Two: Data collection during the event ........................................................... 35
      1.3.3.3. Data collection tools ................................................................................................. 35
      1.3.3.4. Study sample ............................................................................................................ 36
      1.3.3.5. Data collection methods .......................................................................................... 36
1.3.3.6. Stage Three: Collation of data......................................................... 37
1.4. Thesis orientation................................................................................... 38

Chapter 2: Athletes’ Opinions of Food Provision at the 2010 Delhi Commonwealth Games: The Influence of Culture and Sport ........................................ 39
2.1. Introduction to the Chapter...................................................................... 40
2.2. Authors declaration.................................................................................. 40
Introduction........................................................................................................ 41
Methods........................................................................................................... 44
Results.............................................................................................................. 47
Discussion......................................................................................................... 55
Future Research................................................................................................. 60
Limitations......................................................................................................... 61
Conclusions....................................................................................................... 61
References......................................................................................................... 63

Chapter 3: Athletes use and opinion of point of choice nutrition labels in a dining hall environment at a major international competition...................................... 67
3.1. Introduction to the Chapter...................................................................... 68
3.2. Authors declaration.................................................................................. 68
Abstract............................................................................................................ 69
Introduction........................................................................................................ 69
Methods............................................................................................................ 72
Results.............................................................................................................. 76
Discussion......................................................................................................... 80
Limitations......................................................................................................... 84
Future directions............................................................................................... 85
Conclusions....................................................................................................... 85
References......................................................................................................... 87


| Chapter 4: Beyond sports nutrition: The diverse role of dietitians at the Delhi 2010 Commonwealth Games | 91 |
| 4.1. Introduction to the Chapter | 92 |
| 4.2. Authors declaration | 92 |
| Abstract | 93 |
| Introduction | 94 |
| Materials and methods | 96 |
| Results | 98 |
| Discussion | 102 |
| Conclusions | 107 |
| Future directions | 107 |
| References | 108 |

| Chapter 5: Discussion and Recommendations | 111 |
| 5.1. Overview of findings | 111 |
| 5.2. The menu | 112 |
| 5.2.1. Providing a menu that meets specific requirements | 114 |
| 5.2.2. Summary of menu evaluation findings and potential outcomes | 117 |
| 5.3. Nutrition Support Services | 118 |
| 5.3.1. Reasons for seeking support | 121 |
| 5.3.2. Non-use of nutrition support services | 123 |
| 5.3.3. Nutrition support services in the future | 125 |
| 5.3.4. Summary of nutrition support services and potential outcomes | 127 |
| 5.4. Further opportunities for dietitians at major international events | 128 |
| 5.5. Directions for future research | 130 |
| 5.5.1. Summary of the directions for future research | 130 |
| 5.6. Limitations of the studies | 132 |
| 5.6.1. Summary of the limitations of the thesis | 132 |
| 5.7. Recommendations for the future | 134 |
| 5.8. Summary | 136 |
| References | 138 |
Appendices................................................................................................................................. 147
Appendix 1: The dining hall questionnaire.............................................................................. 149
Appendix 2: Kiosk enquiry form ............................................................................................ 157
Appendix 3: Kiosk consultation form ..................................................................................... 161
Appendix 4: Research information sheet ................................................................................ 171
Appendix 5: Related publication not included in the body of the thesis ......................... 177
Appendix 6: Other relevant results not yet published....................................................... 199
Lists of tables, illustrations and figures

Chapter 1:

Figure 1: An overview of the three stages of used in the methods of this thesis.... ..20
Figure 2: The entrance to the main dining hall with residential towers in the background................................................................. 32
Figure 3: Behind the scenes: Local staff clean and prepare for meal service........ ...33
Figure 4: Athletes dining in the main dining hall with buffet stations in the background................................................................. 33
Figure 5: Nutrition kiosk staff providing assistance to athletes in the main dining hall ................................................................. 34
Figure 6: A selection of items with POC labels................................................. 34

Chapter 2:

Table 1: Classification of sport based on physiological requirements. ................. 46
Table 2: Classification of country based on location and cultural style of eating.... 47
Table 3: Characteristics of athletes who returned a completed dining hall questionnaire................................................................. 49
Table 4: Mean scores and ANCOVA for opinion of food and beverage provision in main dining hall for region and sports category................................. 50
Table 5: Athletes’ Suggested Inclusions for the Menu at the 2010 Delhi Commonwealth Games .................................................................52
Table 6: Mean Scores and ANCOVA for Opinion of Availability of Nutrient-Based and Special-Diet Items on the Menu in the Main Dining Hall for Region and Sports Category................................................................. 54
Table 7: Suggested Improvements to the Provision of Items to meet Cultural, Sporting, and Special Dietary Needs ................................................................. 62

Figure 1: Significant associations between region and opinion of freshness, cultural requirements, menu variety, and temperature................................. 51
Figure 2: Significant associations between sport category and opinion of cultural requirements, menu variety, and temperature................................. 53
Figure 3: Significant associations between region and availability of high-carbohydrate, low-fat, and gluten-free items and sports foods. .......................... 54
Figure 4: Significant associations between sports category and availability of high-carbohydrate items, sports foods, and gluten-free items. ......................... 55

Chapter 3:
Figure 1: A template of the POC label layout used at the Delhi Commonwealth Games................................................................. 72
Figure 2: Frequency of POC label use and opinion of usefulness by region......... 78
Table 1: Participant characteristics .......................................................... 79
Table 2: Athletes’ suggested changes to POC nutrition labels............................. 80
Figure 3. Example of POC label content from the Delhi Commonwealth Games and other previous Commonwealth and Olympic Games. ......................... 86

Chapter 4:
Table 1: Number of occasions of service from athletes and officials at the nutrition kiosk .......................................................... 99
Table 2: Athletes source of nutrition information ......................................... 102
Figure 1: Number and type of occasions of service at the nutrition kiosk over the Commonwealth Games period .................................................... 100
Figure 2: Reason for consultation at the nutrition kiosk by athletes and officials... 104
List of original publications

Published articles:


Related publications not included in the body of this thesis

Conference presentations

*American College of Sports Medicine, Denver Colorado, USA,*


*Exercise and Sports Science Australia Conference and Sports Dietitians Update, Gold Coast Australia, April 19th, 2012.*


*Dietitians Association of Australia Conference, Canberra Australia, 23rd – 25th May, 2013.*


**Accepted for presentation:**

*Dietitians Association of Australia Conference, Brisbane, May 17th, 2014.*


*American College of Sports Medicine, Orlando Florida, USA, May 29th 2014.*

# List of acronyms and abbreviations

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
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<tbody>
<tr>
<td>AOC</td>
<td>Australian Olympic Committee</td>
</tr>
<tr>
<td>APD</td>
<td>Accredited Practicing Dietitian</td>
</tr>
<tr>
<td>BM</td>
<td>Body mass</td>
</tr>
<tr>
<td>CFG</td>
<td>Commonwealth Games Federation</td>
</tr>
<tr>
<td>CG</td>
<td>Commonwealth Games</td>
</tr>
<tr>
<td>DAA</td>
<td>Dietitians Association of Australia</td>
</tr>
<tr>
<td>DNC</td>
<td>Delaware North Companies</td>
</tr>
<tr>
<td>EAD</td>
<td>Elite athletes with a disability</td>
</tr>
<tr>
<td>g</td>
<td>Grams</td>
</tr>
<tr>
<td>g.kg.−1</td>
<td>Grams per kilogram of body mass per day</td>
</tr>
<tr>
<td>IOC</td>
<td>International Olympic Committee</td>
</tr>
<tr>
<td>Kg</td>
<td>Kilogram</td>
</tr>
<tr>
<td>kJ</td>
<td>Kilojoule</td>
</tr>
<tr>
<td>Km</td>
<td>Kilometre</td>
</tr>
<tr>
<td>NSWIS</td>
<td>New South Wales Institute of Sport</td>
</tr>
<tr>
<td>OC</td>
<td>Organising Committee</td>
</tr>
<tr>
<td>OCCG</td>
<td>Organising Committee of the Commonwealth Games</td>
</tr>
<tr>
<td>OCOG</td>
<td>Organising Committee of the Olympic Games</td>
</tr>
<tr>
<td>OG</td>
<td>Olympic Games</td>
</tr>
<tr>
<td>PINES</td>
<td>Professionals in Nutrition for Exercise and Sport</td>
</tr>
<tr>
<td>POC</td>
<td>Point of choice</td>
</tr>
<tr>
<td>SDA</td>
<td>Sports Dietitians Australia</td>
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</table>
SSL  Spotless Services Limited
TE   Total energy
Chapter 1: Introduction

This thesis investigates the nutrition support provided to athletes at a major international competition (The Delhi 2010 Commonwealth Games), the role of the sports dietitian in providing these services, and if these services are appropriate for the diversity of athletes present at this event. This is investigated through three studies which have been published in peer-reviewed journals. The introduction provides a background to the thesis with a literature review of this topic (Section 1.1). Sections 1.2 – 1.4 identify the thesis objectives, describe the overall research methodology, and provide a description of the thesis orientation. Chapters 2 – 4 contain the three thesis publications. The thesis discussion, limitations and recommendations are presented in Chapter 5.

1.1. Literature review

There is a consensus that dietary intake can play an important role in athletic performance (IOC, 2011; Rodriguez, DiMarco, & Langley, 2009), however while evidence based guidelines are available for athletes, this does not guarantee that an athlete will choose the food most appropriate for their specific needs. This may be for a number of reasons including limited availability of suitable items in the immediate environment, a lack of knowledge or assistance to help with food choice, or other factors such as religious, cultural or personal food preferences. In the dining hall of a major international competition, for example the Olympic (OG) or Commonwealth (CG) Games, food choice may be even more challenging for the athlete. In order to assist athletes, nutrition support at these events generally includes the provision of appropriate food, availability of a dietitian in the dining hall and some form of nutrition information for menu items. The aim of this literature review is to discuss the role of dietitians in the evolution of food provision (with a focus on menu development), and nutrition support services at major international competitions, in particular the CG.

The first section of the literature review focuses on the role of nutrition on athletic performance and the main limitations to meeting evidence based recommendations, in particular access to appropriate items (Section 1.1.1). Section
1.1.2 introduces the dining hall environment of a major international competition (e.g. the CG and OG) and discusses the challenges of catering for a diverse group of athletes. The role of the dietitian in assisting with food provision in this environment is reviewed in Section 1.1.3. The requirement for nutrition support services at OG and CG events is discussed in Section 1.1.4, with a focus on the nutrition kiosk (Section 1.1.4.1) and Point of Choice (POC) nutrition labels (Section 1.1.4.2). Other methods of nutrition support (website) are discussed in Section 1.1.4.3, while Section 1.1.5 provides an overall summary of the literature review.

1.1.1. The role of nutrition in sports performance

Over the past century research has clearly demonstrated the importance of appropriate nutrition on athletic performance (Bergstrom & Hultman, 1967; Bonen, Malcolm, Kilgour, MacIntyre, & Belcastro, 1981; Coggan & Coyle, 1991; Coyle, Coggan, Hemmert, & Ivy, 1986; Felig, Cherif, Minagawa, & Wahren, 1982; Ivy, Costill, Fink, & Lower, 1979; Krogh & Lindhard, 1920; Levine, Gordon, & Derick, 1924). This has led to a number of published consensus statements on nutrition strategies for training, pre-competition, competition and recovery nutrition. These include the Position Statement of the American Dietetic Association, Dietitians of Canada, and the American College of Sports Medicine: Nutrition and Athletic Performance (Rodriquez, et al., 2009), and the International Olympic Committee (IOC) Consensus Statement on Sports Nutrition 2010 (IOC, 2011). The recent IOC Consensus Statement on Sports Nutrition states that athletes should ‘adopt specific nutritional strategies before, during and after training and competition to maximise their mental and physical performance’ (IOC, 2011). These specific strategies include daily recommendations for the consumption, and timing of the macronutrients; carbohydrate, protein, and fat as well as fluid, and are usually expressed as either a percentage of total energy intake or as a measure of grams (g) per kilogram (kg) of body mass (BM).

Current consensus in regards to nutrition and athletic performance recommends athletes consume 3 – 12 grams (g) of carbohydrate, and 1.2 – 1.7g of protein per kg of BM per day (g.kg.⁻¹), depending on sport category and training phase (Burke, Hawley,
Different sports have varied physiological requirements, and therefore recommendations are sport dependent. For example, an endurance athlete is advised to consume an amount of carbohydrate at the higher end of this recommendation because of the intensity and duration associated with training and competition, whereas an athlete from a skill based sport would need less (Burke, et al., 2011). The higher recommendation of carbohydrate assists the endurance athlete to maintain blood glucose levels while training, and replace muscle glycogen after training sessions (IOC, 2011; Rodriquez, et al., 2009). Recommendations for carbohydrate intake for strength and power athletes are less than that for an endurance athlete, however it is recommended these athletes consume an amount of protein equal to the upper range of the protein recommendation (Phillips & Van Loon, 2011; Rodriquez, et al., 2009; Slater & Phillips, 2011), as protein may assist with maximising protein synthesis and skeletal hypertrophy in athletes undertaking strength training (Phillips, 2004; Slater & Phillips, 2011).

Athletes are also recommended to follow the general guidelines for fat consumption, with fat contributing a total of 20 – 35% of total energy (TE), while the proportion of energy should be evenly distributed between saturated fat (10%), monounsaturated fat (10%) and polyunsaturated fat (10%) (Rodriquez, et al., 2009). Athletes must be mindful to consume the recommended amount of fat as this macronutrient plays an important role in cellular membrane function and hormone synthesis, is an energy source and acts as an aid for the absorption of fat soluble vitamins (e.g. Vitamin D) (IOC, 2011; Stellingwerff, Maughan, & Burke, 2011) and is therefore an essential part of the athletes diet. However, athletes also need to be careful not to consume too much fat, as this may make it more difficult for the athlete to maintain an appropriate body composition (Melby & Hill, 1999), due to the high energy density of this macronutrient. Additionally, a high consumption of fat, particularly saturated fat has been linked to other health conditions (National Heart Foundation of Australia and the Cardiac Society of Australia and New Zealand, 2012). Recommendations for hydration are important to prevent premature fatigue, particularly in hot or humid environments where fluid requirements are increased (IOC, 2011). These recommendations are also dependent on
the training load of the athlete with lower intakes required during rest or periods of low training load (Burke, et al., 2011).

While these general guidelines provide recommendations on daily dietary intake for training, they also provide important information regarding eating and drinking for competition. Specific recommendations regarding intake prior to an event (both in regards to the amount and timing), as well as what the athlete should be eating and drinking during, and directly after competition are more important to the competing athlete. Consequently, guidelines are available for pre, during and recovery (Burke, et al., 2011; Burke, et al., 2007; IOC, 2011; Jeukendrup, 2011; Rodriguez, et al., 2009; Slater & Phillips, 2011; Stellingwerff, et al., 2007; Tipton, et al., 2007). However, these do vary based on the intensity, duration and scheduling of the event. For example athletes competing in events of short duration (< 45 minutes) do not require carbohydrate during this time, however athletes competing in high intensity sustained exercise over a duration of 45 – 75 minutes should aim to consume small amounts of carbohydrate (including mouth rinsing with a carbohydrate solution) (Burke, et al., 2011). Endurance athletes and those who take part in sports that are 1 – 2.5 hours in duration are advised to consume 30 – 60g carbohydrate per hour, while athletes who compete in events greater than 2.5 hours in duration (ultra-endurance events) are recommended to consume up to 90 grams of carbohydrate per hour to assist with athletic performance (Burke, et al., 2011). Athletes competing in endurance events greater than 90 minutes in duration may also choose to super compensate muscle glycogen stores in preparation for their event as this may assist with preventing fatigue (Hawley, Schabort, Noakes, & Dennis, 1997). These may be achieved by consuming a greater amount of carbohydrate over the 24 – 72 hours prior to an event, in conjunction with rest (Burke, et al., 2011).

While evidence based recommendations are available, the athlete requires access to appropriate food and fluid in order to meet their specific requirements. While it may be relatively easy for the athlete to identify and locate appropriate food in their home environment, travelling and living away from home may make appropriate food choice more difficult. At home, an athlete may play an important role in food procurement and preparation. Consequently this may allow the athlete more control over food choice. The athlete may have access to familiar or favourite foods and is likely to be familiar
with the nutrition information provided on items (e.g. nutrition information panels on packaged food). Alternatively, if an athlete attends a competition away from home they may experience significant challenges in choosing appropriate foods, particularly if they have to choose from a fixed selection of foods, and if the nutrition information provided for, or on each item is different. It is possible that many of the foods that the athlete may have access to may be unfamiliar and may be labelled in a different language. The athlete may also find that staple food items may vary. For example, in Asia rice is considered a staple carbohydrate food, while in regions of Africa this may be Ugali, and in the Pacific Islands this is typically taro (Kittler, Sucher, & Nahikian-Nelms, 2012). Protein based foods may also vary. While some regions may traditionally consume a diet based on a particular meat (e.g. beef and lamb in Australia), other nations may rely more on more plant based forms of protein or different meats (e.g. a reliance on soybean and fish products in Japan) (Kittler, et al., 2012). While many athletes regularly travel to compete, one of the most unique travel experiences an athlete may have is that of the Commonwealth (CG) or Olympic (OG) Games where athletes live in a large village environment and eat in a communal dining hall.

1.1.2. Major international competitions

The opportunity to compete against elite athletes from a range of nations means that for many athletes both the OG and CG may be considered their pinnacle of athletic competition. While still a major event on the athletic calendar, the CG vary in comparison to the OGs. They are held every 4 years (biennially from the OG) and are only open to residents from nations of the British Commonwealth. The British Commonwealth is a voluntary association of 53 independent sovereign states, headed by Her Majesty Queen Elizabeth II (Commonwealth Games Federation [CGF], 2013a; The Commonwealth, 2014). The first CG was held in 1930 in Hamilton, Canada with a total of 400 athletes from 11 nations competing in 6 sports and 59 events (CGF, 2013b). At the original CG, athletes were able to compete in athletics, aquatics (diving and swimming), lawn bowls, wrestling, rowing and boxing (CGF, 2013b). While the number of sports and events increased up until the Victoria 1996 CG (to 10 sports and 217 events), only single events (no team sports) were included on the sports program.
(CGF, 2013b). However, at the Kuala Lumpur 1998 CG cricket, netball, hockey and rugby 7’s were introduced (CGF, 2013b). Host nations of the CG must now include 10 core sports and up to 7 optional sports (from a predetermined list) (CGF, 2013c). Since the inception of the CG the number of nations, and athletes participating at this event has also increased. Prior to the Manchester 2002 CG only able bodied athletes were able to participate in the CG, however, the program for this event was designed to include elite athletes with a disability (EAD). Consequently, EAD athletes from 20 nations participated in 5 sports (10 events) at the Manchester 2002 CG (CGF, 2013c). It is estimated that 6500 athletes from 70 nations will compete in 17 sports at the upcoming Glasgow 2014 CG and that EAD athletes will be able to participate in no more than 20 events (CGF, 2013d).

The CG are organised and delivered in a similar way to the OG, however there are differences in the scale of these events. Like the OG, a different host nation is appointed for each CG event. As this only includes nations within the British Commonwealth, some CG events are likely to be held in smaller and/or less developed regions (e.g. Kingston, Jamaica and Delhi, India). These may include countries where food safety and security may be of more concern. Another difference between the CG and OG is the number of athletes and nations who attend the event. Only the nations of the Commonwealth are eligible to send athletes to the CG, however any nation can send athletes to the OG. For example, athletes from 70 nations will compete at the Glasgow 2014 CG, while at the London 2012 OG approximately 10,500 athletes from 204 nations competed in 26 sports events (IOC, 2013). Not all athletes who compete at the CG may compete at the OG. For example, while a number of countries may compete under one nation at the OG, these nations may compete as distinct countries at the CG. In this case, athletes for example, from Jersey, Gibraltar and the Isle of Man compete for their country at the CG, but are part of the Great Britain team at the OG. This may mean that some athletes may be able to qualify for the CG as the pool of athletes is smaller, however may not qualify for the OG where selection is made from a larger pool of athletes. As the CG event is also smaller, it may be easier for poorer nations to send a larger team of athletes, who otherwise would not be able to compete at the OG. This highlights that while some athletes may attend both the CG and OG, some athletes may
only be able to attend the CG, and therefore the group of athletes at these events may differ.

Due to the smaller number of athletes the CG is also run over a shorter period than the OG (~11 days vs. ~16 days) (Australian Commonwealth Games Association, 2012). While both the CG and OG offer EAD events, athletes compete in a fully inclusive schedule with able bodied athletes at the CG, while the Paralympics follow the completion of the OG. This means that at the CG EAD athletes are based in the athletes’ village at the same time as able bodied athletes. The number and type of sports events also differ between the CG and OG. While 17 sports are included on any one CG program, 26 sports are on offer at the OG (CFG, 2013C; IOC, 2013). Sports which are more likely to be played in nations of the British Commonwealth are included on the CG program, including sports such as netball, squash, lawn bowls and tenpin bowling, which are not offered at the OG (CFG, 2013C).

At the CG and OG an overarching Organising Committee (OC) is responsible for the organisation and delivery of the event, including the athletes’ village which accommodates all athletes and their support teams over the duration of the event. At both the CG and OG, the majority of athletes are now housed in the purpose built athletes village. This village contains accommodation facilities for athletes and officials (for example; coaches, managers and doctors), as well as the amenities that may be required over the duration of their stay, which may be up to 6 weeks in duration. This includes a main dining hall, which is the primary dining venue. Additionally, post and souvenir shops, internet facilities, and social or common areas are usually available within the village (Glasgow 2014 Ltd.; OCCG Delhi, 2013). At OG events ‘casual’ dining areas, and ‘street carts or street stalls’ may also be available to the athlete (Pelly, Meyer, Pearce, Burke, & Burkhart, *In press*).

One way of providing nutrition support to athletes in this unique environment is to provide food onsite in the main dining hall. Information regarding the athletes’ village and food provision at the CG is extremely limited. It has been reported that the first athletes’ village at the Edmonton 1930 CG was a nearby school where approximately 24 athletes slept in each classroom (CGA Jersey, 2012). However, there is no information available on food provision at this event or the village set up until more recent events. At the Manchester 2002 CG caterers Sodexho Prestige were
responsible for providing food in the main dining hall. The caterers reported using ~7,000 kg rice, 8,000 kg pasta, 8,600 kg beef, 90,000 eggs, 25,000 kg cheese and 75,000 loaves of bread, amongst other foods to create 300,000 meals over the games period (OCCG Manchester, n.d). A total of 10 main meals were available at each meal period (OCCG Manchester, n.d). These meals were carefully designed with the aim of satisfying the diverse requirements of the athletes at this event (OCCG Manchester, n.d), however no evaluation of the food provision is available.

At the Melbourne 2006 CG, the main dining hall seated ~1800 individuals, and was expected to provide ~20,000 meals per day (MCGC, 2003-2006). While Delaware North Companies (DNC) catered for the main dining hall (Dr. Fiona Pelly, personal communication, 1st March, 2014), there is limited information available on the food provision at this event. While Pelly and colleagues reported on the nutrition support services and factors influencing food choice in this environment (Pelly, Inge, King, & O’Connor, 2006a; Pelly, King, & O’Connor, 2006b), there is no published information available on the number of total meals, nor the menu that was provided.

However, more information is available on the athletes’ village and food provision at the OG. The history of food provision in the dining hall of the OG up to and including the Sydney 2000 OG has been extensively reviewed in Pelly (2007). Prior to the Los Angeles 1932 OG, athletes and members of their support team were either housed in their own home (if the event was held in their home nation), on the ships that they travelled to the event on, or within schools, boarding houses and hotels (Pelly, O’Connor, Denyer, & Caterson, 2011). The first athletes village was introduced at the Los Angeles OG in 1932, and gradually changes have been made to the athletes village and the dining hall set up in order to cater for the increase in number of athletes attending these events (Pelly, 2007; Pelly, et al., 2011). In line with the developments to the dining hall, changes have been seen in the food provision at these events. While there was a focus on providing high protein menu items until the late 1960’s, developments in research on the effect of carbohydrate on performance led to the appearance of more high carbohydrate foods being available (Pelly, et al., 2011).

In order to cater for the diverse dietary needs of athletes in this environment, the OC of the event appoints a food service provider/caterer through a tender process. This tender process is highly competitive and consequently limited details are available on
Chapter 1: Introduction

this process (Pelly, et al., 2011). Catering for a CG or OG is a significant undertaking. Caterers at the CG have reported preparing up to 2000 meals an hour (OCCG Manchester, n.d) or ~20,000 meals a day (MCGC, 2003-2006), while at the OG up to 63,000 meals a day may be produced (Pelly, et al., 2011), on a 5 – 10 rotational menu, over the course of up to 6 weeks (Pelly, et al., 2011). As the dining hall is often the athletes’ sole or main source of food and beverage items, caterers have a responsibility to provide suitable items of high quality for both the athletes and officials living in the village.

At recent events, the athletes village main dining hall at both CG and OG events has been a temporary structure that provides seating for approximately 1800 – 2300 (CG) (MCGC, 2003-2006; OCGC Delhi, 2010) or 3500 - 4000 (OG) individuals (Pelly, et al., 2011). Large buffet stations set up around the main dining hall offer foods from a number of regions, usually within distinct meal periods (breakfast, lunch, dinner and supper), with a focus on the cuisine of the host nation (Pelly, et al., 2011). The main dining hall is usually open 24 hours a day over the competition period at both CG and OG events (Pelly, et al., 2011), and is unique in that a diverse range of athletes from various regions and sports choose from the same foods and dine in a large scale communal area.

Caterers may face a number of significant challenges when developing a menu for a CG or OG. These include being able to provide items to meet cultural, sporting and special dietary requirements, but also ensuring that the food provided is acceptable in terms of taste, visual appearance, freshness, temperature and smell (Pelly, 2007; Pelly, et al., 2011). This may be difficult in regions where the food supply may be limited, for example in some non-Western regions where items for special dietary requirements (e.g. gluten free) may be difficult to source, or the infrastructure is limited (e.g. the distance some foods may have to travel and the availability of refrigerated transport). While the menu is planned ahead of the event, substitute items may be required on the menu if there are limitations in the food supply. Food must also be available 24 hours a day for the athlete who may arrive back in the village late after travelling for training or competition. Caterers may also have to include a number of items based on sponsorship requirements and work within a set budget (Pelly, 2007; Pelly, et al., 2011). While caterers have extensive experience in the logistics of supplying food to a large number
of individuals, they may not have knowledge regarding the suitability of particular items for various cultural, religious, sporting and therapeutic requirements.

As detailed in Section 1.1.1., appropriate food and fluid can play an important role in athletic performance. There is potential for an athlete’s performance to be compromised if appropriate food is not available or the athlete cannot locate it. For example, a weight category athlete (e.g. a boxer, weightlifter or wrestler who is required to be a certain weight or below in order to compete in their event) may find it difficult to make weight as low energy and/or low residue foods are not available or difficult to locate. Ultimately, a weight category athlete may not be allowed to compete if they cannot make weight for their entered category. Additionally, an athlete aiming to increase consumption of carbohydrate prior to competition (e.g. events greater than 90 minutes such as the marathon) may not be able to do this if high carbohydrate foods are not available or clearly identified.

While it is evident that athletes have specific sports related dietary requirements, they may also have clinical or therapeutic conditions, or personal preferences that can influence food choice and dietary intake. Clinical conditions can impact on what an athlete can consume and may include allergy and intolerance, diabetes, cardiovascular disease and gastrointestinal conditions or diseases, among others. There are potentially serious health implications for an individual with clinical or therapeutic conditions who is not able to source information and appropriate food. For example, an athlete with a nut allergy must be able to identify suitable nut-free items and may need assistance to do this, especially if the majority of the food (and names of the food) are unfamiliar to the athlete. The consequences of consuming a food containing nuts could be life-threatening to the athlete. Similarly, an athlete who has Coeliac disease (a permanent inflammatory disease of the small intestine triggered by the ingestion of gluten-containing cereals in genetically predisposed individuals’ [Cataldo & Montalto, 2007]) may experience severe symptoms without access to gluten free items. An individual with Coeliac disease must have access to, and be able to identify gluten free items. Athletes may also have personal preferences regarding what they choose to eat. These preferences are not based on a clinical condition, but athletes may still avoid certain food items for various reasons (e.g. avoiding meat or animal products). While the consequences of consuming a particular food (e.g. meat) may not be life threatening to
the athlete with personal preferences, athletes should still be able to access foods to meet their requirements. A change in the type of food that an athlete consumes, or in portion size has the potential to lead to gastric upsets (Grandjean & Rudd, 2008), which may in turn affect performance. One way of assisting caterers to provide a menu that caters for a diverse group of athletes is to include the services of a dietitian.

1.1.3. The role of the dietitian in assisting with food provision

Dietitians are University educated health professionals who “apply the art and science of human nutrition to help people understand the relationship between food and health and make dietary choices to attain and maintain health, and to prevent and treat illness and disease” (Dietitians Association of Australia, [DAA] 2014). The unique skill set of the dietitian makes them well-placed to assist in the environment of a CG or OG. To date dietitians have been involved with supporting athletes at the CG and OG in a number of different ways including with food provision (particularly menu design) and nutrition support services (Benardot, Berning, Clark, Dugan, Rosenbloom, & DuEST, 1996; Burke, 2009; Pelly, 2007; Pelly, et al., 2006a; Pelly, O’Connor, Denyer, & Caterson, 2009; Pelly, et al., 2011). While health, disease and food have been linked since the early writings of Hippocrates, Plato and Galen (Hwalla & Koleilat, 2004), it was not until the mid-eighteenth century that the term ‘dietitian’ was first used in the USA (Capra, 2012). The profession has grown since this time with a reported 3593 registered dietitians working in Australia in 2012 (DAA, 2012), while approximately 72% of the 75,067 members of the Academy of Nutrition and Dietetics are registered dietitians in the United States of America (Academy of Nutrition & Dietetics, 2014).

Dietitians can work in a variety of settings, with the most common clinical, food service and community and public health. However, as research on the effect of food and beverage on athletic performance has advanced, the field of sports nutrition has evolved. An interest in sports nutrition has led to the development of sports dietetics, and the formation of specialist organisations such as Sports Dietitians Australia (SDA), special interest groups within dietetic organisations, and the international organisation Professionals in Nutrition for Exercise and Sport (PINES) organisation. These organisations and groups have evolved to encourage collaboration between nutrition
professionals working with athletes, to provide information on up skilling and resources, and to encourage excellence in practice (SDA, 2014; PINES, 2014). Consequently, dietitians involved in these organisations tend to have solid general dietetic skills, as well as expertise and experience in sports nutrition.

While the food provision at an OG or CG has to fit within the means of the catering company (budget, facilities available, chef level of skill etc.), a dietitian can suggest improvements to the menu to ensure that athletes can find items to suit cultural requirements (e.g. staple carbohydrate items), sporting requirements (e.g. someone trying to make weight before an event, or an athlete aiming to CHO load), personal requirements (e.g. meat avoidance or religious dietary regimens) and special dietary requirements (e.g. Coeliac or nut allergy). The dietitian is also able to provide advice on menu items that can be used to suit the varied requirements of athletes, and to suggest alternatives when an event is held in a non-Western region.

It is difficult to ascertain when dietitians first became involved in the food provision at OG and CG events. The involvement of dietary specialists was recommended after the Los Angeles 1984 OG after complaints regarding the lack of suitable menu items (low fat items) were reported (Los Angeles Olympic Organising Committee, 1985). While there are reports of nutrition information being available at the Barcelona 1992 OG there is no detail available on dietetic involvement with food provision at this event or at the Atlanta 1996 OG. Subsequently reports from the Atlanta 1996 OG suggest that the menu still did not cater for some athletes (Grundy, 1996; Hula, 1997).

In preparation for the Sydney 2000 OG a head food service dietitian (Dr. Fiona Pelly) was recruited to work with the caterers Aramark Corporation and Spotless Services Limited (SSL) (Pelly, 2007). The main aim of the catering program at this event was to ‘develop a nutritionally balanced menu to support the psychological, physical and performance requirements of athletes and the village community with a focus on nutrition, variety, flexibility, access and the appeal of an appropriate mix of Australian and International influences’ (Pelly, 2007). In order to assist with the development of a comprehensive menu, the head food service dietitian investigated the likely daily energy requirements of athletes in this environment, the food preferences of athletes and specific cultural groups, and obtained feedback on the proposed menu.
The daily energy requirements of the athletes were estimated in order to provide an indication of food production quantities required at this event. A survey of the food preferences of a group of Australian athletes (n = 105) was also conducted in order to identify current food trends within the Australian athletic population. Additionally, items were trialled at sporting camps with athletes from the New South Wales Institute of Sport (NSWIS), and interviews used to obtain feedback on the proposed menu items. Furthermore, based on previous reports of inadequate representation of African and Eastern European items on the menu at OG events, a report on the food preferences of these groups was prepared based on an extensive review of available information sources (books, internet, articles) and through interviews with migrants from these nations (Pelly, 2007). This assisted with the development of a 10 day rotational menu which was then reviewed by a panel of expert sports dietitians. The results of this survey indicated that further improvements should be made to the menu, however not all of these suggested improvements were included (Pelly, 2007). The final menu for this event included 1500 items that were either available every day (not rotated), rotated daily (but available all day) or rotated over the 10 day period (but only available at a specific meal period) (Pelly, 2007). Consequently an evaluation of the menu at this event found that athletes rated the menu qualities highly (taste, temperature, freshness and portion size) and that there was sufficient variety of vegetables/salad, pasta/rice meals, snack foods and low fat items available (Pelly, 2007). However, athletes were not asked to rate the availability of items that may be required for special/therapeutic requirements (e.g. the availability of gluten free items), personal preferences (e.g. the availability of vegetarian items) or sports specific requirements (e.g. the availability of high carbohydrate items), which limited the evaluation of the menu at this event.

Assisting with the development of the menu at this event formed part of Dr. Pelly’s PhD and resulted in a number of publications (Pelly, 2000, 2007; Pelly, et al., 2009; Pelly, et al., 2011), and subsequent research at the Melbourne 2006 CG (Pelly, et al., 2006a; Pelly, 2010; Pelly, et al., 2006b). Unfortunately, apart from the research undertaken by Dr. Pelly, there is little published information available on the food provision at these types of events. As the host nation, and therefore the OC and caterers can change between events, it is difficult to regularly collect data in this environment.
There is a comprehensive process that is required for dietitians to work alongside the caterers, including obtaining approval for research, accreditation for entry to the village and having enough staff to work at the kiosk (an area in the dining hall where dietitians are based to assist athletes and officials), and collect data. It may also be difficult to establish a relationship and have the opportunity to collect data when the catering company can change between CG and OG events. However, if a good relationship can be established with the catering company this can lead to further opportunities at OG and CG events. For example, after the Sydney 2000 OG, Dr Pelly was invited as a consultant to manage the nutrition services at the Melbourne 2006 CG, and was able to conduct research at this event. Consequently, when the same caterers were awarded the tender for the Delhi 2010 CG, Dr Pelly was again asked as a consultant to manage these services, providing the opportunity to conduct research at this event. However, even if a relationship is established with the caterer, the professional focus of the head food service dietitian is likely to dictate if data is collected and then published. While the information available in this area is somewhat limited, the research published by Dr Pelly to date has led to significant changes regarding the food provision at OG events.

Based on the outcomes of the catering program at the Sydney 2000 OG event, in 2007 the International Olympic Committee mandated the use of a registered dietitian to review the menu for the Beijing 2008 OG (Pelly, et al., 2011). This review process is now in place for all Summer and Winter OG events (Pelly, et al., 2011) and provides a valuable service for the caterers for each event. For example, as part of the expert review of the menu for the Beijing 2008 OG by the PINES International Sports Nutrition and Catering Working Group, a lack of adequate allergen-free menu items, snack/sports bars, meal replacement drinks and low fat and low sodium options was reported (Pelly, et al., 2011). This provided feedback on the proposed menu to the caterers, and allowed for improvements to be made prior to the event. Unfortunately no literature assessing the overall food provision at this event and the extent of how the review process assisted the caterers is available. Currently there is no formal menu review process for the CG, however the caterers for these events can consult a dietitian to review the menu at their discretion. This review process was undertaken at the Melbourne 2006 CG, where Dr Pelly performed the original review and then organised for key SDA members to provide comment on this menu. Dr Pelly then provided
caterers with feedback on improvements prior to the event (Dr. Fiona Pelly, personal communication, March 1st, 2014).

In addition to assisting caterers with food provision at these events, dietitians have also played an important role in developing the nutrition support services provided at these events. It is important to note however that the support provided may vary depending on the level of dietetic involvement, as can the evaluation of services. As noted earlier in this section, research in this area is extremely limited, however as Dr. Pelly was also involved in the development of the nutrition support services at the Sydney 2000 OG and the Melbourne 2006 CG, some published literature is available. This research provides some information on who is likely to require assistance, and for what reason in the main dining hall, and provides some evaluation of the nutrition support services.

1.1.4. The requirement for nutrition support

In the unique environment of an OG or CG dining hall some athletes may require assistance in order to make an appropriate food choice. While it is important to provide a wide variety of items to meet the diverse range of athletes present at these events, this could also make it more difficult for athletes to identify suitable items. Additionally, the unique characteristics of the large-scale dining hall may result in different challenges on food choice. As a result some athletes may require assistance to identify and choose appropriate items.

While the large communal dining hall promotes a social atmosphere and can facilitate interaction between athletes from different regions and sports, it may present a number of challenges to the athlete. One of these challenges is the ease of finding familiar foods, or items that are suitable for specific requirements. Depending on the location of the event the athlete may not be able to access ‘favourite’ foods that they usually consume on a regular basis. Athletes may also be exposed to a new culture and a number of unfamiliar foods/food customs. Some athletes may require specific items for cultural and/or religious beliefs, or personal preferences (e.g. avoidance of meat). Athletes who follow a dietary regimen based on religious beliefs (e.g. Halal) or personal preference (e.g. vegetarianism) may also require appropriate substitutes so that they can
choose items to meet their dietary requirements. While cultural items and familiar foods may be important to the athlete, they may also have very specific requirements based on the sport they compete in (e.g. an athlete making weight or preparing for a marathon).

While these items may be available on the menu the athlete still needs to be able to locate these. This may be difficult if the athlete is not sure where the item is likely to be located (e.g. the buffet station), and if they cannot find out what is at each station without visiting each to check, which may be time consuming. Caterers attempt to provide a wide variety of items from different cuisines in the main dining hall and usually provide cuisine specific buffet stations. Depending on the menu design, these stations are likely to provide hot items under categories with similar characteristics such as Asian, African, Indian, and Western food. Additionally a hot vegetarian and specialty stations (e.g. Pizza/Pasta, or unique to the host cuisine e.g. a tandoori oven) may be available. In addition, stations that offer cold items (e.g. breads, breakfast cereals/items, salad, drinks, and ice cream) are also available in the dining hall. If an athlete is unable to access these foods, this may result in undue stress when they may already be under a significant amount of pressure to perform, and may ultimately impact on performance.

Additionally, for many athletes the main dining hall at a CG or OG may be their first experience in choosing food and eating from a large buffet. Athletes may find the large variety of items available in the buffet layout overwhelming, particularly those who may not have this variety in their home environment (Smart & Bisogni, 2001; Grandjean & Rudd, 2008). Access to unlimited quantities of food, free of charge can lead to overeating (Grandjean & Rudd, 2008), and is of particular concern for athletes who are required to make weight for their competition (e.g. Boxing, Wrestling), or those competing in aesthetic sports (e.g. Gymnastics, Diving). Other factors such as the presence of others (Herman, Roth, & Polivy, 2003; Smart & Bisogni, 2001), peer pressure (Smart & Bisogni, 2001) and boredom (Maughan, 2008), may also contribute to overeating, or a change in food the type of food an athlete normally eats. Athletes may also experiment with new foods or inadvertently increase the portion size of their meal to match other individuals that they are dining with (Herman, et al., 2003; Smart & Bisogni, 2001), while boredom may be an issue, particularly for those athletes who are based in the village for an extended period of time, or those who are unable to leave the
village (for example, at events where security is an issue). This highlights the requirement for some form of nutrition support in this environment.

While a number of athletes may have the assistance of a team dietitian who may provide nutrition information prior to arrival at the OG or CG, and/or who travels with the nations team, not all nations may be in the position to be able to do this based on cost or availability of a trained dietitian or nutritionist, and the accreditation process required for entry to the athletes village. The process of accreditation can be arduous and therefore most teams are limited in the number of support staff they can take to these events, with dietitians not always a priority. While some athletes may have access to a dietitian at home environment, or who travels with the team, the dietitian may be limited in how much they can prepare the athlete for the event without any knowledge of the menu or the support services that will be provided in the athletes’ village. It is difficult to determine how many athletes do travel with a dietitian or nutritionist, or if they have received advice prior to attending an OG/CG. Data from previous events is scarce and the only information available to date on athletes’ previous nutrition advice and source of information prior to attending the event is from the Sydney 2000 OG. In a sample of athletes, books were the most reported source of nutrition information (43%), followed by magazines/flyers (30%) and a dietitian/nutritionist (28%) (Pelly, 2007). Only 6% of athletes reported using websites as a source of nutrition information (Pelly, 2007). Nevertheless, it is important that those athletes who do not have access to a team dietitian or nutritionist have an opportunity to access assistance if required. In order to assist athletes to locate appropriate items or avoid items that may compromise performance and/or health (as detailed in section 1.1.2.), nutrition support services have been provided at previous CG and OG events (Benardot, et al., 1996; Burke, 2009; Pelly, 2007; Pelly, et al., 2011). The nutrition support services can vary depending on the caterer and dietetic involvement, however the nutrition kiosk and nutrition labels are now mandatory for all OG events, and have been used at the most recent CG (Pelly, et al., 2006a).
1.1.4.1. The nutrition kiosk

While it is difficult to determine when a nutrition kiosk was first used at the CG due to limited literature, there is evidence of a kiosk being available at the Melbourne 2006 CG (Pelly, 2006a). While the kiosk has been used at the Melbourne 2006 CG, and has been a permanent feature at all OG events since its introduction at the Atlanta 1996 OG (Burke, 2009; Pelly, 2007; Pelly, et al., 2011), there is limited information available the specific services provided at the kiosk, who uses this service and for what reason. The evaluation of these services is also limited.

The nutrition kiosk is a dedicated space in the main dining hall where athletes and officials have access to dietitians. The range of services provided at the kiosk can vary between events and, while it is difficult to determine the specific details of these services, limited information is available based on published research and journal special interest articles. The only information for the CG to date was collected at the Melbourne 2006 CG. Detailed reports kept by kiosk dietitians at this event suggest that dietitians assisted athletes with long consultations and answering general dietetic and catering enquiries (Pelly, et al., 2006a). At the Atlanta 1996 OG, athletes were able to seek assistance from two dietitians at the nutrition kiosk (Benardot, et al., 1996). Dietitians displayed nutrition books prepared by the caterers (Aramark) that provided nutrition information for all of the menu items (Benardot, et al., 1996). Athletes were also able to take away resources and pamphlets and have specific nutrition counselling with one of the dietitians (Benardot, et al., 1996). Dietitians at the Atlanta 1996 OG also reported handling arrangements for special/therapeutic dietary needs (Benardot, et al., 1996). At the Sydney 2000 OG dietitians were available at the kiosk between 7.30am and 10pm daily and responded to general/food service, clinical and sports nutrition enquiries (Pelly, 2007). Dietitians also reported providing meal plans for some athletes (Pelly, 2007). After the Sydney 2000 OG, the IOC mandated that, in addition to a food service dietitian being part of the catering team, a dietitian must be available at the nutrition kiosk of the main dining hall for all OG events (Pelly, et al., 2011). At the Beijing 2008 OG dietitians based at the kiosk reported providing athletes and officials with information on the menu, providing lists of special dietary items (e.g. gluten free), counselling athletes, providing tours, coordinating special meal requests, and providing education on nutrition programs (Burke, 2009). However, apart from the data collected
Chapter 1: Introduction

at the Melbourne 2006 CG and Sydney 2000 OG, no specific information regarding the characteristics of the athletes using these services has been published.

There are, however, a range of athletes who are likely to require support in the dining hall of an CG or OG, with athletes from non-Western regions reportedly having the greatest need for nutrition support at events for which records are available (Pelly, 2007; Pelly, et al., 2006a). At the Melbourne 2006 CG, athletes from Barbados, India and Papua New Guinea made up the majority of enquiries at the nutrition kiosk (Pelly, et al., 2006a). Similarly, at the Sydney 2000 OG, the majority of enquiries to the kiosk were from athletes representing countries within Western Europe, Australia, Asia and Africa, however it is possible that the higher number of enquiries from Australia was due to this being the host nation, the availability of Australian dietitians at the kiosk, and the higher representation of Australian athletes at this event (632 vs. 424 and 290 [Atlanta 1996 & Barcelona 1992 OG, respectively]) (AOC, 2014). The majority of the meal plans provided by dietitians at the kiosk were also for African athletes (Pelly, 2007). While it could be reasoned that these athletes request assistance more often due to a lack of nutrition support in their home environment, there is very little evidence to confirm this. As detailed in Section 1.1.2., the group of athletes competing at a CG may differ from that seen at an OG. This may mean that the support requirements for athletes from some regions may be different at the CG and OG. Data collected from previous events does not provide any information on how many athletes travelled with a dietitian or nutritionist, and as discussed in Section 1.1.4., there is very little information on athletes’ previous source of nutrition information. While it is evident that athletes from non-Western regions utilise the nutrition kiosk frequently, athletes from Western regions may still require assistance from dietitians in this environment. While it is not possible to determine what services were requested, athletes from Canada and Australia were reported to use the nutrition kiosk at the Melbourne 2006 CG (Pelly, et al., 2006a). At the Beijing 2008 OG dietitians based at the nutrition kiosk reported providing advice for athletes following gluten free dietary regimens from primarily Western regions including the USA, Canada, Australia, Denmark, Spain, Finland and NZ (Burke, 2009). Athletes with less experience in this environment may also have a higher requirement for nutrition support however no data has been published on this to date.
Based on the diversity of athletes approaching the kiosk, and the variety of reasons for assistance, dietitians working at the nutrition kiosk would be expected to knowledgeable and skilled in food service, sports dietetics and clinical nutrition. However, there is also no literature that details the specific skills that dietitians are likely to require to work in this environment. The kiosk provides athletes with the opportunity to have direct contact with a dietitian, however some athletes may prefer to use POC labels to access information about foods in the dining hall.

1.1.4.2. Point of Choice nutrition labelling

One of the most prominent and consistent methods of nutrition support at the OG and CG is the use of point of choice (POC) nutrition labelling located near each menu item available for consumption in the dining hall. POC labels were provided at the Melbourne 2006 CG’s (Pelly, et al., 2006a), however there is no evidence available to ascertain if these were provided at CG events prior to this. POC nutrition labelling has been provided at the OG since the 1992 Barcelona OG’s (Barcelona ’92 Olympic Organising Committee). Evidence suggests that labels are considered an important component of nutrition support in this environment as the majority of athletes at similar competitions have reported using the POC labels all or some of the time (Pelly, 2007; Pelly, et al., 2006a), and that they play an important role in food choice (Pelly, et al., 2006b). It is apparent that athletes are conscious of what they are consuming (Pelly, et al., 2006b), and therefore nutrition labels may help them to make a suitable food choice relevant to their stage of competition. However, the effectiveness of nutrition labels in this environment has not been investigated.

Currently, there is no standard format for POC nutrition labels displayed at the OG or CG, and design of the labels is ultimately the responsibility of the catering company. At past CG and OG events nutrition labels have included anything from numeric values or icons to represent the macronutrients, symbols or words to provide information on potential allergens, an indication of the glycemic index, to dietary classifications for religious or vegetarian diets (Pelly, 2007; Pelly, et al., 2009). The POC labels used at the Melbourne 2006 CG provided information on the nutrient composition (g per serve, g per 100g and a rating symbol), energy content (kJ), serving
size (g and household measures), and identification of vegetarian items. In addition, the labels may need to be provided in more than one language. For example, at the OG all signage must be written in the two official languages of English and French. More recently, at the London 2012 OG, labels contained information on serving size (g, mls), energy (calories and kJ), nutrient composition (g per serve), and symbols for potential allergens (i.e. tree nuts, gluten, shellfish), vegan, vegetarian and Halal and were provided in English and French (Food Service Working Group for PINES – Professionals in Nutrition for Exercise and Sport, personal communication, 1st August, 2012). At the Beijing 2008 OG, labels were also written in Mandarin, and contained information on serving size (in g), allergens, energy (calories) and nutrient composition (g per serve) (Burke, 2009). While providing the labels in more than one language is of importance at the OG, this is likely to unnecessary at the CG where the official language is English (CFG, 2013f), and athletes from 70 regions are present, vs. 204 at the CG (IOC, 2013).

Apart from research conducted in preparation for the Sydney 2000 OG, very limited information is available on how the design of the POC label is determined. The design of the POC labels used at the Sydney 2000 OG was based on survey feedback from 12 sports dietitians and 51 Masters of Nutrition and Dietetic students (Pelly, 2007). Sports dietitians and students were asked to rate a number of label formats including combinations of symbolic, numeric, graphic, descriptive and highlighted nutrient formats. The numeric only, and numeric and highlighted nutrient formats were rated highest for clarity, cultural suitability and ease of use by both sports dietitians and students. When surveyed about what was the most important information to include on a label in this environment, total energy (kcal/kJ), percent of total energy (carbohydrate, protein, fat), carbohydrate (g), fat (g) and protein (g) were most commonly reported. This assisted with development of the POC label. Additionally icons to represent energy, carbohydrate, protein and fat were designed for incorporation on the label. Other icons to identify special dietary requirements (e.g. Halal) and for other information (e.g. spicy dish) were also incorporated on the POC label. Consequently the POC labels designed for this event were very comprehensive and provided with the name of the food in both English and French (Pelly, 2007). They were also popular with athletes, with 85% of athletes reporting using these all or some of the time and 93% of athletes rating the label
appearance as good or excellent (Pelly, 2007). At these events there may also be restrictions on the label content format. For example, at the Melbourne 2006 CG the head food service dietitian for the Melbourne 2006 CG was able to provide feedback on the POC label used at this event, however the final design was ultimately the responsibility of the OC. Consequently there was less information included on this label.

While dietitians have had some input into the label and were able to rate the label, athlete opinion is not well investigated. For example at the Sydney 2000 OG athletes were asked to simply rate the overall POC label on a scale of very poor to excellent. No data was collected on the athletes’ opinion of the format and content of the label at this event (Pelly, 2007) and there is no published data to suggest that this has been evaluated at any other OG or CG events since.

While limited information exists on the POC labels used in this environment, published literature is available for the use and opinion of POC information in other environments. However, while this literature is available there can be large variations in the content and format of the POC information studied. There is evidence that the usability of a POC label may depend on the relevance of the information displayed (Worsley, 1996). Previous research in a University setting suggests that consumers prefer a nutrition labelling system that is easy to use, very clear in the presentation of nutrition information, and attractive (Almanza and Hsieh, 1995). Consumers have previously rated a nutrition label with one column of information easier to comprehend and use than a label with more than one column (Levy, Fein & Schucker, 1992). The same authors (Levy, Fein & Schucker, 1996) have reported that a format which showed the percentage of nutrients rather than metric units (e.g. g) rated more highly, as it was easier for subjects to judge between high and low levels of each nutrient. Labels provided in an appropriate language (Signal, Lanumata, Robinson, Tavila, Wilton & Ni Mhurchu, 2007), with pictorial designs (Viswanathan, Hastak & Gau, 2009), as well as bold text, familiar words, colours, and an appropriate text size (Drichoutis, Lazaridis & Nayga, 2005; Ranilovic & Baric, 2011; Bialkova & Van Trijp, 2010), may also be better received. Appropriate terminology may also influence usability. Technical terms may be confusing to some individuals (e.g. sugar and carbohydrate, salt and sodium) (Besler, Buyuktuncer, & Uyar, 2012; Cowburn & Stockley, 2005) as can calculating or comparing serve sizes (Mackison, Anderson & Wrieden, 2008; Ni Mhurchu & Gorton,
2007), and interpreting unfamiliar symbols, expressions or abbreviations (Besler, et al., 2012). Gender differences in terms of what is considered important information on a nutrition label (Driskell, Schake & Detter, 2008; Conklin, Cranage & Lambert, 2005; Freedman, 2011) may also influence usability, while it is also plausible in this environment that the relevance of sport specific information may also affect the opinion and use of nutrition labels.

Nutrition support in the form of POC labelling appears to be an important component of the main dining hall at major international competitions, especially when athletes from a diverse range of countries are competing. However, despite the requirement for nutrition labelling of all menu items as part of the tender process for catering at major competition events, (Dr Fiona Pelly, personal communication, 21st March, 2012), the design and content of POC labels is at the discretion of the caterer and may vary significantly between events. Given that such a diverse group of athletes is likely to be exposed to these labels, more research needs to focus on evaluating the content and format of POC labels in the dining hall of major international competitions.

1.1.4.3. Other forms of nutrition support used at OG and CG events

In addition to the nutrition kiosk and POC labels used at the Sydney 2000 OG, a website was also available to athletes at this event (Pelly, 2007). This website allowed athletes, coaches, dietitians and other individuals to review the menu and plan dietary intake ahead of time (Pelly, et al., 2009). Based on feedback from a survey of sports dietitians and coaches the website was designed to provide comprehensive nutrition information for each item, including identification of allergens and glycaemic index (Pelly, 2007). The final format of the website was also based on the results of focus groups with caterers, athletes, a website developer and the principle investigator (Dr. Pelly). The final website had a home page, links to view the menu (as well as the capacity to search for specific items or meals), meal plans, nutrition fact sheets and the opportunity to ‘ask a sports dietitian’ a question. It also included information on the nutrition kiosk and the research that was being undertaken at this event, and provided an opportunity to rate the menu (Pelly, 2007). It appears that the website was a valued nutrition support service at this event. Data collected on the use of the website suggests that athletes and other
individuals were most interested in searching the menu for items by day, while searching for high carbohydrate (or combinations of high carbohydrate and other macronutrient items) was also popular (Pelly, 2007). The ‘ask a sports dietitian’ page received 105 questions, with these coming from athletes (both elite and recreational), coaches, dietitians, those involved in sports medicine and spectators (Pelly, 2007) suggesting that this is a valued service for a range of individuals. Unfortunately a website has not been implemented at any other CG or OG events since this time, with the exception of the London 2012 OG. However no information or evaluation of the website at this event is available as yet.

1.1.5. Overall summary and conclusions

Appropriate dietary intake plays an important role in sports performance, and as the majority of the athletes at OG and CG events live and dine in the athletes village, it is important that the menu provided is adequate for their varied sporting, cultural and personal requirements. In addition to providing appropriate food and beverage, some athletes may require support services to make the right food choice in this environment.

Previous research demonstrates the importance of having a dietitian to assist with food provision and the IOC currently mandates a menu review process for all Summer and Winter OG, while CG events are often voluntarily reviewed. However, while the menu review process is an important part of the menu design for an event, the published literature on athletes’ opinions of the food provision (specifically the menu) at these events is scarce. Additionally the only research that is available is somewhat limited. For example at the Sydney 2000 OG athletes were only asked to rate if enough of some food groups were available (e.g. vegetables/salad). Additionally, athletes were not asked to rate the availability of allergen free foods. While reports from the Beijing 2008 OG suggest that GF items were required by athletes (Burke, 2009), no data was collected on the athletes opinion of the availability of items to meet specific sporting or special/therapeutic dietary needs at this, or previous events.

While nutrition support, and the role that the dietitian plays in providing support has evolved since the introduction of POC labels at the Barcelona 1992 OG, the scope
of these services changes based on the event and host nation. As the host nation changes for each OG and CG, there is a change in the OC and often caterers for each event. While it is possible to find out information regarding the food provision and nutrition support services at previous OG events through the use of games reports and through other publications (Benardot, et al., 1996; Burke, 2009), these sources do not provide any evaluation of the services provided. It is also difficult to source detailed post games reports for CG events. Consequently, published literature evaluating the nutrition support provided at these events is scarce and is limited to that conducted by Dr Pelly at the Sydney 2000 OG and the Melbourne 2006 CG.

POC labels have been implemented at a number of OG and CG events; however there is limited data available on athletes’ use and opinion of these. While at the Sydney 2000 OG and the Melbourne 2006 CG athletes were asked to report how frequently they used the POC nutrition labels, at the Sydney 2000 OG athletes were only asked to rate the POC labels generally on a scale of excellent – very poor. No data was collected on athlete’s opinion of format and content at either the Sydney 2000 OG or the Melbourne 2006 CG, however athletes were asked to provide an opinion of the POC labels usefulness at the Melbourne 2006 OG (Pelly, et al., 2006a). To further compound this, the labels for each event change at the discretion of the caterer, making it difficult to ascertain what format is best for this environment.

To date, the only recent literature available on food provision and nutrition support services has been collected at Australian events (Sydney 2000 OG and Melbourne 2006 CG). This is because this was driven by Dr Pelly, who built a relationship with the caterers of the Sydney 2000 OG and then was asked to assist with the Melbourne 2006 OG. Additionally, while some information is available regarding the nutrition services at the Beijing 2008 OG, no published data exists on food provision and nutrition support services for athletes at a major international competition held in a non-Western region. As demonstrated by the lack of research in this area, it is very rare to have the opportunity to collect data in this environment. Dr Pelly’s relationship with Australian caterers after the Sydney 2000 OG and Melbourne 2006 CG subsequently led to an invitation to assist Delaware North Companies with the nutrition services at the Delhi 2010 CG. This research study is therefore the first where data will be collected and published in a non-Western CG setting, and where access to specific dietary items
can be challenging. Furthermore this research has the potential to further understand the role of the dietitian at major international competitions, particularly in an environment where food provision can be challenging and access to special dietary items may be limited. This has potential to assist dietitians and caterers as they prepare for a number of upcoming Summer and Winter OG and CG events (e.g. Glasgow 2014 CG and Rio 2016 OG).

While there may some differences between the main dining hall environment at the OG and CG events, particularly the increased number of athletes that need to be catered for at the OG, the limited opportunities to conduct research in this environment means that this research is of importance. At the Delhi 2010 CG the author has the ability to investigate a wide variety of elite athletes (in terms of nationality, age, gender and sport) concurrently at the one competition. A varied pool of approximately 6000 athletes from 71 countries competed in 17 sports (OCCG Delhi, 2013), which would be difficult to replicate outside this type of event making this data very unique. Therefore, the overall objective of this thesis is to investigate the nutrition support (including the menu, nutrition kiosk and POC labels) provided to athletes at a major international competition (The Delhi 2010 Commonwealth Games), the role of the sports dietitian in providing these services, and if these services are appropriate for the diversity of athletes present at this event.

1.2. Research objectives

Based on the information and the gaps identified in the literature review (section 1.1), the overall objectives of this research are to:

1. To evaluate the nutrition support (including the menu, nutrition kiosk and POC labels) provided to athletes at a major international competition (The Delhi 2010 Commonwealth Games),
2. To investigate the role of the dietitian in providing these services, and
3. To identify if these services are appropriate for the diversity of athletes present at this event.
The specific research questions to be answered are:

- Do athletes believe that the menu provided at the Delhi 2010 Commonwealth Games catered for all of their sporting, cultural and personal requirements?

- Does an athlete’s sport, cultural background, stage of competition and previous experience at major international events influence their perception of the menu?

- Do athletes use Point of Choice (POC) nutrition labelling in this environment and what is their opinion on the format and content of these?

- Does an athlete’s sport, cultural background, gender, age, stage of competition and previous experience at major international events influence their use of POC nutrition labelling?

- What role do dietitians based at the nutrition kiosk play in assisting athletes with food choice in this environment?

- What are the characteristics of athletes likely to present at the nutrition kiosk for assistance?

- What advice may a dietitian be required to provide to athlete at this event, and what skills and knowledge are they likely to require?

- Is there a relationship between an athlete’s previous source(s) of information and education, and the support they require from dietitians at the nutrition kiosk?

- What strategies can be implemented to improve nutrition support in similar environments? How may this play a role in the future planning of similar events?
1.3. **Research methodology**

While the methods for each study are reported in each publication (Chapter) this section provides a detailed overview of the methodology and methods used for this study. This section includes; the research methodology (Section 1.3.1), details of the Delhi 2010 CG (1.3.2), and the three stages of the methods (1.3.3). Section 1.3.3, includes the pre-competition stage (1.3.3.1), the data collection stage (1.3.3.2), and the data collation stage (1.3.3.3). Figure 1 provides an overview of the three stages of the research.

### 1.3.1. Research methodology

The research design of this study is based on a postpositivist view and is primarily based on a non-experimental cross sectional design using survey instruments and interviews.

### 1.3.2. The Event

On the 13th November, 2003, Delhi, India was announced as the host nation for the 2010 Commonwealth Games. This led to an extensive period of preparation as both sporting venues and the athletes’ village were constructed. The athletes’ village was located close to the banks of the Yamuna River, near the Akshardham Temple and was designed to have five distinct areas; the residential zone, the dining area, the international zone, a training area and the transport mall (OCCG 2010 Delhi). The residential zone included accommodation for athletes and officials, while the main dining hall was the main area for athletes to access food and beverage (Figure 2). Services and amenities provided in the International zone included an entertainment centre, a religious services centre, a casual dining area and a large polyclinic (medical services) (OCCG 2010 Delhi). While the athletes’ village had a training area, the majority of athletes were required to travel between 3 and 14km to training and competition venues. As the security of athletes and officials was a major concern at this
event, the majority of athletes were only allowed to leave the village to train and compete, meaning that athletes may have spent more time in the village than at other events where they are able to leave to socialise or visit tourist attractions.

Once the development of the athletes’ village was underway, the OC advertised for tender of the catering services of the main dining hall. Amongst the objectives of the Catering Functioning Area group were to ‘provide catering services to all customer groups at games venues, and to manage food safety to eliminate health risks’ (OCCG 2010 Delhi, pg. 81). The successful caterer for the Delhi CG was Delaware North Companies Australia Pty. Ltd. (DNC) who worked in conjunction with the local catering company TajSATS. Located in a central area of the athletes’ village, the dining hall was a temporary structure that provided seating for up to 2300 individuals (OGCG Delhi, 2010). The majority of the main dining hall management staff were Australian, however some of the main buffet station chefs were recruited from other regions to ensure the food provided at that station was prepared according to cultural requirements. Buffet station serving staff were recruited from India (Figure 3). The main dining hall kitchen was opened for test-starting from the 13th September, 2010, while the soft opening occurred on the 16th September, 2010 and the nutrition kiosk opened on the 23rd September (OC CG Delhi, 2010).

The main dining hall was designed with the various food stations located around the back wall of the hall, and with seating in the middle (Figure 4). These food stations were based on different cuisines (Asian, African, Indian, and Western) and menu items at these stations were rotated on a 6 day menu cycle. Additionally a vegetarian station was available, as was a pizza/pasta station, where pizzas could be made to order. As the host nation is encouraged to showcase their cuisine, in addition to the Indian buffet station, a Tandoori oven was provided for chefs to prepare Tandoori breads in front of athletes and officials. The majority of food was prepared using the cook fresh method. Permanent items (those available 24hrs a day) included a sizzling salad bar, bread stations and a cold breakfast area (with cereals). Small trailers (tuk-tuks) based around the dining hall offered fruit, while cold drinks and ice creams were also available. In addition to the main dining area, the dining hall also contained areas for cooking, storage and staff facilities (e.g. areas to take lunch breaks).
Chapter 1: Introduction

30

Figure 1. An overview of the three stages of used in the methods of this thesis.

Pre-Event

- Development of data collection tools
  - Dining hall questionnaire – adapted
  - Kiosk enquiry record form - adapted
  - Consultation record form - new

- Review of menu by head food service dietitian
- Feedback of menu changes to caterers
- Caterers develop final menu

During event

- Methods of data collection in the main dining hall
  - POC labels and nutrition kiosk available in the main dining hall

- Various data collection methods:
  - **Dining hall questionnaire**
    - Menu
    - POC labels
    - Source of nutrition information
    - Dietary regimens

  - **Nutrition Kiosk records**
    - Enquiries
    - Consultations (including a 24hr recall)

Post event

- Data collated
- Statistical analysis
- Results
- Overall findings/observations
- Recommendations

1. Adapted from questionnaires used at the Melbourne 2006 CG
The nutrition support services that were provided at this event included the nutrition kiosk (Figure 5) and POC nutrition labels (Figure 6). The nutrition kiosk was located on the side of the main dining hall, near the Pizza/Pasta station. It was identified with a large sign, similar to the food station signs. The nutrition kiosk team consisted of a head dietitian, 3 Australian Accrediting Practising Dietitians (APD’s) and a research assistant as described in Section 1.3.3.1. At least 2 dietitians were available at the nutrition kiosk from 8am – 8pm from the 23rd September – 13th October, 2010. A local Indian dietitian and nutrition assistant (who were recruited by TajSATS), were also available in the dining hall. The Indian dietitian and nutrition assistant were primarily involved in the quality control of POC labels and updating these when necessary; however the Indian dietitian was available to assist with nutrition consultations and enquiries at the nutrition kiosk if required.

1.3.3. The three stages of methods

The three stages of the research are discussed in Sections 1.3.2.2. – 1.3.2.4.

1.3.3.1. Stage One: Preparation for the event

Stage one of the research study occurred prior to the start of the Delhi CG. In preparation for the event, the caterers DNC appointed an experienced food service and sports dietitian (Dr. Fiona Pelly) as a consultant, who then recruited a team of three APD’s and a research assistant (the author) to prepare, and travel to the event. As detailed in Section 1.1.3., Dr Pelly has extensive experience in this environment and is an Advanced APD and fellow of SDA. While all of the APD’s had experience in sport dietetics, two of these APD’s worked primarily in this area, while the third had extensive clinical experience. The caterers were responsible for the design of the menu; however the head dietitian was responsible for reviewing the menu and providing feedback to the caterers on this prior to the event. POC labels were also designed by the caterers and provided to the head dietitian for review at this time. However, due to time constraints, not all suggested changes were able to be implemented.
During this stage the data collection tools were also revised and finalised. A dining hall questionnaire that was previously used at the Sydney 2000 OG and Melbourne 2006 CG to investigate athletes’ opinions of food provision and nutrition support was adapted for use at this event. The nutrition kiosk enquiry form was also adapted from a similar form used at the Melbourne 2006 CG. The consultation record form was designed specifically for this event and included questions on basic demographic information and a 24hr proforma for dietitians to record the athletes’ intake over the previous 24hr period. The development of these data collection tools is detailed in Section 1.3.3.3. Ethical approval for this research was provided by The University of the Sunshine Coast Ethics Committee.

Figure 2: The entrance to the main dining hall with residential towers in the background.
Figure 3: Behind the scenes: Local staff clean and prepare for meal service.

Figure 4: Athletes dining in the main dining hall with buffet stations in the background.
Figure 5: Nutrition kiosk staff providing assistance to athletes in the main dining hall.

Figure 6: A selection of items with POC labels
1.3.3.2. Stage Two: Data collection during the event

This section details the data collection tools, study sample and limitations of the methods.

1.3.3.3. Data collection tools

All data was collected at the Commonwealth Games in New Delhi during September and October 2010.

The methods used for data collection consisted of the following:

1. The Dining Hall Questionnaire (Appendix I): The dining hall questionnaire was based on a questionnaire previously used in this environment that consisted of predominately closed ended questions (Likert scale) used to assess athletes’ opinions of the menu, and utilisation of nutrition support. This questionnaire was originally developed for use at the Sydney 2000 OG, and subsequently modified for use at the Melbourne 2006 CG, where it was reviewed by experts before use at both events. Upon review of the questionnaire by the author of this thesis and the original author (Dr Pelly), 11 new questions were included for use at the Delhi 2010 CG. The revised questionnaire was then reviewed by four experienced dietitians to ensure content validity. Additional changes were then made in response to this feedback. The final questionnaire contained 25 questions.

2. The Kiosk Enquiry Record Form (Appendix II): All occasions of service at the nutrition kiosk were recorded by APD’s and the research assistant on the kiosk enquiry record form. This form was adapted from the original kiosk enquiry form that was used at the Sydney 2000 OG and the Melbourne 2006 CG, in conjunction with the original author (Dr Pelly). The form was designed to collect information on the individuals reason for visiting the kiosk and demographic characteristics (gender, country representing, sport/event and if the
individual was an athlete or official). The form was reviewed by four experienced dietitians before use at the kiosk.

3. The Consultation Record Form (Appendix III): The consultation record form was designed to collect information on those athletes and officials who requested, and took part in a consultation. Dietitians recorded basic demographic information, as well as the individual’s intake over the previous 24 hour period on a standard proforma. The 24 hour recall was checked with a provided list of foods to ensure all meals/snacks were recorded. Dietitians were also asked to provide a description of the advice they provided to the athlete. This form was designed specifically for use at this event in conjunction with Dr Pelly, and was reviewed by four experienced dietitians before use at the kiosk.

1.3.3.4. Study sample

The target population for this study were athletes competing in the 2010 Delhi Commonwealth Games (n=4352) living within the athletes’ village, and eating meals within the main dining hall. The target population included; 966 athletes representing regions of the British Isles, 896 from Africa, 614 from India/Sri Lanka, 589 from Australia and New Zealand, 567 from South East Asia and the Pacific Islands, 408 from the Caribbean, 255 from Canada, and 57 from Europe (Cyprus). Two-thirds of the target population were male (61%, n = 2645) (OCCG Delhi, 2010).

1.3.3.5. Data collection methods

The author was responsible for distributing the dining hall questionnaire to athletes dining in the dining hall over the games period. Due to the difficulties of recruiting a truly random sample in this environment, athletes from a variety of regions and sports were approached and asked to take part in the research based on the convenience and availability of athletes present at each main meal period over the entire games period (23rd September – 13th October, 2010).
Athletes were provided with a research information sheet if required (Appendix IV), and were considered to have given permission to take part in the research on completion of the questionnaire. Athletes were only allowed to complete the dining hall questionnaire once. While the majority of data collected in the dining hall questionnaire was collated and analysed in phase three, updated reports were provided to the caterers (DNC) based on feedback on the opinion and provision of specific items throughout the games period.

The author and the kiosk dietitians recorded all enquiries to the kiosk over the games period on the kiosk enquiry form. All three APD’s as well as the Indian dietitian were instructed on the use of the nutrition kiosk enquiry form, and the consultation record form, before using. A research information sheet was available for athletes if required, and an enquiry at the kiosk constituted permission to take part in the research. Dietitians completed the kiosk consultation form and 24hr recall proforma (if appropriate), during the athletes’ consultation. As the data collection for the record of enquiries and the 24hr recall were based on athletes who approached the kiosk there was no control over the representation of regions and sports in this sample group.

1.3.3.6. Stage Three: Collation of data

Upon completion of the event data was collated and analysed based on the objectives of this thesis, and for the publications in Chapters 2 – 5. Further detail on the data analysis is provided in each of the publications. Some of the data collected at this event does not fit within the scope of the objectives of this thesis, however it does contribute to the context of this research and has therefore been included in Appendix V (dietary regimens) and Appendix VI (24 hour recall dietary intake).

A total of 351 athletes returned completed dining hall questionnaires, while dietitians recorded 443 total occasions of service at the nutrition kiosk (enquiries n = 383, consultations n = 60). Ideally the sub samples from each method of data collection would be used in a comparative analysis, however this was not feasible as not all participants took part in each stage of the data collection. While every attempt was made to invite athletes to participate in each form of data collection, this was difficult due to time constraints, the accessibility to athletes in an environment where athletes are
often focused on their performance, and the limited time frame for data collection (e.g. the Commonwealth Games are only held for 3 weeks, every 4 years).

1.4. **Thesis orientation**

This thesis contains the following publications in the order listed. An introduction to each of these publications detailing how they contribute to the thesis is included at the start of each Chapter.

*Chapter 2.*

*Chapter 3.*

*Chapter 4.*

*As these chapters are presented exactly as they are in published form, some repetition may be present.*

*There may also be differences in spelling due to the country of publication, and reference style due to journal specifications.*

*Each chapter contains a reference list of all sources cited within that publication. References cited in Chapters 1 and 5 are contained in the main references section (p.138).*
Chapter 2:
Athletes’ Opinions of Food Provision at the 2010 Delhi Commonwealth Games: The Influence of Culture and Sport

Sarah J. Burkhart and Fiona E. Pelly

Full publication reference:
2.1. Introduction to the Chapter

When an athlete preparing for competition relies on a dining hall for all of their food and beverage needs, it is important to provide items to meet their varied sporting, cultural and personal requirements. Additionally, it is important that the food provided is visually appealing, is fresh, served at the correct temperature and in an appropriate portion size, and tastes good. However, catering for a group of individuals from diverse cultures and sports can be a challenge.

This Chapter consists of a published paper that investigates athletes’ opinion of the food provision (menu) at the Delhi 2010 CG from a cultural and sporting perspective. This paper was published in the peer-reviewed International Journal of Sport Nutrition and Exercise Metabolism. The key aspects of this paper for the thesis are the investigation of the overall opinion of food provision, including the qualities (e.g. taste, freshness, temperature), and the availability of specific items (e.g. high carbohydrate), the influence of an athlete’s culture and sport on opinion, and the reported ease of finding items in this environment. Additionally, this paper presents strategies that may assist with improvements to the menu provided at similar events, and the findings can help to further define the role of the dietitian at this type of event.

2.2. Authors declaration

Sarah Burkhart was responsible for study conception and design, acquisition, analysis and interpretation of data, statistical analysis, drafting and critical revision of the manuscript.

Dr. Fiona Pelly was responsible for study conception and design, acquisition, analysis and interpretation of data, critical revision of the manuscript, and supervision.

This chapter is an exact copy of the above mentioned article.
Athletes’ Opinions of Food Provision at the 2010 Delhi Commonwealth Games: The Influence of Culture and Sport

Sarah J. Burkhart and Fiona E. Pelly

The aim of this study was to investigate whether athletes’ opinion of food provision in the main dining hall of the athletes’ village at the Delhi 2010 Commonwealth Games varied according to cultural background, sport, stage of competition, and previous experience at similar events. A previously developed questionnaire was distributed over 3 meal periods to 351 athletes dining in the main dining hall during the course of the games (Sept. 23 to Oct. 4, 2010). Despite the challenges of food provision in a non-Western region, the availability of food and beverage items was rated highly. However, athletes from Western regions tended to rate food provision qualities lower than athletes from non-Western regions. Most athletes found it easy to find items to meet their nutrition needs; however, requests for sports foods, snacks, and culturally specific items were received. Power/sprint athletes were more critical of the food provision, whereas athletes from aesthetic sports tended to rate it more highly. Athletes farther from competition gave higher ratings for taste, while athletes who had more experience in this type of environment also tended to be more critical of the food provision. Overall daily mean opinion scores for taste and menu variety decreased over the games period. The results of this study can help organizers and caterers ensure that appropriate food and beverage are provided for athletes at major competition events.

Keywords: competition, catering, sport nutrition

Introduction

Both appropriate food provision (Heaney, O’Connor, Naughton, & Gifford, 2008) and nutrition support (Pelly, 2010; Pelly, O’Connor, Denyer, & Caterson, 2009) can play a significant role in an athlete’s preparation for competition. At major international competition events such as the Olympic and Commonwealth Games, competitors and officials live “in house” in a village environment from anywhere from a few days to 6
weeks and dine from a range of food-service facilities in a main dining hall that can seat 3,500–4,000 individuals at any one time (Pelly, O’Connor, Denyer, & Caterson, 2011). A central kitchen, staffed by a number of chefs and their catering team, produces meals over a 24-hr period, usually in four distinct meal periods of breakfast, lunch, dinner, and supper. While the length of the menu cycle varies depending on the period of competition, it is commonly based on a 7- or 10-day cycle and can contain up to 1,500 menu items (Pelly, 2007). As the volume of food production in this environment is significant, and athletes from a large number of nations (71 at the Delhi Commonwealth Games) consume most of their food in this hall, caterers must ensure that they provide a range of items that meet athletes’ varied expectations for freshness, temperature, sensory appeal, and aesthetic properties.

In addition, some athletes may have clinical conditions, religious beliefs, or personal preferences that affect their food intake. Furthermore, athletes compete in a range of sports that have differing physiological requirements and energy demands. Previous research on food provision at elite-level competitions suggests that improvements have been made in line with advances in research into performance nutrition (Pelly et al., 2011). Historically, the food provided at elite-level competitions was predominantly based on high-protein items; however, in the 1970s more high carbohydrate options began to appear on the menu as the benefit of high-carbohydrate foods to performance became apparent (Pelly et al., 2011). From a cultural perspective, a unified menu catering for all nations was not introduced until the 1972 Olympic Games (Pelly et al., 2011). Before this time, athletes ate in separate dining halls and were provided with culturally specific menus. Since the inaugural Commonwealth Games in 1930 (Hamilton, Canada), there has been an increase in the number of sports (from 6 to 17), competitors (from 400 to 4,352), and nations (from 11 to 71; Commonwealth Games Federation, 2012), resulting in the need to cater for a significantly broader range of food preferences. Currently the menu at elite-level competitions tends to cater to a range of cultural eating styles including African, Asian, Indian, and Western palates; however, a lack of culturally acceptable food, in particular for Chinese, Eastern European, and African athletes, has been previously reported (Pelly, 2007). Evidence from past competition events has shown that sports-specific nutrition (precompetition diet, recovery diet, weight management), as well as diets based on
clinical conditions (food allergy/intolerance) and personal preference, are also of concern to athletes competing at major competition events (Burke, 2009; Pelly, 2007; Pelly, Inge, King & O’Connor, 2006). More recently, input from sports dietitians has allowed food-service providers to present a menu that is appropriate for athletes competing in a range of sports with different physiological demands (Pelly et al., 2011). Subsequently, the International Olympic Committee commissioned an international group of sports nutrition professionals with appropriate expertise to review the proposed food provision for the summer and winter Olympic Games (Pelly et al., 2011). However, not all elite-level events are externally reviewed, and it is often at the discretion of the caterer to provide suitable food.

Despite advances in the provision of appropriate food, athletes may still make inappropriate food choices or simply overeat due to the significant amount of choice available. Previous research has shown that hockey players are more likely to overeat in a buffet environment due to the abundance of food items not normally available at home (Smart & Bisgoni, 2001). Athletes may also vary from their usual competition intake because they have the opportunity to consume a wide range of food that may be different, both in taste and composition, from their usual intake in their home environment (Milne, Shaw, & Steinweg, 1999; Reilly, Waterhouse, Burke, Alonso, & International Association of Athletics Federations, 2007). Food choice may be influenced by a number of factors including nutrition knowledge, availability, aesthetic properties, nutrient composition, convenience, peer pressure, and cultural acceptability of items (Nestle et al., 1998; Pelly, King, & O’Connor, 2006; Smart & Bisgoni, 2001).

The dining-hall environment offers the opportunity to consume a wide range of food and fluid suitable for competition, and nutrition education is available in the dining hall to inform athletes on their choices. However, other influences such as the presence of other athletes, friends, and coaches (de Castro, 1994; Herman, Roth, & Polivy, 2003; Smart & Bisgoni, 2001), along with the possibility of limited cultural items (Reilly et al., 2007), may affect food selection. An athlete’s stage of competition may also influence food choice. Hockey players have been reported to base their choice of food on the effect it may have on performance and health during a competition period, while taste is more influential when choosing food in the off-season (Smart & Bisgoni, 2001). Athletes may also vary from their usual intake as the novelty of attending an elite
competition event and living in an athletes’ village may distract them from focusing on nutrition-related goals (Reilly et al., 2007). Preparation and planning before arrival and access to nutrition information once they have arrived may also influence what athletes choose to consume (Burke, 1995; Gibson, 2008; Milne et al., 1999; Reilly et al., 2007). Therefore, the aim of this particular study was to investigate whether athletes’ opinion of food provision in the main dining hall of the athletes’ village at the Delhi 2010 Commonwealth Games varied according to their cultural background, sport, stage of competition, and previous experience at similar events.

Methods

Survey Instrument
A modified version of a questionnaire previously developed to investigate athletes’ opinion of the nutrition service at the Melbourne 2006 Commonwealth Games (Pelly, Inge, et al., 2006; Pelly, King, & O’Connor, 2006) formed the basis for data collection. This questionnaire underwent content evaluation before the Melbourne Commonwealth Games and subsequently by three Australian sports dietitians in advance of this study, resulting in an additional 11 questions. The revised questionnaire consisted of 25 questions divided into four broad topic areas. Three sections were designed to assess athletes’ opinion of food provision as outlined in the following sections.

Participant Characteristics. Participants were asked for demographic information including gender, date of birth, country of origin, country representing, postal code/ZIP code, native language, and level of education. In addition, stage of competition (more than 2 days before competition, day before event, day of event, between events, or event completed), and previous experience competing at a Commonwealth or Olympic Games and living in an athletes’ village.

Opinion of Food and Beverage Provision and Availability of Appropriate Menu Items. Participants were asked to rate the food and beverage qualities on a Likert scale of 1 (very poor) to 5 (very good). These qualities included menu variety, presentation, temperature, portion size, taste, freshness, and cultural requirements. To assess the
perceived availability of appropriate items on the menu, participants were asked to rate the availability of a range of items (low-fat, high-carbohydrate, high-protein, vegetarian, low-energy [kJ], gluten-free, low-lactose, and sports foods) on a Likert scale. To avoid guessing about items that they may not have been aware of, athletes were given the option to report unsure or did not eat.

**Improvements to Food Provision and Assistance in Finding Appropriate Items.** To identify how improvements could be made to food provision and assistance in finding appropriate items, participants were able to provide details on additional items that they would like to see on the menu and any other factors that would help them locate specific items.

**Participant Selection.** The target population was athletes competing in the 2010 Delhi Commonwealth Games (N = 4,352) living in the athletes’ village and eating meals in the main dining hall. The dining hall was the main food (provision) provider for residents and catered for all meals and snacks 24 hr a day. The questionnaire was distributed by nutrition kiosk staff over each of the three meal periods to athletes dining in the athletes’ village main dining hall during the games (September 23 to October 14, 2010). The self-administered questionnaire was distributed and collected by the researcher, allowing participants to ask questions if required. The sample was chosen by convenience based on availability of athletes at each meal period. However, the questionnaire was distributed to athletes representing a variety of regions and sports at each meal period over the course of the games to gain a representative sample. Athletes who had previously completed the dining-hall questionnaire were excluded from completing it on a second occasion. Despite the breadth of nations participating at the Commonwealth Games, most were either English speaking or had been taught English as part of their school curriculum. Individuals who were determined as having minimal comprehension of English were excluded from the study (n = 2). Only those over the age of 16 were able to participate, unless they had consent of a parent or guardian.

**Data Analysis.** The participants were classified into sports groups based on the physiological needs of their sports and into region categories based on cultural style of
eating (Tables 1 and 2). The results were analyzed with the Statistical Package for the Social Sciences (SPSS Inc., Chicago, IL, Version 19, 2011). One questionnaire was excluded from analysis, as more than five questions were left unanswered on it. Depending on the normality of data, associations were calculated with the chi-square statistic, Kruskal–Wallis ANOVA, and Mann–Whitney U test. Significant confounders were identified with analysis of covariance (ANCOVA) within parametric data.

Table 1: Classification of sport based on physiological requirements (n = 17).

<table>
<thead>
<tr>
<th>Sport category</th>
<th>Sport</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aesthetic</td>
<td>Diving, gymnastics</td>
</tr>
<tr>
<td>Endurance</td>
<td>Athletic events 800m and over, cycling, swimming distance events</td>
</tr>
<tr>
<td>Power/Sprint</td>
<td>Athletic events under 400m, athletic field events, swimming sprint events</td>
</tr>
<tr>
<td>Racquet</td>
<td>Badminton, table tennis, tennis, squash</td>
</tr>
<tr>
<td>Skill</td>
<td>Archery, lawn bowls, shooting</td>
</tr>
<tr>
<td>Team</td>
<td>Hockey, netball, rugby 7’s</td>
</tr>
<tr>
<td>Weight</td>
<td>Boxing, weightlifting, wrestling</td>
</tr>
</tbody>
</table>

Pearson’s correlation coefficient was used to determine whether there was a relationship between mean daily rating and duration of the games period. Statistical significance was considered to be \( p \leq .05 \). Post hoc analysis was calculated with Bonferroni for significant relationships to determine the location of the effect, based on \( p \) values adjusted for multiple comparisons.

**Ethical Approval.** Ethics approval was granted by the University of the Sunshine Coast’s Human Research Ethics Committee. Participation was voluntary for both the dining-hall questionnaire and visiting the nutrition kiosk. A research information sheet was available for all participants, and consent was considered to be given by completing the questionnaire.
Table 2: Classification of country based on location and cultural style of eating (n = 53).

<table>
<thead>
<tr>
<th>Region category</th>
<th>Country</th>
</tr>
</thead>
<tbody>
<tr>
<td>Africa</td>
<td>Botswana, Cameroon, Ghana, Kenya, Lesotho, Malawi, Mauritius, Namibia, Nigeria, Rwanda, Sierra Leone, South Africa, Tanzania, The Gambia, Uganda</td>
</tr>
<tr>
<td>Australia &amp; New Zealand</td>
<td>Australia, New Zealand</td>
</tr>
<tr>
<td>British Isles</td>
<td>England, Falkland Islands, Gibraltar, Guernsey, Isle of Man, Jersey, Northern Ireland, Scotland, Wales</td>
</tr>
<tr>
<td>Canada</td>
<td>Canada</td>
</tr>
<tr>
<td>Caribbean</td>
<td>Antigua, Barbados, Bermuda, Cayman Islands, Dominica, Guyana, Jamaica, St Kitts, St Lucia, St Vincent, Trinidad</td>
</tr>
<tr>
<td>India &amp; Sri Lanka</td>
<td>India, Maldives, Seychelles, Sri Lanka, Uzbekistan</td>
</tr>
<tr>
<td>South (S.) East Asia &amp; Pacific Islands</td>
<td>Cook Islands, Kiribati, Malaysia, Niue, Norfolk Island, Papua, New Guinea, Samoa, Singapore, Tonga</td>
</tr>
</tbody>
</table>

Results

Participant Characteristics. A total of 351 athletes returned completed dining-hall questionnaires (8.1% of the target population). Athletes were 24 ± 6.4 years old, were well educated (60% attended university), and represented a range of countries (53 of 71). There was a significant association between sport category and region represented (p ≤ .001), with less representation from athletes competing in aesthetic sports, in particular from the Caribbean, Africa, and India. Additional demographic characteristics are presented in Table 3. There was a significant association between age and sport category (p ≤ .001) and between level of education and sport (p ≤ .001). Skill-based athletes tended to be older than competitors in other sports, while all athletes from aesthetic sports were under the age of 29 years. Team and skill athletes had a higher level of education, with 84% and 79%, respectively, having attended university. A higher proportion of Canadian athletes (89%) had attended university, while athletes from Africa had a significantly lower level of education than athletes from Canada (p ≤ .001), India and Sri Lanka (p = .036), Australia and New Zealand (p = .012), and the British Isles (p = .024). There was no association between age and region. Most (70%)
participants reported that this was their first experience at a Commonwealth or Olympic Games, with approximately half (49%) reporting that it was their first time living in an athletes’ village. Over half the participants (52%) were more than 2 days away from the start of their event; 28% were on the day before, day of, or between events; and 20% had completed their event. Seventy percent of the dining-hall questionnaire respondents spoke English as their first language.

**Provision of Food and Beverage.** The menu was generally well received (Table 4), with freshness (82%), food and beverage presentation (80%), menu variety (78%), temperature (77%), and taste (72%) rated as good or very good by most respondents. Portion size (88%) and availability of culturally acceptable items (83%) were also rated highly. Minimal ratings of “poor” responses were received across all categories. A significant association was found between stage of competition and rating of taste, with athletes who were closer to starting their event more likely to rate taste lower than those 2 or more days away ($p = .005$). There was a moderate negative correlation ($r = -.660$, $p = .01$ between overall daily mean score for taste and duration of the games period (21 days) and a weak negative correlation for menu variety ($r = -.470$, $p = .031$).

**Opinion Based on Region.** Opinion of the menu differed significantly for a number of qualities across regions (Figure 1). Although the overall rating for the availability of culturally acceptable items was high ($M = 4.2$), athletes from the Caribbean rated it lower than athletes from other regions. A number of qualities including temperature, menu variety, presentation, freshness, and taste were rated lowest by Canadian athletes, while African athletes generally rated qualities highest.
Table 3: Characteristics of athletes who returned a completed dining hall questionnaire.

<table>
<thead>
<tr>
<th></th>
<th>TOTAL</th>
<th>Africa</th>
<th>Australia &amp; New Zealand</th>
<th>British Isles</th>
<th>Canada</th>
<th>Caribbean</th>
<th>India &amp; Sri Lanka</th>
<th>S. East Asia &amp; Pacific Islands</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n (%)</td>
<td>54 (15)</td>
<td>53 (15)</td>
<td>89 (26)</td>
<td>26 (8)</td>
<td>32 (9)</td>
<td>26 (8)</td>
<td>66 (19)</td>
</tr>
<tr>
<td><strong>Gender n (%)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>183 (52)</td>
<td>34 (65)</td>
<td>25 (42)</td>
<td>50 (56)</td>
<td>6 (23)</td>
<td>23 (72)</td>
<td>15 (58)</td>
<td>28 (42)</td>
</tr>
<tr>
<td>Female</td>
<td>166 (48)</td>
<td>18 (35)</td>
<td>28 (53)</td>
<td>39 (44)</td>
<td>20 (77)</td>
<td>9 (28)</td>
<td>11 (42)</td>
<td>38 (58)</td>
</tr>
<tr>
<td><strong>Age (X, range) (years)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>24.2 (16-60)</td>
<td>23.6 (15-55)</td>
<td>25.2 (16-49)</td>
<td>25.4 (15-51)</td>
<td>24.0 (17-31)</td>
<td>23.9 (16-40)</td>
<td>24.0 (16-42)</td>
<td>22.8 (15-60)</td>
</tr>
<tr>
<td><strong>Sport category n (%)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aesthetic</td>
<td>24 (7)</td>
<td>0</td>
<td>6 (11)</td>
<td>5 (6)</td>
<td>2 (8)</td>
<td>0</td>
<td>1 (4)</td>
<td>10 (16)</td>
</tr>
<tr>
<td>Endurance</td>
<td>79 (23)</td>
<td>15 (32)</td>
<td>9 (17)</td>
<td>17 (20)</td>
<td>9 (36)</td>
<td>5 (16)</td>
<td>8 (31)</td>
<td>16 (25)</td>
</tr>
<tr>
<td>Power/sprint</td>
<td>46 (14)</td>
<td>11 (23)</td>
<td>5 (10)</td>
<td>5 (6)</td>
<td>7 (28)</td>
<td>5 (16)</td>
<td>6 (23)</td>
<td>7 (11)</td>
</tr>
<tr>
<td>Racquet</td>
<td>52 (15)</td>
<td>5 (10)</td>
<td>6 (11)</td>
<td>22 (25)</td>
<td>1 (4)</td>
<td>10 (32)</td>
<td>6 (23)</td>
<td>2 (3)</td>
</tr>
<tr>
<td>Skill</td>
<td>38 (11)</td>
<td>2 (4)</td>
<td>7 (13)</td>
<td>21 (24)</td>
<td>0</td>
<td>2 (7)</td>
<td>3 (11)</td>
<td>2 (3)</td>
</tr>
<tr>
<td>Team</td>
<td>55 (17)</td>
<td>2 (4)</td>
<td>11 (21)</td>
<td>11 (13)</td>
<td>6 (24)</td>
<td>4 (13)</td>
<td>1 (4)</td>
<td>20 (31)</td>
</tr>
<tr>
<td>Weight</td>
<td>43 (13)</td>
<td>13 (27)</td>
<td>9 (17)</td>
<td>5 (6)</td>
<td>0</td>
<td>5 (16)</td>
<td>1 (4)</td>
<td>7 (11)</td>
</tr>
<tr>
<td><strong>Level of education n (%)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Attended university</td>
<td>208 (60)</td>
<td>20 (38)</td>
<td>36 (68)</td>
<td>56 (64)</td>
<td>23 (89)</td>
<td>18 (56)</td>
<td>18 (75)</td>
<td>34 (52)</td>
</tr>
<tr>
<td>Completed senior school</td>
<td>86 (25)</td>
<td>18 (34)</td>
<td>13 (25)</td>
<td>22 (25)</td>
<td>3 (11)</td>
<td>11 (35)</td>
<td>4 (17)</td>
<td>15 (23)</td>
</tr>
<tr>
<td>Intermediate/middle</td>
<td>50 (14)</td>
<td>15 (28)</td>
<td>4 (7)</td>
<td>9 (10)</td>
<td>0</td>
<td>3 (9)</td>
<td>1 (4)</td>
<td>16 (25)</td>
</tr>
<tr>
<td>Never attended school</td>
<td>2 (1)</td>
<td>0</td>
<td>0</td>
<td>1 (1)</td>
<td>0</td>
<td>0</td>
<td>1 (4)</td>
<td>0</td>
</tr>
</tbody>
</table>

*There was a significant association between age and sport (p=<0.001), age and level of education (p=<0.001), sport category and level of education (p=<0.001), sport category and region representing (p=<0.001) and region and level of education (p=<0.001).
Table 4: Mean scores and ANCOVA for opinion of food and beverage provision in main dining hall for region and sports category.

<table>
<thead>
<tr>
<th>Provision of food and beverage</th>
<th>Region</th>
<th>Sport</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variables</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Portion size (n = 336)</td>
<td>M ± SD</td>
<td>4.3 ± 0.7</td>
</tr>
<tr>
<td>Taste (n = 337)</td>
<td>4.2 ± 0.7</td>
<td>4.2 ± 0.7</td>
</tr>
<tr>
<td>Freshness (n = 338)</td>
<td>4.2 ± 0.7</td>
<td>4.2 ± 0.7</td>
</tr>
<tr>
<td>Cultural requirements (n = 281)</td>
<td>4.1 ± 0.8</td>
<td>4.1 ± 0.8</td>
</tr>
<tr>
<td>Presentation (n = 338)</td>
<td>2.94</td>
<td>2.94</td>
</tr>
<tr>
<td>Menu variety (n = 342)</td>
<td>.008*</td>
<td>.008*</td>
</tr>
<tr>
<td>Temperature (n = 336)</td>
<td>.003*</td>
<td>.003*</td>
</tr>
<tr>
<td>*p &lt; .05.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Opinion Based on Sport.** Athletes’ opinion of the menu was significantly associated with the category of sport they were participating in for a number of qualities (Figure 2). The availability of culturally acceptable items was rated lower by power/sprint athletes, who also rated a number of other qualities lower than other sport categories. Athletes from aesthetic sports gave the highest rating for portion size and a number of other qualities. Weight-category athletes rated the menu variety higher than athletes from other sports did.

**Improvements to Food and Beverage Provision.** Athletes were asked to provide suggestions for additional items they would like to see on the menu, particularly if they believed that it did not cater to their needs. A range of suggestions were provided for breakfast, lunch, and dinner; snacks; desserts; and cultural items (Table 5). Three
athletes requested McDonalds, while other specific food items included fajitas, quiche, sweet and sour chicken, Mexican, and wraps with a sandwich press to heat.

Figure 1. Significant associations between region and opinion of freshness, cultural requirements, menu variety, and temperature. Note: Significant differences between regions and opinion of food and beverage qualities are denoted by matching letters.

**Ability to Find Appropriate Items on the Menu.** Overall, 72% of the participants found it very easy or easy to find items on the menu to meet their nutrition needs. The athletes rated the food provision favorably (Table 6), most rating the availability of each option highly, with high-carbohydrate items (87%), high-protein items (84%), low-energy (kJ) items (72%), and low-fat items (66%) rated as good or very good. Seventy percent rated the availability of sports foods as good or very good, while the availability of vegetarian items (79%) and low-lactose items (66%) were also rated as good or very good. The availability of gluten-free items was rated as good or very good by 66% of
the participants; however, of the 5 participants who reported following a gluten-free diet, 1 gave no rating, 2 rated the availability of gluten-free items as average, and 2 rated it as good.

Table 5: Athletes’ Suggested Inclusions for the Menu at the 2010 Delhi Commonwealth Games.

<table>
<thead>
<tr>
<th>Food type</th>
<th>Country or region</th>
<th>Suggestion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breakfast</td>
<td>British Isles, Australia and New Zealand, Canada,</td>
<td>More variety of cereal, Weetbix, porridge oats,</td>
</tr>
<tr>
<td></td>
<td>Southeast Asia and Pacific Islands</td>
<td>gluten-free cereals, cereal muesli</td>
</tr>
<tr>
<td>Lunch/Dinner</td>
<td>British Isles, Canada, Southeast Asia and Pacific</td>
<td>Meat, fish, and poultry: more roasted meats, turkey, chicken,</td>
</tr>
<tr>
<td>main meals</td>
<td>Islands, Australia and New Zealand, Caribbean</td>
<td>steak burgers, steak, beef, more single serves of meat and poultry, fish,</td>
</tr>
<tr>
<td></td>
<td></td>
<td>and seafood</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Fruit and vegetable: more vegetables and greens, salad, vegetable chunks</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Breads and grains: larger variety of pasta, fresh pasta, brown rice,</td>
</tr>
<tr>
<td></td>
<td></td>
<td>more variety of grains than rice—quinoa, more whole-meal options,</td>
</tr>
<tr>
<td></td>
<td></td>
<td>and whole-wheat bread</td>
</tr>
<tr>
<td>Snacks/Desserts</td>
<td>Australia and New Zealand, British Isles, Canada,</td>
<td>More variety of desserts, lamingtons, cheesecake, snacks (e.g., nuts,</td>
</tr>
<tr>
<td></td>
<td>Southeast Asia and Pacific Islands</td>
<td>gluten-free options, muesli bars), low-fat desserts (e.g., custards,</td>
</tr>
<tr>
<td></td>
<td></td>
<td>stewed fruits, muesli with pieces of fruit in it)</td>
</tr>
<tr>
<td>Cultural items</td>
<td>Southeast Asia</td>
<td>Sushi, kimchi</td>
</tr>
<tr>
<td></td>
<td>Pacific Islands</td>
<td>Roast pig, baby pig, taro, takhi, corned beef</td>
</tr>
<tr>
<td></td>
<td>Africa</td>
<td>Matooke, biltong, ugali, droewors, boerewors</td>
</tr>
<tr>
<td></td>
<td>Australia</td>
<td>Milo, Vegemite</td>
</tr>
<tr>
<td></td>
<td>Caribbean</td>
<td>More Caribbean dishes including yam</td>
</tr>
<tr>
<td>Sports related</td>
<td>Australia, British Isles</td>
<td>PowerBar, protein bars, electrolyte/carbohydrate/protein drinks</td>
</tr>
</tbody>
</table>
Figure 2. Significant associations between sport category and opinion of cultural requirements, menu variety, and temperature. Note: Significant differences between sport category and opinion of food and beverage qualities are denoted by matching letters.

Ease of Finding Items and Opinion of Availability Based on Region. Reported ease of finding items was significantly associated with region. Athletes from the Caribbean region were more likely to find it difficult or very difficult to locate items (9.7%), while athletes from the British Isles found it easiest to locate items. Athletes’ opinion of availability differed significantly across regions for a number of items (Figure 3). Australian and New Zealand athletes, as well as those from Canada, tended to rate availability of items lower, with the exception of high-carbohydrate items, which athletes from the Caribbean, Southeast Asia, and the Pacific Islands rated lowest. Athletes from the British Isles, India, Sri Lanka, and Africa generally rated availability of all items higher.
Table 6: Mean Scores and ANCOVA for Opinion of Availability of Nutrient-Based and Special-Diet Items on the Menu in the Main Dining Hall for Region and Sports Category

<table>
<thead>
<tr>
<th>Nutrient-Composition-Based Items</th>
<th>Special-Diet Items</th>
</tr>
</thead>
<tbody>
<tr>
<td>High protein ( (n = 300) )</td>
<td>Vegetarian ( (n = 241) )</td>
</tr>
<tr>
<td>High carbohydrate ( (n = 302) )</td>
<td>Low lactose ( (n = 164) )</td>
</tr>
<tr>
<td>Sports foods ( (n = 260) )</td>
<td>Gluten free ( (n = 154) )</td>
</tr>
<tr>
<td>Low energy ( (n = 207) )</td>
<td></td>
</tr>
<tr>
<td>Low fat ( (n = 277) )</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Region</td>
<td></td>
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<tr>
<td>( M \pm SD )</td>
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<tr>
<td>( F (df = 6) )</td>
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<tr>
<td>( p )</td>
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<td></td>
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<td>Sport</td>
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<td>( F (df = 6) )</td>
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<td></td>
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</tr>
<tr>
<td>( p )</td>
<td></td>
</tr>
</tbody>
</table>

*\( p < .05 \). **\( p < .001 \).

Figure 3. Significant associations between region and availability of high-carbohydrate, low-fat, and gluten-free items and sports foods. 

*Note:* Significant differences between region and opinion of food and beverage availability are denoted by matching letters.
Opinion of Availability Based on Sport. Athletes’ opinion of availability differed significantly across the sports categories. A number of significant associations were observed between sports group and the availability of high-carbohydrate items, sports foods, and gluten free items, as athletes from power/sprint sports rated the availability of all items lower than did those from other sports (Figure 4).

Figure 4. Significant associations between sports category and availability of high-carbohydrate items, sports foods, and gluten-free items. Note: Significant differences between sport category and opinion of food and beverage availability are denoted by matching letters.

Discussion

The unique environment of the main dining hall at the Delhi Commonwealth Games provided an opportunity to investigate athletes’ perception of food provision in the lead-up to a major competition event. We found that most athletes rated the food available in the Delhi village dining hall favorably and reported that it was easy to find the items they required. While this result is similar to those obtained at past major competition events (Pelly, 2007; Pelly, Inge, & King, 2006; Pelly et al., 2009), it suggests a
significant positive outcome, as it was evident through direct liaison with the catering team that there were difficulties in sourcing specific food items from suppliers in Delhi. Favorable results were obtained for most factors (portion size, taste, freshness, cultural requirements, presentation, menu variety, and temperature); however, results depended on the region from which the athletes came. Although not significantly, athletes from non-Western regions (India and Sri Lanka, Africa) tended to rate the food and beverage qualities higher than athletes from Western regions for portion size, taste, freshness, temperature, and presentation. There may be a number of reasons for regional differences, including cultural acceptance of the food provided, sports-specific opinion, level of experience at international competition, and stage of competition.

**Cultural Acceptance of the Food Provided**

Cultural values are strongly associated with beliefs about food and therefore can have one of the greatest influences on food intake (Nestle et al., 1998). A lack of culturally appropriate food at a major competition event such as the Commonwealth Games may lead to difficulty in choosing appropriate food, which could result in a change in usual eating patterns and ultimately affect performance. Athletes from different regions, and different countries within those regions, have specific eating behaviors and patterns. We found that athletes’ suggestions for additional menu items generally related to their cultural style of eating, for example, Vegemite and Milo for Australian athletes, sushi and kimchi for those from Southeast Asian nations, and matooke, biltong, ugali, droewors, and boerewors for African athletes. These foods are strongly associated with ethnic identity and hence have a greater influence on athletes’ perception of the provision of suitable food. At previous major competition events, athletes from African, Eastern European, and Chinese regions indicated that there was a lack of culturally suitable items available (Pelly, 2007; Pelly et al., 2011). Furthermore, a lack of culturally specific food may influence athletes’ perception of their ability to locate appropriate food for their particular needs. Our results suggest that traditional Caribbean food items, in particular (staple foods such as cassava and yam), were not well represented on the menu, and subsequently athletes from this region reported more difficulty in finding suitable food. We also found that athletes from Southeast Asia and
the Pacific Islands rated the availability of high-carbohydrate items lower than did those from other regions, which may be because they typically consume rice and other starchy vegetables (e.g., sweet potato or taro) as their main carbohydrate source, and these familiar options may not have been provided as often as they desired. Alternatively, athletes from Western regions reported the availability of culturally suitable items higher, as they may have found it easier to find familiar foods that were acceptable to the Western palate. However, a number of requests for breakfast items, in particular breakfast cereal such as oats and muesli, came predominantly from athletes from Western countries. The Indian and Sri Lankan athletes rated the food highly and had no additional suggested food items, which may be indicative of the focus on Indian cuisine in the dining hall.

**Cultural Suitability of Snack and Sports Foods**

Athletes requested a number of different food items (more variety of meats, grains, vegetables, salads, and desserts); however, most specific food requests were for snacks and sports foods. Athletes from Western nations suggested that more snack foods be available day to day. Results from previous studies suggest that snacking contributes significantly to energy intake for some athletes and may be region dependent. A previous study on the competition eating behaviors of athletes competing at the Sydney 2000 Olympic Games (Pelly, 2007) found that snack items were eaten more frequently by athletes from Australia and North America, while a study of the eating patterns of Australian Olympic athletes suggested that snacking contributed approximately 23% of their total energy intake (Burke et al., 2003). Therefore, it would be prudent for food-service providers to consider adequate provision of snack-food items on the menu. We also believed that requests for sports-specific foods would come from athletes who rated the availability of sports food lowest (Australia and New Zealand, Canada, and Southeast Asia and the Pacific Islands). The comments we received about sports foods were from athletes from a variety of sports and only two regions; for example, protein bars were suggested by a power/sprint athletes (New Zealand) and a weight-category (Australia) athlete, while PowerBars were suggested by an athlete from an aesthetic sport (Australia). Only one endurance athlete, from the British Isles, suggested more
carbohydrate/electrolyte and protein drinks be available. It is possible that athletes who are less familiar with sports foods inadvertently rated the availability of these items higher or may have misunderstood the term sports food. For example, some athletes may associate the term sports foods with supplements, whereas others may perceive sports foods as bars, drinks, and meal replacements. Regardless of the sport and region, it is apparent that food-service providers should provide an adequate number of sports foods on the menu at major competitions.

Sport-Specific Opinions

Athletes from different sports have varied physiological and nutritional needs (Grandjean, Ruud, & Reimers, 2001), so it is plausible that athletes will have varied opinions of the food provision based on their sports’ requirements and their preferences. We found a number of associations between athletes’ opinion of the food and sports category. This is in contrast to Pelly et al. (2009), who found no relationship between menu satisfaction and sports category in athletes competing at the Sydney 2000 Olympic Games. Although this could be attributed to the use of different sports categories in the analysis of results (the four categories endurance, team, weight category, and power/skill [Pelly, 2007] vs. the seven categories aesthetic, endurance, power/sprint, racket, skill, team, and weight), a subsequent analysis of our results using four sports categories still found a significant association between sport and menu variety, presentation, temperature, and taste. Athletes in power/sprint sports rated menu variety and temperature lower than athletes in weight-category and aesthetic sports and the availability of culturally suitable items significantly lower than those in aesthetic and team sports. Although a large proportion (63%) of the power/sprint athletes were from non-Western regions, we found that Western athletes were more critical of the food provision. Athletes from power/sprint sports may therefore have higher expectations and be more critical of the food provided. We found that athletes from these sports rated the availability of all items, including sports foods and gluten-free items, lower than those in other sports and were more likely to follow a special diet (i.e., high protein). Previous reports in the literature indicate that athletes participating in these sports more frequently use sports supplements (Heikkinen, Alaranta, Helenius, &
Vasankari, 2011; Maughan, King, & Lea, 2004; Ronsen, Sundgot-Borgen, & Maehlum, 1999; Tscholl, Alonso, Dolle, Junge, & Dvorak, 2010) and sport-specific foods (Burke, Gollan, & Read, 1991). It is feasible that trainers had an influence on the athletes’ perception of the food provided.

**Previous Experience at Major International Competitions**

Previous experience in this type of environment may influence an athlete’s opinion of food provision. A higher proportion of athletes from Australia, New Zealand, and Canada reported experience in traveling and living in this type of competition environment, which may have resulted in higher expectations of food provision but also an increased confidence in selecting appropriate items. Similar to previous reports (76% at the Sydney 2000 Olympic Games; Pelly, 2007), most (70%) athletes reported that this was their first experience at a Commonwealth Games or Olympic Games. It is feasible that athletes who have not previously experienced a village dining hall may be less critical of the food on offer. We found that athletes from the British Isles had less experience in this environment and were generally less critical of the food provided. Higher overall ratings of food were obtained from African athletes, which may be the result of exposure to a wider range and volume of food than available in their home countries. We also found that athletes from aesthetic sports generally gave higher ratings for all food-provision qualities. Although we did not find a relationship between overall age and rating of food provision, athletes from aesthetic sports were younger than other athletes, suggesting that they have less experience in this environment. It is also feasible that athletes with a higher level of education may have a greater expectation of food and beverage qualities due to a more thorough understanding of eating for performance; however, we found no association between level of education and overall rating of food provision.

**Stage of Competition**

Athletes may also be less critical when they first arrive in the village, as we found that athletes who were more than 2 days away from their competition rated taste higher than
those closer to competition. We also found a moderate negative correlation between the overall daily mean score for taste, and a weak negative correlation for opinion of menu variety over the duration of the games. This suggests that either athletes are more critical of food provision the longer that they are accommodated in the athletes’ village and dine in the dining hall or, alternatively, the quality and variety of food provided may have declined over the games period. It is also possible that more scrutiny of the food occurs in the immediate phase before competition. Hodge and Hermansson (2007) reported that they have found athletes experience the “second-week blues” at Olympic Games competitions, where monotonous food, along with other factors, can cause athletes to become “irritable and stressed” (p. 5). This could lead athletes to be more critical of their surroundings, including food provision.

**Future Research**

This research provides information on athletes’ perception of food provision in this unique environment. It would be of further value to investigate athletes’ actual food and nutrient intake to understand whether athletes are choosing appropriately and how perception can influence intake. Due to the budgetary concerns and issues around environmental sustainability when providing food for such a large event (Pelly et al., 2009), food-service providers may benefit from having a more thorough understanding of food consumption and the various factors that lead to plate wastage. More information on the factors that influence food choice in this environment would also be beneficial to support staff (kiosk dietitians, team dietitians), as this may help in assisting athletes to make optimal food choices. In order for the opinions of non-English-speaking athletes to be included in future research, the questionnaire could be translated into other languages. A larger sample could also be obtained if the questionnaire were distributed to athletes via the *Chef de Mission* of each country. Nutrition knowledge may also influence food choice, but to what extent it plays a role in this type of unique environment is unknown. Further research on the level of nutrition knowledge of elite athletes may determine if education is a potential way to improve food choices in this setting.
Limitations

Several limitations need to be recognized in this study. One of the authors previously developed the questionnaire, and although it was evaluated for content by three Australian sports dietitians before use at the Delhi Commonwealth Games, due to the unique environment of this type of major competition test-retest reliability has not been examined. Although the cultural eating styles of some regions are similar, grouping the nations into one category may mean that individual differences are not recognized. It is possible that some of the lighter-weight category boxing athletes should have been included in the aesthetic sports category, but we did not have data to determine which weight-category event boxers took part in. The questionnaire was based on self-reported responses, although athletes may have misunderstood or misinterpreted questions, and at times the answers provided may have lacked detail. Non-English-speaking athletes were not able to take part in the study, so our results and discussion are limited to English-speaking athletes. Although many questions were opinion-based, as the questionnaire was distributed by nutrition-kiosk staff, athletes may have responded with a higher rating of the food provision than their actual perception, despite being assured that their responses were confidential. Some athletes may have completed the questionnaire in conjunction with other athletes and may have been influenced by others’ opinions. Finally, our sample was indicative of athletes attending the Commonwealth Games, with a mixture of ages, sports, and regions as the sample was chosen based on convenience and availability of athletes in the dining hall. A larger sample size would give a more representative sample.

Conclusions

At major competition events, dietary intake is important for athletes, as it can play a role in the preparation for and recovery from events. Appropriate food provision, especially for athletes who have specific dietary needs, is essential in this environment. Despite the difficulties in sourcing certain food items, food provision was rated favorably by athletes at the 2010 Delhi Commonwealth Games, although more culturally acceptable foods, sports foods, and special dietary foods (e.g., gluten-free items) could have
improved the overall opinion of food provision (for a summary of items refer to Table 7). Power/sprint athletes and athletes from Western regions were generally more critical of food provision, especially of the availability of culturally suitable items, sports foods, and special dietary foods. Suggested improvements in provision of meal and snack items to meet cultural, sporting, and special dietary needs may further help athletes make positive food choices at this type of elite-level competition.

Table 7: Suggested Improvements to the Provision of Items to meet Cultural, Sporting, and Special Dietary Needs

<table>
<thead>
<tr>
<th>Food provision area</th>
<th>Suggestions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Culturally acceptable foods</td>
<td>Caribbean staple foods (e.g., cassava and yams)</td>
</tr>
<tr>
<td></td>
<td>Southeast Asian and Pacific Island staples (e.g., taro, sweet potato, more rice-based dishes)</td>
</tr>
<tr>
<td></td>
<td>African foods such as ugali and matooke</td>
</tr>
<tr>
<td></td>
<td>More breakfast cereal options including muesli, Weetbix, and oats</td>
</tr>
<tr>
<td>Sports foods</td>
<td>More variety of sports and protein drinks</td>
</tr>
<tr>
<td></td>
<td>Protein and energy bars</td>
</tr>
<tr>
<td>Special dietary items</td>
<td>A larger variety of gluten-free items (e.g., breads, breakfast cereals)</td>
</tr>
<tr>
<td></td>
<td>A larger variety of lactose-free items (e.g., milk and yogurt alternatives)</td>
</tr>
<tr>
<td>Snacks and desserts</td>
<td>Muesli/cereal bars, nuts</td>
</tr>
<tr>
<td></td>
<td>Low-fat dessert options (e.g., stewed fruits and custard)</td>
</tr>
</tbody>
</table>
References


Chapter 2: Athletes' Opinions of Food Provision at the 2010 Delhi Commonwealth Games: The Influence of Culture and Sport


Pelly, F. (2007). A comprehensive environmental nutrition intervention for athletes competing at the Sydney 2000 Olympic Games. Sydney, Australia: School of Molecular and Microbial Biology, University of Sydney.


Chapter 3: Athletes use and opinion of point of choice nutrition labels in a dining hall environment at a major international competition
Chapter 3:
Athletes use and opinion of point of choice nutrition labels in a dining hall environment at a major international competition.

Sarah J. Burkhart & Fiona E. Pelly

Full publication reference:
3.1. **Introduction to the Chapter**

As reported in Chapter 3, appropriate food provision is an important service at major international competitions. In the dining hall of these events, a wide range of items need to be provided to cater for the diversity of athletes present. However, even if the right food is provided this does not guarantee that an athlete will make an appropriate food choice. As athletes may have difficulty identifying unfamiliar foods, the presence of allergens (e.g. nuts), or the macronutrient content of an item, one way of assisting athletes with food choice is through the use of POC labels. POC labels have been used at the OG and CG previously, and while rates of use have been reported, very limited information exists on the athletes’ opinion of the format and content of these labels. There is also little research regarding what specific groups of athletes are more likely to use labels, or how this can influence perception of labels.

This chapter includes a published paper that investigates and reports the findings on the use and opinion of POC labels by athletes at the Delhi 2010 CG. This paper was published in the peer-reviewed journal *Appetite*. The key aspects that relate to this thesis are the findings regarding athletes’ opinions of the POC label content and format, reported use of POC labels and suggested improvements to the label. Additionally, this paper assists with further refinement of the role of the dietitian at this type of event.

3.2. **Authors declaration**

Sarah Burkhart was responsible for study conception and design, acquisition, analysis and interpretation of data, statistical analysis and drafting and critical revision of the manuscript.

Dr. Fiona Pelly was responsible for study conception and design, acquisition, analysis and interpretation of data, critical revision of the manuscript, and supervision.

*This chapter is an exact copy of the above mentioned article*
Athletes use and opinion of point of choice nutrition labels in a dining hall environment at a major international competition.

Sarah J. Burkhart & Fiona E. Pelly

Abstract

Point of choice (POC) labels may assist individuals to choose food appropriate for their needs when dining away from home. However, limited research exists on the use and opinion of labels by athletes in a large dining hall environment. The aim of this study was to evaluate athletes’ utilisation and opinion of POC nutrition labels provided in the athletes village main dining hall at a major competition event (the 2010 Commonwealth Games, New Delhi, India). A questionnaire was distributed to athletes from a range of cultural and sporting backgrounds (n = 351) while present within the dining hall during main meal periods throughout the competition event (23rd September–14th October, 2010). While the majority of respondents (79%) reported that it was important/very important to provide POC information for menu items and 59% rated the POC labels as useful/very useful, only 14% of athletes reported using labels all of the time. Athletes from specific regions (India/Sri Lanka, Africa), sports (team and weight category), and those with less education reported using the labels more frequently. Although females rated the importance of providing nutrition information higher than males (p = 0.008), there was no gender difference in reported use of POC labels. Athletes believed that POC labels could be improved with the addition of more information, better aesthetic properties, and better positioning in more convenient locations. Further research to identify the most effective POC label for use in this environment, and ultimately the development of a standardised label may assist a broader range of athletes at future competitions.

Introduction

Point of choice (POC) nutrition labels may play an important role in assisting individuals with food choice when dining away from home. While taste, availability,
nutrition knowledge, cultural acceptability, sensory properties and the presence of other individuals (De Castro, 1994; Herman, Roth, & Polivy, 2003; Nestle et al., 1998; Smart & Bisgoni, 2001; Sproul, Canter, & Schmidt, 2003; Stroebele & De Castro, 2004), can influence food selection, there may be situations where nutrient composition is of higher importance to the diner. POC labels have been successfully implemented in a number of settings, including workplace and university canteens/cafeterias, public food outlets and at athletic competition sporting events (e.g. the Olympic and Commonwealth Games), as a means of providing users with information about the food item and potentially assisting them with food choice. POC labels can include information on a range of factors including nutrient composition, ingredients, glycemic index, the presence of allergens and suitability for religious diets. Previous research on the use, acceptability and format of labels has varied significantly with limited consensus on the most appropriate layout.

There is evidence to suggest that POC labels are used by certain individuals above others. Females have been reported to use labels more frequently than males (Besler, Buyuktauncer, & Uyar, 2012; Cowburn & Stockley, 2005; Driskell, Schake, & Detter, 2008), and individuals with a higher level of education (Besler et al. 2012; Satia, Galanko & Neuhouser, 2005; Cowburn & Stockley, 2005; Drichoutis, Lazaridis, & Nayga, 2005). However, there is less consensus on whether age (Coulson 2000; Drichoutis et al., 2005; Govindasamy & Italia, 1999; Kim, Nayga, & Capps, 2001a, 2001b; Satia, et al., 2005) and income/working status (Drichoutis, Lazaridis, & Nayga, 2006) can predict label use. Although reasons for label use are not well investigated, there is evidence to suggest that the usability of a POC label may depend on the relevance of the information displayed to the user (Worsley, 1996). For example, females place more importance on serving size, ingredients, energy, fat and sodium, while males favour information on protein (Conklin, Cranage, & Lambert, 2005; Driskell et al., 2008). A number of studies have shown that certain POC label formats and features are preferred by consumers, which in turn may influence use. This includes the use of one column of information as opposed to two (Levy, Fein, & Schucker, 1992), displaying nutrients as a percentage rather than metric units (e.g. grams) (Levy, Fein, & Schucker, 1996), and use of a percentage per 100 g instead of per serving (Higginson, Rayner, Draper, & Kirk, 2002). Furthermore, preference is given to appropriate
language (Signal et al., 2007), as well as the use of bold text, familiar words and appropriate text size (Bialkova & Van Trijp, 2010; Drichoutis et al., 2005; Ranilovic & Baric, 2011). Terminology may also play a role in an individual’s ability to use a label. For example, scientific and technical terms (for example; cholesterol/fatty acids, and sugar/carbohydrate) on the label may be confusing (Besler et al., 2012; Cowburn & Stockley, 2005). Individuals may also have difficulty with calculations of serve size or comparing the nutrient content of different sized items (Mackison, Anderson, & Wrieden, 2008; Ni Mhurchu & Gorton, 2007), and understanding unfamiliar symbols, expressions or abbreviations (Besler et al., 2012).

While it is clear from the limited available studies that some POC label formats and content are preferred by individuals in the general population, it may be more of a challenge to provide a label that can be used by a specific, yet diverse group, such as athletes competing at a major international competition. At international competition events such as the Commonwealth (CG) and Olympic Games (OG), competitors and their support teams are housed in a designated athletes’ village. This village contains a central dining hall which provides meals, snacks and beverages 24 h a day, and may feed up to 10,000 individuals a day (Pelly, O’Connor, Denyer, & Caterson, 2011). Athletes living in the village come from a range of cultural backgrounds, may be unaccustomed to living away from home, and have varying nutrition knowledge. While reports of food provision at previous events has been rated favourably (Burkhart & Pelly, 2013; Pelly, 2007; Pelly, Inge, King, & O’Connor, 2006), a large proportion of athletes have been shown to follow specialised dietary regimens (Pelly & Burkhart, submitted for publication), and report needing assistance to identify appropriate items for sports specific, cultural, religious, therapeutic and personal requirements (Burkhart & Pelly, submitted for publication; Pelly, King, & O’Connor, 2006). In order to assist athletes make appropriate food choice, POC labelling has been displayed above food items in the central dining hall since the 1992 Barcelona OG’s (Barcelona ’92 Olympic Organising Committee) and the Melbourne 2006 CG’s (Pelly, Inge, King, & O’Connor, 2006), respectively. Furthermore, there is evidence that labels are considered an important component of nutrition support in this environment with the majority (87%) of athletes using the POC labels all or some of the time (Pelly, 2007; Pelly, Inge, King,
& O’Connor, 2006), and reporting that label information played an important role in food choice (Pelly, 2008; Pelly, King, & O’Connor, 2006).

Despite current requirements in catering tenders for nutrition labelling of all menu items in the main dining hall, (F. Pelly, personal communication, 21st March, 2012), the design and content of POC labels is at the discretion of the caterer and may vary between events. In addition, the use and opinion of POC labels by athletes competing at these events has not been fully investigated. Therefore, the aim of this study was to evaluate athletes’ utilisation and opinion of the POC nutrition labels provided in the athletes village main dining hall at the Delhi 2010 Commonwealth Games (New Delhi, India).

Figure 1. A template¹ of the POC label layout used at the Delhi Commonwealth Games

<table>
<thead>
<tr>
<th>CHINESE FRIED RICE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nutritional information</td>
</tr>
<tr>
<td>Serving size: 75g</td>
</tr>
<tr>
<td>Energy</td>
</tr>
<tr>
<td>Carbohydrates</td>
</tr>
<tr>
<td>Sugars</td>
</tr>
<tr>
<td>Protein</td>
</tr>
<tr>
<td>Fat, total</td>
</tr>
<tr>
<td>Saturated</td>
</tr>
</tbody>
</table>

¹ Due to copyright requirements a template has been provided

Methods

Event

This research was undertaken at the XIX Commonwealth Games, held in Delhi, India from 23rd September–14th October, 2010. A total of 4352 athletes from 71 nations
competed in 17 sports (Commonwealth Games Federation, 2012). Delaware North Companies, in conjunction with TajSATS were the caterers responsible for providing all food and beverage in the athletes’ village main dining hall. This included hot food stations serving African, Asian, Indian, Western and Vegetarian items on an 6 day rotational menu offered over 24 h in four meal periods (breakfast, lunch, dinner and supper), as well as a salad bar and a breakfast/breads station (offered all day). A substantial number of items were included on the menu. Additionally, the caterers were also responsible for providing a nutrition kiosk, which was staffed by a head catering dietitian, three Australian accredited practising dietitians, one Indian accredited dietitian, and a research assistant. The kiosk staff were responsible for undertaking quality assurance testing of all dishes in order to check the content of POC labels.

**Point of choice nutrition labelling**

The caterers were responsible for designing the POC labels, and while these were reviewed by an expert sports dietitian and changes suggested, due to time constraints, not all changes were implemented. The POC labels included information on nutrient composition (serving size, and amount of energy (kJ), total carbohydrate (g), sugar (g), protein (g), total fat (g) and saturated fat (g) per serve and per 100 g) (see Fig. 1 for an example of the layout). The labels were colour coded (based on a system used for Buddhist eating regimens), to signify if the item was vegetarian (green), contained red meat (red) or contained pork (burgundy). The label also identified if the item was spicy, vegan, contained seafood, or was high in carbohydrate or low in fat. Indian cuisine items were occasionally only referred to by Indian names, and were not provided with an English translation (e.g. gujjar halwa – an Indian dessert). Labels were displayed above all menu items with the exception of drinks and were updated at each meal period to reflect menu changes.

**Survey instrument**

A questionnaire previously used to investigate nutrition support at the Melbourne 2006 CG (Pelly, Inge, King, & O’Connor, 2006) was revised for use at the Delhi CG. Further
detail on this instrument and the content evaluation process may be found in Burkhart and Pelly (2013). The questionnaire contained 25 questions divided into 4 broad focus areas, including three sections designed to assess athletes’ opinion of the POC nutrition labels. Participants were asked how the POC labels assisted with finding suitable items on the menu to meet their particular dietary/nutrition needs, the usefulness of POC nutrition label information, and the content and presentation of the nutrition labels on a Likert scale from one (not at all useful) to five (very useful). They were also asked to indicate how often they used the nutrition labels (all of the time, some of the time or never) and how important they believed it was to provide nutrition information for each item on the menu (not important to essential) at a CG. Finally, participants were asked in an open ended question if any other information should be provided on the labels, and if so, to provide details on suggested improvements that would assist them to find appropriate items or items they desired. Demographic information including: gender, date of birth, country representing, sport category and event, native language, cultural style of eating, previous experience at similar events, stage of competition and level of education (based on level of completed schooling: never attended; intermediate/middle school, senior school, University or other tertiary institution) was also reported.

Participants

The questionnaire was distributed by nutrition kiosk staff to the target population (n = 4352), who were defined as athletes living in the athletes village, and dining in the main dining hall, at any of the four meal periods (breakfast, lunch, dinner and supper) throughout the games period. Athletes ate the majority of their meals within the dining hall unless at competition or training due to security and food safety issues outside the village. While the questionnaire was self-administered, the researcher was available to answer participants’ questions if required. In order to gain a representative sample, athletes from a variety of regions and sports were approached to take part based on the availability of athletes at each meal period. Only those individuals who were over the age of 16, unless consent was given by a parent or guardian, and considered having sufficient comprehension of the English language (as determined by kiosk staff) were eligible to participate. Six athletes approached were 15 years of age but kiosk staff
determined these athletes to have adequate comprehension of the questionnaire in order to take part in the study.

**Data analysis**

Participants who completed the questionnaire were classified into a sport category (aesthetic, endurance, power/sprint, racquet, skill, team and weight category) based on the physiological needs of their sport and a region (Africa, Australia and New Zealand, British Isles, Canada, Caribbean, India and Sri Lanka, and South East Asia and the Pacific Islands) based on location and cultural style of eating (Table 1). One dining hall questionnaire was excluded from analysis as more than five questions were unanswered. The results were analysed with Statistical Package for the Social Sciences (SPSS Inc., Chicago, IL. Version 19, 2011). Depending on the normality of data, associations were calculated with the Chi-Square statistic, Kruskall–Wallis ANOVA and Mann–Whitney U tests. Significant confounders were identified with analysis of covariance (ANCOVA) within parametric data. Pearson’s Correlation Coefficient was used to determine if there was a relationship between opinion of label usefulness and use of labels. Statistical significance was considered to be \( p \leq 0.05 \). Post hoc analysis was calculated with Bonferroni for significant relationships in order to determine the location of the effect, based on \( p \)-values adjusted for multiple comparisons.

**Ethical approval**

The University of The Sunshine Coast Human Research Ethics Committee granted ethical approval for this research. Participation was voluntary for the questionnaire and a research information sheet was available for all participants. Consent was considered to be given upon completion of the questionnaire. Approval for this research was also given by the catering companies; Delaware North Companies and TajSATS, as well as the Delhi 2010 CG Organising Committee.
Chapter 3: Athletes use and opinion of point of choice nutrition labels in a dining hall environment at a major international competition

Results

Participant characteristics

A total of 351 athletes returned a completed dining hall questionnaire (8.1% of the target population) (Table 1). This included athletes from 53 of the 71 countries competing at this event. Approximately half of the participants (49%) reported that this was their first experience living in an athletes village, while 70% reported that this was their first experience competing at a Commonwealth or Olympic Games. English was reported as being spoken as a first language by 70% of participants. Twenty percent of the athletes had completed their event at the time of questionnaire participation, while 28% were on the day before, day of, or between events, and 52% were more than 2 days away from competition.

Nutrition labels

Nutrition labels were viewed as playing a positive role in assisting athletes to find items to meet their needs with 59% considering them very useful or useful. Nutrition labels were used all of the time, some of the time and never by 14%, 65% and 22% of athletes respectively. The majority of the participants (79%) thought that it was very important or important to provide nutrition information for each dish on the menu. Females (87%) rated the importance of providing nutrition information higher than males (71%) (p = 0.008). Athletes who rated the importance of providing nutrition information higher were more likely to report using the POC labels all of the time or some of the time, whereas those who reported the importance lower were more likely to report never using labels (p ≤ 0.001). There was no relationship between gender, age, or phase of competition and use of POC nutrition labels, however athletes who had attended university were less likely to use the POC labels all of the time than those with intermediate school as their highest level of education (p = 0.003). The content of the nutrition labels was rated positively with information provided on the labels (82%), information about the nutrients (77%), allergens (72%), and portion size (64%) rated as good or very good. The presentation of the labels was also viewed positively with overall impression and presentation of the label rated highly (79% and 85% respectively). Seventy-one percent rated their understanding of the nutrition labels as
good or very good. Anecdotally, dietitians at the kiosk reported being asked to provide English translations of some Indian items.

**Label use and opinion based on region and sport**

Use of the nutrition label was significantly associated with region (p ≤ 0.001) with athletes from India and Sri Lanka, and Africa reporting the highest use of labels (Fig. 2). There was a weak positive correlation between athletes from non-Western regions opinion of label usefulness and use of labels (r = 0.266, p = 0.001), while a moderate positive correlation between opinion of usefulness and use of labels (r = 0.310, p ≤ 0.001) was seen for athletes from Western regions. The participants who followed an Indian style of eating rated the usefulness of the nutrition labels higher than those who did not report an Indian style of eating (p = 0.027). There was a significant association between sport category and use of the nutrition labels (p = 0.002) with highest use reported by team and weight category athletes.

**Improvements to nutrition labels**

Twenty percent of the participants believed that improvements could be made to the nutrition labels through the addition of more information. Of these, 19 athletes suggested a number of specific changes to the nutrition labels based on location, aesthetic properties and content of the nutrition labels (Table 2). There was a significant relationship between changes being needed on the label and sport category (p = 0.014). Athletes following a Western style of eating were less likely to believe that changes were needed on the nutrition labels (p = 0.006) than those following a non-Western style of eating.
Figure 2: Frequency of POC label use\(^1\) and opinion of usefulness\(^2\) by region

Note: 1 – in response to “how often do you use nutrition labels?”, 2 – in response to “how useful are the POC nutrition labels in assisting you to find items/dishes to meet your nutrition needs?”. There was a significant association with athletes from India/Sri Lanka and Africa reporting higher use of POC labels.
Table 1. Participant characteristics

<table>
<thead>
<tr>
<th>Gender</th>
<th>Sport</th>
<th>Level of education</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>Aesthetic</td>
<td>Attended University</td>
</tr>
<tr>
<td>Female</td>
<td>Endurance</td>
<td>Completed High school</td>
</tr>
<tr>
<td>183</td>
<td>79 (23)</td>
<td>Completed Middle School</td>
</tr>
<tr>
<td>166</td>
<td>46 (14)</td>
<td>Never attended school</td>
</tr>
<tr>
<td></td>
<td>52 (15)</td>
<td>208 (60)</td>
</tr>
<tr>
<td></td>
<td>38 (11)</td>
<td>86 (25)</td>
</tr>
<tr>
<td></td>
<td>55 (17)</td>
<td>50 (14)</td>
</tr>
<tr>
<td></td>
<td>43 (13)</td>
<td>2 (1)</td>
</tr>
</tbody>
</table>

Note: There was a significant association between level of education and sport (p ≤ 0.001) as well as region (p ≤ 0.001). Athletes from skill and team sports reported a higher level of education, while those from Africa reported a lower level of education than athletes from other regions. There was also an association between age and sport (p ≤ 0.001), with athletes competing in aesthetic sports being younger, and athletes in skill based sports older than other participants. There was an association between sport category and region (p ≤ 0.001), with less representation by athletes competing in aesthetic sports, particularly from Africa, Canada, the Caribbean and India/Sri Lanka, while majority of the racquet and skill athletes represented the British Isles.

a Diving, gymnastics  
b Athletic events 800m and over, cycling, swimming distance events  
c Athletic events under 400m, athletic field events, swimming sprint events  
d Badminton, table tennis, tennis, squash  
e Hockey, netball, rugby 7’s  
f Boxing, weightlifting, wrestling  
g Botswana, Cameroon, Ghana, Kenya, Lesotho, Malawi, Mauritius, Namibia, Nigeria, Rwanda, Sierra Leone, South Africa, Tanzania, The Gambia, Uganda  
h England, Falkland Islands, Gibraltar, Guernsey, Isle of Man, Jersey, Northern Ireland, Scotland, Wales  
i Antigua, Barbados, Bermuda, Cayman Islands, Dominica, Guyana, Jamaica, St Kitts, St Lucia, St Vincent, Trinidad  
j Cook Islands, Kiribati, Malaysia, Niue, Norfolk Island, Papua New Guinea, Samoa, Singapore, Tonga  
k Canada  
m India, Maldives, Seychelles, Sri Lanka, Uzbekistan  

79
Table 2: Athletes’ suggested changes to POC nutrition labels

<table>
<thead>
<tr>
<th>n</th>
<th>Suggested changes to POC nutrition labels</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>An ingredient list</td>
</tr>
<tr>
<td>3</td>
<td>The size of the nutrition labels be increased</td>
</tr>
<tr>
<td>2</td>
<td>Provide the label at all times and place nutrition labels on the tables or on top of the counter</td>
</tr>
<tr>
<td>2</td>
<td>A colour coding index, and more colour coding including pie graphs</td>
</tr>
<tr>
<td>1</td>
<td>A guide to gauge if a food is suitable for a particular sport</td>
</tr>
<tr>
<td>1</td>
<td>Better identification of low fat items</td>
</tr>
<tr>
<td>1</td>
<td>Information on allergens</td>
</tr>
</tbody>
</table>

Discussion

Appropriate food choice in a large dining hall environment depends not only on the food and beverage provided, but the support available to assist athletes to find suitable food that meets their specific individual requirements. This setting provided a unique opportunity to investigate athletes’ use and opinion of POC labels in the dining hall of a major competition event held in a non-Western region. A high proportion of athletes reported that POC labels were an important/very important component of the support provided in the dining hall and used them all or some of time, although opinion differed across regions and sport, similar to results reported at past competition events (Pelly, 2008; Pelly, Inge, et al., 2006). As most athletes report following some sort of dietary regimen (Pelly & Burkhart, submitted for publication), and have previously been shown in a similar environment to rate nutrition composition as having the greatest effect on food choice (Pelly, King, & O'Connor, 2006), it is apparent that POC nutrition labels may play an important role in assisting athletes make an informed food choice. In an unfamiliar environment, nutrition labels may be an effective method of providing information on the nutrition composition of each menu item.
Regional use and opinion of POC labels

Athletes from India/Sri Lanka and Africa reported using POC labels more often than athletes from other regions which could be explained by familiarity with the foods provided, level of education, and level of experience. As caterers endeavour to represent the host nations cuisine in the dining hall, it is likely that the athletes from India and Sri Lanka used the labels more, and rated the POC label of more assistance as the colour coding for meat, pork and vegetarian was based on a system commonly used in this region for those that follow a Buddhist eating regimen. It is also possible that these athletes were more familiar with the Indian names of some items, and were therefore more likely to use the POC label provided. Kiosk dietitians reported requests for translations for a number of Indian items, suggesting that some athletes from Western regions did not know what certain food items were, and consequently may not have used the POC label.

In contrast to previous research (Nayga, 1996; Shine, O’Reilly, & O’Sullivan, 1997), we found that individuals with a lower level of education (including athletes from Africa) were more likely to report using POC labels. It is possible that less educated athletes may possess less general knowledge of the nutrient composition of food and therefore seek out more information about each item from the POC label. This may also be influenced by the high pressure environment of a major international competition where each athlete is aiming to perform to the best of their ability. Those with less knowledge or experience may believe that using labels to choose appropriate food helps them to have the same nutritional advantage as other, more knowledgeable athletes. It is also possible that more educated or experienced athletes believe that they can choose a food that meets their requirements without using a POC label.

The regional differences in use could also be due to less experience in this type of environment resulting in greater use of the POC labels in order to choose food that is unfamiliar. There is evidence that some individuals may have a greater need for information about foods that are unfamiliar to them (Besler et al., 2012; Cowburn & Stockley, 2005). However, we did not find any significant association between experience at an OG/CG and use of POC labels or opinion of POC label usefulness. It is
feasible that athletes with less experience have had less exposure to POC labels, and the novelty of POC labels could potentially increase use in these individuals.

**Gender, age, sport and stage of competition**

While there was no relationship between use of labels and gender, females rated the importance of providing nutrition information higher than males. Females have previously been shown to use labels more often (Besler et al., 2012; Cowburn & Stockley, 2005; Driskell et al., 2008), and have a stronger desire for display of particular information on the label (Conklin et al., 2005; Driskell et al., 2008; Freedman, 2011). While it is feasible that our sample size was not large enough to detect a difference between gender and use, the relevance of the format and content of the label used at the Delhi CG’s may have influenced use. Not surprisingly, the majority of the suggestions for improvement to the POC labels, including an ingredients list and more specific serving size information, were from females, whereas males generally suggested including more sports specific information. It is also plausible that a difference was not detected due to variance in motivation for use of labels between elite athletes (regardless of gender) and the general public. Athletes from specific sports are known to follow particular dietary practices based on the physiological needs or culture of their sport (Grandjean, Ruud, & Reimers, 2001), and may therefore be more concerned with sport specific information, such as the carbohydrate content of a food, or the total fat content of an item as related to their performance. In addition, the nutrient composition of an item has been shown to have more of an influence on food choice than sensory factors for athletes competing in team, weight category and endurance sports at a similar event (Pelly, King, & O’Connor, 2006). This may explain why athletes competing in weight category and team sports were more likely to report using POC labels.

While it could be hypothesised that an athlete’s stage of competition may influence their use of POC labels, with greater use pre-event, we did not find an association between competition phase and use of labels. It is possible that the sample of athletes who reported using labels were more focused on eating well for the duration of their stay in the village, regardless of competition phase. Similarly, no relationship
was apparent between age and use of labels. This is not surprising given that previous research is inconclusive on the effect of age on label use (Coulson, 2000; Drichoutis et al., 2005; Govindasamy & Italia, 1999; Kim et al., 2001a, 2001b; Satia et al., 2005).

Non-use of POC labels

Although the POC labels were reported to be of assistance, some athletes did not use these to find appropriate food. At the Melbourne 2006 CG, only 12% of athletes reported not using the nutrition labels provided (Pelly, King, et al., 2006), less than the 22% of athletes who reported not using labels in this sample. This research did not investigate why an athlete may not use the labels, although reasons reported in other settings have included; a lack of understanding, print size which is hard to read, inadequate time to read the label, a lack of confidence in the accuracy of nutrition information, and poor location of the label (Besler et al., 2012; Cowburn & Stockley, 2005). One possible reason for the difference in usage rates between recent competition events could be that athletes did not understand the label content. Although the majority (71%) rated their understanding of the label as good or very good, athletes who reported poorer understanding were less likely to use the label. This indicates that athletes may use POC labels more frequently if they have a better understanding of the label content. Individuals who have previously reported that they did not understand, or only partially understood nutrition labels, cited that labels contained expressions, symbols or abbreviations that were unclear or used a foreign language (Besler et al., 2012). It is possible that these factors were unclear to some individuals at this event. Alternatively, athletes that did not use labels may have been unconcerned with the nutrient content of the food, and were more focused on the familiarity or sensory appeal of the food item. Although we have noted that nutrient composition may be an important influence in this environment, it has been previously reported that taste and sensory attributes may override nutrient composition when choosing a food (Sproul et al., 2003). It is therefore possible that some athletes base their food choice on taste, smell and appearance, especially with the buffet layout that is used in this environment. Alternately, athletes may simply choose foods that are familiar and therefore not have a need to use labels to
identify these foods. It is also feasible that the athletes were not confident that the labels were an accurate representation of the food item.

Another possible reason for the difference in usage rates between recent competition events may be due to variation in the overall presentation and content of the nutrition label. While labels at the Sydney, Beijing and London OG’s have generally provided information on the serve size, macronutrient composition and the presence of allergens, a standardised format has not been used at these events (Fig. 3). Although the majority of athletes reported that the content and presentation was good or very good at both the Melbourne 2006 (Pelly, Inge, et al., 2006) and Delhi 2010 CG, the format may have influenced the ease of use of the labels. Although there is varied opinion on the best format for a nutrition label (Almanza & Hsieh, 1995; Bialkova & van Trijp, 2010; Cowburn & Stockley, 2005; Drichoutis et al., 2005; Levy et al., 1992, 1996; Ranilovic & Baric, 2011; Signal et al., 2007), participants in our study suggested colour coding, identification based on suitability for specific sports, better identification of low fat items and an ingredient list as ways to improve the format. A standardised nutrition label could provide uniformity between events, allowing athletes, caterers and support staff to become familiar with the format allowing improved nutrition support and potentially reducing the time involved in food choice. The outcome of this study supports previous recommendations for a standardised label for major competition events (Pelly, O’Connor, Denyer, & Caterson, 2011).

Limitations

There were a number of limitations that need to be recognised in this study. Our questionnaire was self-administered by kiosk staff and based on self-reported responses. Some athletes may have completed the questionnaire in conjunction with others, or in the presence of the researcher, which may have influenced their responses. As the questionnaire was anonymous, kiosk staff were not always able to follow up with athletes who may have misunderstood questions and/or given answers with insufficient detail. Participants were chosen based on convenience due to the availability of athletes at each meal period; however athletes from a range of sports and regions were approached to participate in order to obtain a representative sample. Due to the unique
nature of the environment in which this survey is distributed, test–retest reliability evaluation was not possible; however content evaluation was undertaken both before implementation at the Melbourne 2006 CG and again for this study (Burkhart & Pelly 2013). Our study was also limited to English speaking athletes and therefore our results and discussion can only be attributed to this group.

Future directions

Further research should be undertaken to determine the most effective POC label format for this environment, including identification of the reasons for limited label use, which can ultimately lead to the development of a standardised label that can be trialled at future competition events. Additionally, research into innovative methods of nutrition support, such as the use of smart phone applications/quick response codes, websites, and materials (i.e. posters/flyers) to use in conjunction with POC labels would be beneficial. It would also be of interest to investigate whether labels and other methods of nutrition support correlate to the suitability of athletes’ dietary intake for competition, as well as the various factors which may influence food choice in this unique environment.

Conclusions

Appropriate nutrition support, especially for athletes who have specific dietary needs or who are unfamiliar with the athletes’ village environment, is an important and valued inclusion at major competition events. POC labels are an integral part of the nutrition support service and should be further developed to meet the needs of a broad range of athletes. Increased use of nutrition labels may occur if a standardised format is adopted for major international competition events. Further research on opinion and utilisation of nutrition support and the influences on food choice in this unique environment would ensure that caterers and organisers of similar events in the future can provide appropriate POC labels that are suitable for a range of athletes with diverse needs.
Chapter 3: Athletes use and opinion of point of choice nutrition labels in a dining hall environment at a major international competition

<table>
<thead>
<tr>
<th>Information provided on POC nutrition labels</th>
<th>Olympic Games</th>
<th>Commonwealth Games</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Sydney 2000</td>
<td>Bejing 2008</td>
</tr>
<tr>
<td>Language</td>
<td></td>
<td>London 2012</td>
</tr>
<tr>
<td>English</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>French</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Mandarin</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td></td>
<td>Delhi 2010</td>
</tr>
<tr>
<td>Serve size</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Metric (grams, mLs)</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Household measures</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Energy content</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Calories (cal)</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Kilojoules (kJ)</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Ingredients</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nutrient composition</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grams per serve</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Grams per 100g</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Rating symbol</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Vegetarian/Vegan</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Gluten free/contains gluten</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Other allergens</td>
<td>✓ ²</td>
<td>✓ ³</td>
</tr>
<tr>
<td>Halal</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Other</td>
<td>✓ ⁵</td>
<td>✓ ⁶, ⁷</td>
</tr>
</tbody>
</table>

1. Some items were provided with Indian names
2. Shellfish/fish, lactose, egg, nuts/tree nuts
3. Seafood/fish, eggs, soya, peanuts/tree nuts, dairy
4. Shellfish
5. Glycemic index
6. Indication of spicy
7. Colour of card represented vegetarian (green), contained red meat (red), contained pork (burgundy)

Figure 3. Example of POC label content from the Delhi Commonwealth Games and other previous Commonwealth and Olympic Games.
References


Burkhart, S. J., Pelly, F. (submitted for publication). Beyond sports nutrition. The diverse role of dieticians at a major competition event.


Chapter 4:

Beyond sports nutrition: The diverse role of dietitians at the Delhi 2010 Commonwealth Games

Sarah J. Burkhart & Fiona E. Pelly

Full publication reference:

4.1. Introduction to the Chapter

In Chapter 3 the importance of appropriate food provision was highlighted. The findings discussed in Chapters 3 and 4 show that the majority of athletes rated the food provision and POC labels highly at this event, and that POC labels can be an effective method of assisting with food choice. However, it is plausible that some athletes may need individual assistance. In this instance, dietitians based at a nutrition kiosk in the main dining hall may be well placed to help.

The following chapter consists of a published paper that investigates the activities of dietitians based at the nutrition kiosk at the Delhi 2010 CG. This study investigates the services provided by dietitians, as well as the skills that are required to assist athletes in this environment. The study also investigates athletes’ previous source of nutrition information to gain an understanding of what support athletes have had prior to attending this event.

This paper was published in the peer-reviewed *Journal of Human Nutrition and Dietetics*. The key aspects that relate to this thesis are the specific information on who approached the kiosk and why, what role the dietitian plays and the skills required for assisting athletes at this event. The findings on athletes previous source of nutrition information is also important in understanding how kiosk services may be developed in the future.

4.2. Authors declaration

Sarah Burkhart was responsible for study conception and design, acquisition, analysis and interpretation of data, statistical analysis, drafting and critical revision of the manuscript.

Dr. Fiona Pelly was responsible for study conception and design, acquisition, analysis and interpretation of data, drafting and critical revision of the manuscript, and supervision.

This chapter is an exact copy of the above mentioned article.
Beyond sports nutrition: The diverse role of dietitians at the Delhi 2010 Commonwealth Games

Sarah J. Burkhart & Fiona E. Pelly

Abstract

Background: Although registered sports dietitians commonly assist athletes with training and competition nutrition advice, an emerging area of practice is focused around food provision and nutrition support provided at major competition events. The present study aimed, first, to identify the dietetic skills and scope of practice that dietitians may require to work in this environment as determined by the occasions of service provided by dietitians at a nutrition kiosk located in the dining hall at a major competition event and, second, to investigate athletes’ opinion and usage of the nutrition services and the association with their type of sport and previous source of nutrition information. Methods: Dietitians based at a nutrition kiosk recorded all enquiries (n = 383) and consultations (n = 60) from 23 September to 14 October 2010. A questionnaire was also distributed to athletes in the main dining hall over this period to investigate their opinion and use of nutrition support, as well as their previous source of nutrition information. Results: Although athletes from Western regions made up the majority of the enquiries regarding food provision and special/therapeutic dietary requirements (predominately food allergy and intolerance), athletes from non-Western regions, and those in weight category sports, had more sports nutrition enquiries and were more likely to request a consultation. A number of athletes (32%) reported no previous or one source of nutrition information, whereas only eight of 52 athletes who requested a consultation had prior nutrition assistance. Conclusions: In addition to sport nutrition knowledge and experience, dietitians working in this environment are likely to require an understanding of cultural eating styles, food beliefs and customs, large-scale food service operation, and local food availability.
Chapter 4: Beyond Sports Nutrition: The Diverse Role of Dietitians at the Delhi 2010 Commonwealth Games

Introduction

Dietitians can play a significant and diverse role in providing support to athletes. Although this often includes advice on training, recovery and competition nutrition, an emerging area of practice includes reviewing food provision, menu planning and specifically targeted dietary advice at competition venues away from home. Elite athletes frequently travel internationally to a range of countries as part of their standard competition schedule and, although they may have access to dietitians in their home environment, the dietitian does not always have the opportunity to accompany the athlete to these events. For many athletes, the pinnacle of competition is the summer or winter Olympic Games (OG), or similar [e.g. the World Athletics championships, Commonwealth Games (CG), or Pan Pacific Swimming championships]. At events of this scope and size, food is commonly provided in a large purpose built dining hall, often located within an athlete’s village where athletes and officials from a range of countries and sports stay for some, or all, of the duration of the event. For all athletes, the food is provided is free of charge and there is no limit on dining frequency or intake. Subsequently, athletes may struggle to choose appropriate types and quantities of food in this environment without professional dietetic input.

A recent new development at major competition events has been the introduction of dietetic expertise in the design, nutritional analysis and nutrition labelling of the menu (Barcelona ‘92 Olympic Organising Committee, 1992) and the provision of one or more dietitians located at a ‘nutrition kiosk’ within the main dining hall (The Atlanta Committee for the Olympic Games, 1997). The first apparent advances in nutrition support occurred at the Sydney 2000 OG where dietitians worked with caterers in the menu planning phase through to the implementation of a broad range of services, including a website that allowed athletes to view the menu before arriving in the village, education sessions for catering staff, design of nutrition labels and a kiosk staffed by expert sports dietitians in the main dining hall (Pelly, 2007). Evaluation of nutrition support services at this event suggested that, although they were well valued and utilised by athletes and officials, they could be further developed to assist athletes from different sports, regions and stages of competition (Pelly et al., 2009). Consequently, it has become mandatory for food service providers at the OGs to
include the services of a specialist dietitian who can review the design and analysis of the main menu, and provide menu guidance and nutrition consultations within the main dining hall (Pelly et al., 2011). Dietitians have therefore played an important role at all Summer OG and CG events ever since the Sydney 2000 OG, and the Melbourne 2006 CG.

Although, traditionally, dietitians contracted to work at the OG and similar events tend to have expertise in sports nutrition, there is evidence that a broad range of skills are desirable to cater for the cultural diversity of athletes, the complexity of dietary regimens (in particular food allergy and intolerance) and the varying influences on food choice in this environment. Records of occasions of service from past events suggest that dietitians have been required to provide advice to athletes and officials on food provision, weight management, clinical conditions and sports nutrition (Pelly, 2007). Anecdotally, it has been reported that observance of religious events such as Ramadan, which coincided with the London 2012 OG, may also lead athletes and officials to seek dietary advice. In addition, dietitians based in the dining hall serve as a link to catering staff and management and therefore need an understanding of large-scale food production and food service management (Pelly et al., 2009, 2011). Although caterers aim to provide a wide range of menu items to meet the requirements of diners (Pelly et al., 2011), there are athletes and officials who require assistance with their food choice and meal plans. The dietitian may be required to source suitable menu items or advise on alternative choices to fit their dietary regimen because there may be limited availability of staple or specialised foods (e.g. gluten-free items), particularly when competing in less developed locations (Burkhart & Pelly, 2013a). Some athletes may also require performance or sports specific advice; for example, those making weight before competition, or may need to plan dietary intake around unique competition scheduling (e.g. the marathon held early in the morning, or competition events held late in the evening). Description of those individuals who seek nutrition advice and the type of assistance required is beneficial for both dietitians who have an interest in working in this setting, as well as for caterers who are planning to tender for future events. Therefore, the aim of the present study was, first, to describe the occasions of service (consultations and enquiries) at a nutrition kiosk, staffed by dietitians, located in the competition dining hall at the 2010 Delhi CG in New Delhi, India, and, second, to
investigate athletes’ opinion and usage of the nutrition services. The results of this study can subsequently help to identify the dietetic skills and scope of practice required to work in this unique environment.

**Materials and methods**

Dietitians (n = 5; four Australian Accredited Practising Dietitians and one Indian dietitian) kept records of enquiries (a request for information about specific food items or the menu) and consultations (a full dietetic consultation) at a nutrition kiosk located in the main dining hall of the Delhi CG during the games period (23 September to 14 October, 2010) on predesigned standard forms. Of these dietitians, three were full members of Sports Dietitians Australia (SDA) with expertise in sports nutrition, four had extensive experience in individual dietary counselling for clinical nutrition issues and three had experience in food service provision, with one dietitian having extensive experience in this setting. Athletes who took part in a consultation were asked to provide demographic information and self-reported height and weight, in addition to information on current dietary practices, previous nutrition support and reason for enquiry at the kiosk. In addition, a modified version of a self-administered questionnaire previously designed to investigate athletes opinion and use of nutrition services at a major international competition (Pelly et al., 2006a) was distributed by nutrition kiosk staff to randomly selected athletes dining in the main dining hall during the games period.

Based on the availability and convenience of athletes at each meal period, kiosk staff approached athletes from a wide variety of sports and regions to gain a representative sample. Athletes who were under the age of 16 years (unless they had consent of a parent or guardian) and those who did not speak English (as determined by kiosk staff) were unable to take part in the questionnaire. Athletes were only able to complete the questionnaire once. The questionnaire consisted of 25 questions divided into four broad topic areas. Basic demographic information was asked, including region and sport representing, highest level of education, phase of competition and experience at similar events. Participants were asked to indicate if they had visited the nutrition kiosk, and then to rate on a Likert scale of 1–5 the usefulness (1 = not useful at all – 5 =
very useful) and importance of kiosk (1 = not important – 5 = essential) at these types of events. Participants were also asked to identify sources of nutrition information from a predetermined list [other individuals (partner/spouse, family members, other athletes), sports dietitian, coach, written resources (magazines, flyers, books), sports doctor or general practitioner, trainer (personal, team, sports conditioner), websites, scientific research, physiotherapist, naturopath/herbalist]. Further details on this instrument and the content evaluation process are provided in Burkhart & Pelly (2013a,b). Although the questionnaire has previously undergone content evaluation by expert sports dietitians, test–retest reliability was not feasible in this setting.

Ethical approval for the present study was granted by The University of The Sunshine Coast Human Research Ethics Committee. Participation was voluntary for both components. A research information sheet was available for all participants and consent was considered to be the completion the questionnaire or an enquiry/consultation at the kiosk. The study was approved by the caterers; Delaware North Companies and TajSATS, as well as the Delhi 2010 CG Organising Committee.

**Statistical analysis**

Participants were classified into categories for their sport (aesthetic, endurance, power/sprint, racquet, skill, team and weight category) and cultural style of eating based on geographical location. These included Western [Australia and New Zealand, the British Isles (England, Northern Ireland, Scotland, Wales, Falkland Islands, Guernsey, Isle of Man, and Jersey) and Canada] or non-Western (Africa, Caribbean, India and Sri Lanka, South East Asia and the Pacific Islands) regions. One dining hall questionnaire had more than five unanswered questions and was therefore excluded from analysis.

In addition, the nutrition kiosk enquiries and consultations were classified into groups based on the reason for visiting the kiosk. These included enquiries about food provision [such as a request for a specific item (e.g. plain oats and warm milk) or suggested alternative, or feedback on menu stations (e.g. ‘the western buffet, pizza and pasta are too fatty’)], special/therapeutic diet (e.g. allergy/ intolerance), performance nutrition (e.g. making weight for a specific competition event), weight management (e.g. weight loss or change in weight not related to performance at this event) and other
(including requests for birthday cakes and information about kiosk services). The results were analysed using SPSS (IBM Corp., Armonk, NY, USA). Depending on the normality of data, associations were calculated with the chi-squared statistic, Kruskall–Wallis analysis of variance and Mann–Whitney U-tests. Significant confounders were identified with analysis of covariance within parametric data. $P < 0.05$ was considered statistically significant. Post-hoc analysis was calculated with Bonferroni for significant relationships to determine the location of the effect, based on $P$-values adjusted for multiple comparisons.

**Results**

There were a total of 443 occasions of service (383 enquiries and 60 consultations) at the nutrition kiosk over the games period. Of the 4352 athletes who lived in the athletes village at some stage during competition, 351 (8.1%) completed questionnaires representing athletes from 53 of the 71 competing nations. The nutrition kiosk was rated the most useful method to seek assistance in finding specific menu items, with over half of the participants (64%) rating this as being very useful or useful compared to point of choice nutrition labels (59%), assistance from a coach or teammates (55%) or serving staff (54%). Over half of the participants (64%) rated the importance of having a nutrition kiosk in the main dining hall as very important or essential. Seventeen percent of participants who completed the questionnaire had visited the nutrition kiosk at least once. Of the 383 enquiries at the kiosk, 56% were from athletes and 44% from officials, whereas a total of 52 athletes and eight officials visited the nutrition kiosk for a dietetic consultation (Table 1). The occasions of service at the nutrition kiosk peaked 6 days prior to the opening ceremony (3 October, 2010), before declining and then peaking again on the day of the opening ceremony. Kiosk activity then levelled off until the close of the games (Fig. 1). The majority of enquiries were related to food provision (Table 1), followed by special/therapeutic dietary requests, with most (71%) coming from athletes representing Western regions. Enquiries about food availability (both for specific items and the location of items) came predominately from Australian and New Zealand (43%) and British Isles (21%) athletes. There was no correlation between the type of occasion of service and the CG period (Fig. 1)
### Table 1: Number of occasions of service from athletes and officials at the nutrition kiosk

<table>
<thead>
<tr>
<th>Enquiries (n=383) &amp; Consultations (n=60)</th>
<th>TOTAL</th>
<th>Gender</th>
<th>Region</th>
</tr>
</thead>
<tbody>
<tr>
<td>(total n=443)</td>
<td>n (% of total)</td>
<td>Male (n=246)</td>
<td>Female (n=192)</td>
</tr>
<tr>
<td>Enquiries (n=383) &amp; Consultations (n=60)</td>
<td>n (% of total gender)</td>
<td>n (% of total region)</td>
<td></td>
</tr>
<tr>
<td>Food provision¹</td>
<td>195 (44)</td>
<td>97 (51)²</td>
<td>94 (49)³</td>
</tr>
<tr>
<td>Performance nutrition</td>
<td>77 (17)</td>
<td>58 (76)²</td>
<td>18 (24)³</td>
</tr>
<tr>
<td>Making weight</td>
<td>40 (9)</td>
<td>33 (83)³</td>
<td>7 (17)³</td>
</tr>
<tr>
<td>Training nutrition</td>
<td>37 (8)</td>
<td>25 (69)³</td>
<td>11 (31)³</td>
</tr>
<tr>
<td>Special/therapeutic diet</td>
<td>71 (16)</td>
<td>26 (37)³</td>
<td>45 (63)³</td>
</tr>
<tr>
<td>Allergy/intolerance²</td>
<td>63 (14)</td>
<td>23 (37)³</td>
<td>40 (63)³</td>
</tr>
<tr>
<td>Other³</td>
<td>8 (2)</td>
<td>3 (38)³</td>
<td>5 (62)³</td>
</tr>
<tr>
<td>Weight management</td>
<td>58 (13)</td>
<td>37 (64)³</td>
<td>21 (36)³</td>
</tr>
<tr>
<td>Lose weight</td>
<td>35 (8)</td>
<td>23 (66)³</td>
<td>12 (34)³</td>
</tr>
<tr>
<td>Gain weight</td>
<td>9 (2)</td>
<td>8 (89)³</td>
<td>1 (11)³</td>
</tr>
<tr>
<td>Healthy eating⁴</td>
<td>14 (3)</td>
<td>6 (43)³</td>
<td>8 (57)³</td>
</tr>
<tr>
<td>Other³</td>
<td>42 (10)</td>
<td>28 (67)³</td>
<td>14 (33)³</td>
</tr>
</tbody>
</table>

Note: 1. Includes requests for specific/specialised menu items. 2. Includes allergy/intolerance to nuts, seafood, lactose and gluten. 3. Includes advice for other clinical conditions i.e. diabetes. 4. Includes advice for general healthy eating. 5. Includes information about kiosk services and requests for birthday cakes. 6. Gender was not recorded for 4 participants. 7. Region was not recorded for 6 participants. 8. Gender was not recorded for 1 participant. 9. Region was not recorded for 1 participant. 10. Region was not recorded for 1 participant. 11. Region was not recorded for 1 participant.
Figure 1. Number and type of occasions of service at the nutrition kiosk over the Commonwealth Games period.
By contrast, the majority (84%) of the consultations were with athletes representing a non-Western region (predominately India 19%, Kenya 17% and Trinidad and Tobago 10%) and were primarily for weight management ($n = 24$) and performance nutrition ($12$ for making weight and $11$ for general advice on training nutrition). Five athletes sought advice for special/therapeutic dietary requirements [nut allergy and lactose intolerance ($n = 1$), coeliac disease ($n = 2$), coeliac and corn intolerance ($n = 1$) and reflux ($n = 1$)]. There was a significant relationship between sport and reason for consultation at the kiosk with weight category athletes more likely to request a consultation about their competition nutrition plan ($P = 0.001$) (Fig. 2) and between region and reason for consultation ($P = 0.001$), with athletes from Africa and India/Sri Lanka more likely to request a consultation for weight loss. Although most dietitians provided written (meal plan) and verbal advice, some complemented this with factsheets from SDA or the dietitians’ own personal collection. The majority (74%) of athletes who approached the kiosk for a consultation reported that this was their first experience at a CG or OG, similar to 70% of athletes who completed the dining hall questionnaire.

Of the 52 athletes who presented at the nutrition kiosk for a consultation, eight indicated that they had received nutrition support [nutritionist ($n = 2$), coach ($n = 2$), dietitian ($n = 1$), director of sports ($n = 1$), unknown ($n = 2$)] prior to arrival at the competition, whereas five reported having a competition nutrition plan to follow. Of those athletes who completed the questionnaire, the most commonly reported source of nutrition information was other individuals (partner/spouse, family members and other athletes; 48%), although sports dietitians (44%), and coaches were well utilised (41%) (Table 2). The majority (68%) of athletes reported using two or more sources to obtain nutrition information, 26% reported using only one source and 6% reported not using anything. There was no association between source of nutrition information and region or sport category; however, athletes who were more highly educated (attended university) were significantly ($P = 0.025$) less likely to use a local doctor as a source of nutrition information than school leavers.
Table 2: Athletes source of nutrition information

<table>
<thead>
<tr>
<th>Source of information* (n=351)</th>
<th>TOTAL n (%)</th>
<th>Sex Male (n=183)</th>
<th>Sex Female (n=166)</th>
<th>Region Western (n=168)</th>
<th>Region non-Western (n=178)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Other individuals1</td>
<td>163 (48)</td>
<td>90 (55)</td>
<td>73 (45)</td>
<td>78 (49)</td>
<td>82 (51)</td>
</tr>
<tr>
<td>Sports dietitian</td>
<td>148 (44)</td>
<td>80 (54)</td>
<td>67 (46)</td>
<td>71 (49)</td>
<td>75 (51)</td>
</tr>
<tr>
<td>Coach</td>
<td>139 (41)</td>
<td>75 (54)</td>
<td>64 (46)</td>
<td>66 (48)</td>
<td>71 (52)</td>
</tr>
<tr>
<td>Written resources2</td>
<td>105 (31)</td>
<td>52 (50)</td>
<td>52 (50)</td>
<td>57 (55)</td>
<td>46 (45)</td>
</tr>
<tr>
<td>Sports doctor or GP**</td>
<td>89 (26)</td>
<td>50 (57)</td>
<td>38 (43)</td>
<td>41 (47)</td>
<td>47 (53)</td>
</tr>
<tr>
<td>Trainer3</td>
<td>87 (26)</td>
<td>37 (43)</td>
<td>50 (57)</td>
<td>44 (51)</td>
<td>43 (49)</td>
</tr>
<tr>
<td>Websites</td>
<td>70 (21)</td>
<td>37 (53)</td>
<td>33 (47)</td>
<td>38 (55)</td>
<td>31 (45)</td>
</tr>
<tr>
<td>Scientific research</td>
<td>51 (15)</td>
<td>28 (55)</td>
<td>23 (45)</td>
<td>28 (56)</td>
<td>22 (44)</td>
</tr>
<tr>
<td>Physiotherapist</td>
<td>18 (5)</td>
<td>10 (56)</td>
<td>8 (44)</td>
<td>11 (61)</td>
<td>7 (39)</td>
</tr>
<tr>
<td>Naturopath/herbalist</td>
<td>8 (2)</td>
<td>3 (38)</td>
<td>5 (62)</td>
<td>4 (50)</td>
<td>4 (50)</td>
</tr>
</tbody>
</table>

Note: 1. Includes partner/spouse, family members and other athletes, 2. Includes magazines, flyers and books, 3. Includes personal trainer, team trainer and sports conditioner. * Athletes were able to identify more than one source of nutrition information. **GP - General practitioner.

Discussion

It is evident from the results of the present study that there is a need for dietetic support for athletes competing at this level of competition, in particular for individuals from non-Western regions and those needing assistance with special/therapeutic dietary requirements. Furthermore, it is apparent that dietitians can play a pivotal and diverse role in supporting athletes at major competition events, with skills extending beyond those of a specialist sports dietitian. The nutrition kiosk was consistently utilised by dining hall patrons, and was reported to be the most useful form of assistance with respect to finding items on the menu and supporting enquiries about food availability. Although a large number of the occasions of service at the kiosk were related to food provision (44%), dietitians were still required to have an in depth understanding of the
local food supply to provide athletes and officials with alternative items to meet specific dietary regimens. Furthermore, dietitians experienced in both sports nutrition and the competition setting were able to mentor the less experienced members of the nutrition team, whereas inclusion of an Indian dietitian with local food knowledge was beneficial to understanding the food supply. Similar to past events, the majority of enquiries and consultations were received prior to competition (Pelly, 2007), highlighting the importance of a nutrition kiosk being available for athletes from the initial opening of the village to support an athlete’s preparation for competition.

Overall, most consultations were requested by athletes from non-Western regions (88%), particularly for weight management and performance nutrition. This has been reported at past events where athletes from non-Western regions commonly sought dietary advice (Pelly et al., 2009) and reported the highest need for a kiosk (Pelly et al., 2006a; Pelly, 2007). Although there was no significant difference between region and the rating of importance of providing a nutrition kiosk, athletes from non-Western regions clearly have a need for this type of service as evident by their use of the service. Interestingly, all of the consultations with officials were also requested by individuals from non-Western regions. Because only six athletes from non-Western regions reported that they had received nutrition assistance (from a nutritionist, coach, director of sports and unknown) before this event, it is possible that these athletes request consultations because they have less access or opportunity to seek credible sports nutrition advice prior to arrival, and they may not have access to an individual/team dietitian when travelling. Limited access to appropriate nutrition advice may be the result of a lack of trained sports dietitians in their home country or the inability to afford the fee of consulting a specialist dietitian. It is also possible that athletes from non-Western regions are less familiar with this type of environment because the majority of athletes (74%) requesting a consultation also reported that this was their first experience at this type of event.

The results of the present study also suggest that some athletes may require assistance despite travelling with an individual allocated to provide nutrition support. Interestingly, five athletes (Kenya, n = 2; Australia, n = 2; Trinidad & Tobago, n = 1) who presented for a consultation noted that they had a competition nutrition plan to follow, although two of these athletes did not report having dietetic input or any other
source of nutrition information. Anecdotally, some of these athletes reported to kiosk staff that the plans were provided ‘by the nutrition expert travelling with their team’ and not from a dietitian. This may indicate that those who had received previous advice may have had difficulty using their meal plan in the dining hall because specific food items may not have been available, the plan was inappropriate for the athlete, or the athlete perceived the kiosk dietitians as specialists and wanted to utilise their expert advice. Unfortunately, the number of sports dietitians/nutritionists that travelled with individual athletes or teams to this event is unknown and we acknowledge that this may have impacted on the results.

Figure 2. Reason for consultation at the nutrition kiosk by athletes and officials

*Other special/therapeutic includes type II diabetes and haemorrhoids.

Although the majority of athletes requesting a consultation reported no nutrition assistance at, or prior to the competition, they may have accessed other sources of nutrition information prior to arrival. A small number (6%) of athletes who completed the dining hall questionnaire reported that they had not used any previous source of nutrition information, whereas 26% had only used one source of information before
attending the CG, indicating that there are a number of athletes with limited nutrition assistance prior to entering the dining hall. Although it could be assumed that athletes from non-Western regions have less access to credible nutrition information sources, relatively even numbers of athletes from Western and non-Western regions reported using other individuals, coaches, websites and other sources of information. However, the similarities between these regions may be a result of the survey sample. Athletes who had attended university were less likely to use a local doctor as a source of nutrition information than those athletes who had completed senior school, which suggests that athletes with a higher level of education may be more selective in their choice of nutrition information, and favour using a specialist dietitian. Given the large proportion of consultations with athletes from non-Western regions, and given that a large number of athletes may have had limited support and preparation prior to entering this environment, dietitians at the kiosk require an adequate knowledge of cultural styles of eating, religious diets and various cultural influences on food choice in addition to sports nutrition expertise to assist these individuals.

By contrast, the enquiries regarding availability of food for special dietary requirements were more commonly reported by athletes from Western regions. Interestingly, the majority (89%) of special/therapeutic diet enquiries and consultations were related to allergy and intolerance (Coeliac, nut and lactose). It has been reported that the prevalence of athletes following dietary regimens and competing at these major events appears to be increasing (Pelly & Burkhart, 2013), which may account for the large number of food availability and special/therapeutic diet enquiries at the kiosk. This highlights the need for dietitians to be knowledgeable and have experience in therapeutic diets (particularly allergy and intolerance). The kiosk dietitian may also be responsible for liaising with the caterers and sourcing the item or finding an alternative in situations when an athlete requests a specific item that may not be on the menu (e.g. gluten-free bread). Events held in non-Western regions may be even more challenging because dietitians need to be able to adapt to local foods and be able to identify suitable substitutions to requested items. It is therefore imperative that dietitians working in this environment are able to interact with caterers to service enquiries and have an understanding of large-scale food production, as well as food availability in the host
The inclusion of a dietitian from the local region can be of benefit in countries where the food supply vary significantly from a Western style of eating.

It is also possible that the number of enquiries from athletes from Western regions is the result of an increased awareness of (and familiarity with) nutrition support by athletes from these countries. It has been previously reported that a higher proportion of athletes from Australia and New Zealand had more difficulty in finding appropriate food items in the dining hall, yet had more experience competing at similar events (Burkhart & Pelly, 2013a), indicating that they are possibly more familiar with, and more likely to use the nutrition support provided. Because this event was held in a non-Western region, it is possible that more enquiries related to food service were received as the food provided may have been different to that of an athlete’s normal diet. However, at a similar event held in a Western country, food service enquiries also made up a large amount of the total enquiries (Pelly, 2007), suggesting that unfamiliarity may be more of an influence than the cuisine of the host region.

Athletes in weight category sports (boxing, weightlifting and wrestling) were more likely to request a nutrition consultation at the kiosk, specifically for making weight, whereas athletes in power or skill based sports had a high proportion of requests for information on weight loss. This may be the result of added pressure of meeting a certain weight prior to competition. Although it is recommended that these athletes aim to lose weight gradually before an event (Wilmore, 2000), travel associated with attending these events may make it difficult for these athletes to maintain their goal weight in the immediate period before competition, and hence require advice on arrival in the dining hall. The dining hall environment may also present difficulties for the athlete when choosing from a buffet with a large number of items on offer. Previous studies suggest that athletes from weight category sports are amongst the highest users of nutrition labels placed at point of choice at this type of event (Burkhart & Pelly, 2013b) and report that nutrient composition of menu items is a major influence on their food choice (Pelly et al., 2006b). It is also feasible that athletes that seek advice on making weight had less exposure to dietitians with expertise in this area prior to arrival as most of the athletes came from non-Western regions, and were not clear on what to eat as a result of having less experience at this level of competition (74% reported this was their first time competing at the CG). This suggests that dietitians working in this
environment need experience with advising athletes competing in weight category sports, and support the need for training for dietitians to increase their skill in providing sports nutrition advice for this level of competition. Furthermore, dietitians who assist athletes in the lead up to similar events can benefit from an understanding of potential issues that may arise and how the support provided in this environment may assist athletes with implementing their competition meal plan.

Conclusions

The results of the present study suggest that athletes from different regions have varied reasons for using a nutrition kiosk at major competition events, and nutrition support may need to be catered towards their specific demands. It is clear that dietitians can play an important role in guiding athletes to select appropriate food; however, it is clear that a broad range of dietetic skills are required. These include a good understanding of performance nutrition for different sports, particularly weight category sports, a broad knowledge of different cultural eating styles, religious-based diets and food taboos, food allergy and intolerance and a range of other therapeutic dietary regimens (e.g. diabetes). This may mean the inclusion of a local dietitian, as well as those with sports nutrition, food service and clinical expertise, working in the nutrition support team. In addition, dietitians should have the ability to interact with individuals from a wide range of cultures and religions, and adapt to the available food supply in varied locations throughout the world.

Future directions

Further research on the nutrition support provided in similar competition environments may assist dietitians in planning for future events. Although dietitians provided athletes with factsheets from SDA, and their personal collection, it is possible that the development of standardised cultural and sport specific resources may assist dietitians with educating athletes, and the development and evaluation of these should be
investigated. Inclusion of non-English speaking athletes may help to identify the needs of these athletes in more detail. Although nutrition information is provided in English only at CG events, as well as French and the host nation’s primary language at OG events, dietitians who are able to converse in additional languages may result in an increase in consultations with athletes from non-English speaking backgrounds utilising the kiosk.

It would also be of interest to determine the level and type of nutrition support provided to athletes on a regional and sporting basis from their own support staff in the lead up to, as well as during, the competition event, and whether there is a relationship to those seeking advice from the kiosk. Although a committee of experts from the Professionals in Nutrition for Exercise and Sport organisation currently reviews the menu for OG events, further collaboration of international experts from a range of regions may assist caterers to provide a menu that suits the requirements of a diverse range of individuals. However, the location of the event and available funding may still limit the cultural diversity of food provided. Insight regarding the factors that influence food choice in this environment would also be beneficial for menu planning and nutrition support.

References


Pelly, F. E., & Burkhart, S. J. (In press) Dietary regimens followed by athletes at a major international competition.


Chapter 5: Discussion and Recommendations

This Chapter summarises and discusses the main findings of the studies presented in Chapters 2 – 4. The implications for future research and the limitations of the studies are summarised in Section 5.5 and 5.6. Recommendations for future events are presented in Section 5.7, while an overall summary of the thesis is provided in Section 5.8.

5.1. Overview of findings

This study had three objectives:

1. To evaluate the nutrition support (including the menu, kiosk and POC labels) provided to athletes at a major international competition (The Delhi 2010 Commonwealth Games),
2. To investigate the role of the sports dietitian in providing these services, and
3. To identify if these services are appropriate for the diversity of athletes present at this event.

This research provided a unique opportunity to evaluate the nutrition support provided at a major international competition held in a non-Western country and contribute to the limited pool of literature in this area. Overall, the menu and nutrition support services were well rated, however there is scope to make improvements to better cater for the diversity of athletes present at this type of event. It is evident that the consultant dietitian and the dietitians based at the nutrition kiosk played an important role in supporting athletes with food choice at the Delhi 2010 CG as they performed a number of duties including; reviewing the menu and POC labels before the start of the CG, providing a liaison between the athletes and caterers, providing specific nutrition information in the form of consultations and answering enquiries, performing dietary analysis for the POC nutrition information, and quality control. However, as the services offered at this event may not have satisfied the diverse range of cultural, sporting and personal requirements of this group of athletes, further involvement of
dietitians may assist caterers with improved menu design and more comprehensive nutrition support services for future events. The findings and outcomes of this thesis may be useful not only for upcoming CG and OG events, but also other sporting events where large scale food provision is required (for example the Paralympics and IAAF World Championships).

5.2. The menu

It appears that the menu provided at the Delhi 2010 CG met the diverse requirements of the majority of athletes at this event. The main dining hall supplied 527,227 meals throughout the games period (Delhi, 2010), with the majority of athletes (>72%) surveyed rating the portion size, freshness, presentation, variety, temperature and taste as good or very good. The availability of specific items, such as high carbohydrate and high protein items was also rated highly, suggesting that the menu successfully catered for the majority of athletes attending this event. Given the diverse group of athletes that were present, and that food availability was difficult in this country, this represents a significant achievement in food provision.

This success can be attributed to the collaboration between the Australian catering management team (DNC), the consultant dietitian; Dr Pelly, and the local caterers TajSATS. While catering company management are experienced in planning a menu based on budget constraints, the facilities available and ensuring qualities such as temperature, visual appeal, and freshness are of a suitable standard, they may not always have the knowledge required to plan meals for the specific cultural and sporting requirements of a diverse range of athletes. When events are held in a different country, they may also be unfamiliar with the local food supply and food customs of the area. While food provision has to fit within the means of the catering company and the tender brief agreed upon with the OC, a consultant dietitian can suggest improvements to the menu to ensure that athletes can access items to suit their cultural needs (e.g. staple carbohydrate items such as rice or taro) and the therapeutic requirements of various clinical conditions (e.g. Coeliac disease or nut allergy). Dietitians with sports nutrition training can also provide information about the varied nutritional requirements for athletes in different sports (e.g. suitable items for an athlete attempting to make weight
before an event, or an athlete aiming to carbohydrate load). Additionally staff from a local catering company can assist the caterers and consultant dietitian with information on the local food supply, cultural cooking practices and regional ingredients.

In preparation for the Delhi 2010 CG, the menu developed by DNC was reviewed by Dr Pelly, who was then able to suggest improvements for the caterers to consider and implement. Additionally, kiosk dietitians were able to provide feedback to the caterers during the competition period. This was important as the availability of some items was restricted due to the food supply system in Delhi, and resulted in a number of substitute items being added to the menu (Chapter 2). Currently there is no requirement for a menu review at the CG, and this undertaken at the discretion of the appointed caterer. However, the catering tender agreement for the Summer and Winter OG requires a dietitian to review the event menu (Pelly, et al., 2011). This review process can vary from a review by one individual dietitian to a review conducted by an international committee of expert sports dietitians (e.g. The PINES International Sports Nutrition and Catering Working Group). To date the PINES International Sports Nutrition and Catering Working Group has undertaken a menu review, on behalf of the IOC for the Beijing 2008, and London 2012 Summer OG, as well as the Vancouver 2010 and Sochi 2014 Winter OG (Pelly, et al., In press). While an individual dietitian can review the menu for these events, a group of international experts is likely to be more culturally diverse, and can therefore provide more detailed feedback on the provision of cultural items. In fact, members of the PINES International Sports Nutrition and Catering Working Group have compiled a database of culturally suitable items that is used as part of the menu review process (Dr Pelly, personal communication 28th February, 2014). As a menu review process appears to be of use for OG events, and assisted caterers to develop the menu for the Delhi 2010 CG, this should be made mandatory for the CG. This could take the same form as the OG review, and ideally be undertaken by a group of international experts with knowledge of the specific cultural requirements of CG nations.

An important outcome of a nation hosting a major international event, such as the CG or OG, is the legacy that is left after the event (IOC, 2012; CFG, 2011). While improvements to infrastructure and faculties are often highlighted as part of an events legacy, the up skilling of local dietitians is one way catering and nutrition services can
contribute to this. As the catering companies for CG and OG events tend to be based in Western regions (e.g. DNC in Australia and Aramark in the United States of America), the dietitians appointed to work in this environment tend to be from these regions and well skilled in clinical and sports dietetics. At this event the consultant dietitian, Dr Pelly was responsible for appointing three APD’s to work at the nutrition kiosk, however the inclusion of a local Indian dietitian from TajSATS, was of great assistance. The mix of Australian APD’s and an Indian dietitian led to a reciprocal transfer of knowledge. The local Indian dietitian was able to provide in-depth knowledge of the local food supply, specific ingredients and of food preparation methods, while the Australian APD’s were able to mentor the Indian dietitian and provide education in sports dietetics and research practice. At future events there is likely to be the opportunity for experienced dietitians to mentor and advise other less experienced dietitians from local regions and this can contribute greatly to leaving a nutrition legacy. Other members of the catering workforce (e.g. chefs, serving staff) may also benefit from the presence of the dietetic team through the use of staff training (e.g. information sessions on nutrition – see Section 5.4.). Developing ways to contribute to a legacy should be a priority when planning for future events.

5.2.1. Providing a menu that meets specific requirements

While a review of the menu was completed prior to the event and modifications were made during the competition period to satisfy the requirements of the majority of athletes, some athletes were more critical of the menu. Although it is difficult to compare athletes opinions of the menu at major international events due to the change in caterers, the different regions that events are held in (and therefore a different food supply), and the limited literature available, it is evident that caterers still need to improve food provision for some cultural groups, particularly for athletes from Africa, Asia, the Caribbean and Eastern Europe, and items for special dietary and sporting requirements.

While athletes from non-Western regions generally rated the menu higher than those from Western regions, athletes from the Caribbean and Africa still reported experiencing difficulty in finding some culturally suitable items at the Delhi 2010 CG.
While the research conducted at the Delhi 2010 CG, and events held prior to this is based on the athletes opinion of the menu, dietitians and sports nutritionists also rated the available menu at the recent London 2012 OG (Pelly, et al., *In press*) and noted that there was less representation of culturally suitable items for athletes from the Middle East, Eastern Europe and Western Europe (Pelly, et al., *In press*).

Athletes from Africa, Asia, the Caribbean and parts of Europe may report that it is harder to find items in this environment due to cultural acceptance of food. Athletes from some Western nations may recognise a wide variety of items as being culturally suitable and therefore find it easier to choose foods in the dining hall. It is well known that the food preferences of some nations are linked to the settlers that arrived and colonised these areas (Kittler, et al., 2012). For example, while they are different countries, the cultural food preferences of Australians and New Zealanders are very similar, and have strong links to that of the British Isles (Kittler, et al., 2012). Many Western areas (e.g. Australia, New Zealand, the British Isles, and the United States of America) are also multicultural (Kittler, et al., 2012) and therefore athletes from these regions may be used to consuming a wide variety of food from different cuisines (e.g. Chinese, Japanese, Mexican, Indian). Consequently it may be easier for these athletes to identify foods they are familiar with in the dining hall (even if they are not country specific items). However, athletes from poorer or less multicultural areas, for example African nations or some areas of Asia may not be familiar with different cuisines and therefore feel limited in their food choice.

While caterers aim to provide a wide range of cultural items for each regional group, it is difficult to meet the requirements of every single athlete, particularly when cultural food preferences may differ between countries within the same region. For example, while caterers may aim to provide a variety of African items on the menu, different sub-groups within this region can have different food preferences. Ugali (cornmeal made into a thick, porridge like consistency), for example, is a cultural staple of Kenya, however one of the cultural staples of Ethiopia (a non CG region) is Wat (a thick spicy stew made with legumes, fish, poultry or meats) (Kittler, et al., 2012). This may lead to difficulties in designing a suitable menu and highlights that what may be suitable for the OG may not necessarily be suitable for the CG. Therefore the menu for
Chapter 5: Discussion and Recommendations

116

each of these events needs to be carefully planned based on the countries competing, not just on the region athletes come from.

The evaluation of the menu provided at the Delhi 2010 CG also highlighted the need for appropriate items for special dietary requirements, particularly gluten free and low lactose items to be included on the menu. In addition, dietitians and nutritionists rating the menu at the London 2012 OG also rated the availability of gluten free, low energy/kJ and nut free items poorly (Pelly, et al., *In press*), suggesting that caterers need to put more focus on including these items at future events. Data collected at this event also suggests that the number of athletes following dietary regimens appears to be increasing (Pelly & Burkhart, 2014) and this has implications for both the caterers and dietitians working in this environment. As reported in Pelly & Burkhart (2014) (Appendix V), there are a number of reasons for why this may be occurring including; an increased awareness of the relationship between food, health and athletic performance, an increase in the diagnosis of clinical conditions, and the greater diversity of athletes who are now present at these events (Pelly & Burkhart, 2014). Future events are scheduled to be held in non-Western regions (e.g. Rio 2016 OG) where the food supply system may remain challenging and where the availability of some items (e.g. gluten free) may be limited. Further investigation of the dietary regimens followed by athletes would be of benefit to both caterers and the dietitians who are appointed to work in this environment. This would allow caterers to ensure suitable items are included on the menu of upcoming events, and to pre-empt any issues that may arise with procurement and preparation of specific dietary items (e.g. gluten free breads) in the host nation. Again, it may be helpful during the menu design and review process to have the assistance of a local dietitian to suggest alternative items from the local food supply. This information would also assist kiosk dietitians in preparing resources to support these athletes at the nutrition kiosk (e.g. handouts).

It is also evident that improvements could be made to the provision of some sports specific items on the menu at CG and OG events. While athletes in Delhi rated the availability of items likely to assist with performance (e.g. high carbohydrate) highly, a number of suggestions for specific items were received. These requests included; sports foods such as energy and protein bars, as well as electrolyte, carbohydrate and protein based drinks. Interestingly, dietitians and nutritionists rating
the menu at the recent London 2012 OG rated the availability of recovery food and beverages, sports and snack bars and meal replacement/high energy drinks poorly (Pelly, et al., In press). This provides further evidence that more consideration of sports and snack foods is required when caterers design a menu, and when it is reviewed. However, as there are fewer sports at the CG, the range of these items may not need to be as diverse as what may be required at the OG.

5.2.2. Summary of menu evaluation findings and potential outcomes

In summary, this thesis has further emphasised the importance of the head food service dietitian and the kiosk dietitians playing an active role in menu development and review not only prior to, but also during the event. When planning for future events caterers need to be aware of the need to provide culturally suitable items, particularly for athletes from non-Western regions (such as Africa, India and Sri Lanka and the Caribbean), and items that meet sport specific requirements, particularly for recovery. As the number of athletes reporting a specialised dietary regimen appears be increasing caterers also need to be aware of the requirement for suitable items for these athletes, that alternative preparation areas may be required (e.g. nut free areas), and the potential limitations of the local food supply.

Based on reports from previous events where a lack of items for African, Asian and Eastern European athletes was reported (Grundy, 1996; Hula, 1997), a major component of the menu development process in preparation for the Sydney 2000 OG was the creation of a specific report on the cultural eating styles of African and Eastern European athletes (Pelly, 2007). This report assisted the caterers to ensure that items for these athletes were adequately represented on the menu at this event. While the PINES International Sports Nutrition and Catering Working Group have compiled a list of specific cultural requirements for each region that is used as part of the menu review process, this could be incorporated into a comprehensive catering manual to be used at CG, OG and similar events where large scale food service is required. Detailed information on the nutritional requirements for different groups of athletes (e.g. weight category, endurance) may assist caterers to include appropriate snack and recovery items on the menu and should be included in this manual. Additionally the data
available on the types of dietary regimens athletes are likely to follow, including those based on macronutrient composition (e.g. high carbohydrate) and those related to special and therapeutic needs (e.g. Coeliac disease), should also be included so that caterers can include suitable items for these athletes. However, as the group of athletes at these events may differ based on nationality and sport, the specific requirements of athletes at each event (CG vs. OG) would need to be outlined. The development of a comprehensive catering manual has potential to assist caterers with development of a menu that suits the majority of cultural, sporting, personal and clinical requirements of athletes at events in the future, and should be investigated further.

While this catering manual could be of assistance to the caterers, a committee (such as the PINES International Sports Nutrition and Catering Working Group) could also support the dietitians who assist athletes with preparation for CG and OG events. Currently, dietitians working with these athletes are generally unaware of what might be included on an event menu, and how special dietary needs will be catered for. Additionally, dietitians are likely to be unaware of what support services will be available at the kiosk and the format and content of the POC labels. A committee could provide an information pack to dietitians working within each team that outlines the menu, what options are provided for athletes with special requirements (e.g. Coeliac disease), and what support services will be provided in the dining hall. Obviously this would be a time consuming, and potentially difficult task given that it may be hard to identify the dietitians working with each team, however an alternative way to disseminate this information is through the Chef de Mission.

5.3. Nutrition Support Services

It is apparent that nutrition support is regarded by athletes as an important service in the dining hall of at major international events and that dietitians play an important role in providing this assistance. At the Delhi 2010 CG the importance of providing nutrition support in the form of a nutrition kiosk, and the display of POC nutrition information above each menu item was evident as athletes rated the nutrition kiosk as the most useful source of nutrition information in the dining hall and used the kiosk frequently.
Athletes also reported using the POC nutrition labels and that these assisted with food choice.

The nutrition kiosk was open in the main dining hall from approximately 8am – 8pm daily, every day of the games period, with at least two Australian APD’s available throughout this period to assist with enquiries and consultations. In addition to the nutrition kiosk, a polyclinic providing medical services was available in the residential village. At some events (e.g. the Melbourne 2006 CG), polyclinic and nutrition kiosk staff work together collaboratively to assist athletes. In Melbourne this was facilitated by existing networks between sports dietitians based at both the polyclinic and the nutrition kiosk (Dr. Pelly, personal communication, 1st March, 2014). At the Delhi CG there was very little collaboration between the polyclinic and the nutrition kiosk and consequently it is not known if nutrition services were provided at the polyclinic in Delhi, or if athletes were referred to the nutrition kiosk. While there is no evaluation on the outcome of these services working collaboratively, it would be expected that this would improve the support provided to athletes. While the organisational changes associated with a different host nation for each event may make it difficult to coordinate services at the kiosk and polyclinic, further research could investigate and evaluate how these two services may work together to further improve the support services provided to athletes.

While there was a lack of advertisement about the kiosk and the services that were provided, a total of 443 enquiries and consultations were recorded by dietitians, highlighting the need for this service at this event. As far back as the Atlanta 1996 OG, the importance of providing a kiosk in the main dining hall has been reported (Benardot, et al., 1996), however this is often from the perception of the kiosk dietitians and cannot be verified with published literature on athletes opinions. The exception to this is data which was collected at the Melbourne 2006 CG where 67% of athletes surveyed rated the importance of providing a nutrition kiosk as essential or very important (Pelly, 2006a). These results are similar to that seen at the Delhi 2010 CG where 64% of athletes rated the importance of providing a nutrition kiosk as very important or essential, and rated the nutrition kiosk as the most useful method of nutrition assistance in the main dining hall. In conjunction with the number of athletes requesting assistance at this event, this clearly indicates that athletes value this service and it is useful in this
Chapter 5: Discussion and Recommendations

environment. The dietary intake of athletes who requested assistance at the kiosk also highlights the importance of providing nutrition support services in this environment. While this data only provides a snapshot of the dietary intake of this group of athletes, it does show that the majority of these athletes did not consume appropriate food to meet the evidence based recommendations for their sport within the 24hrs prior to requesting assistance (Appendix VI). It is also interesting to note that the nutrition kiosk is not only utilised by athletes, but that officials also make use of this service. This may be due to the convenience of having access to dietitians, free of charge, in the main dining hall.

Based on the number of enquiries recorded at the Delhi 2010 CG, it is possible that use of the nutrition kiosk may be increasing. While it is reported that two dietitians were responsible for assisting athletes, officials and coaches from 76 countries (of 197) at the Atlanta 1996 OG (Benardot et al., 1996), there is no published data available on the total number of enquiries at this event. However, at the Sydney 2000 OG a total of 153 enquiries were recorded at the nutrition kiosk, of which 68.5% were athletes (n = 83) (Pelly, 2006). This number further increased to 356 athletes (n = 247, 69%) and officials (n = 109, 31%) seeking assistance at the Melbourne 2006 CG, with 29% of these services long consultations (Pelly 2006a). While there is a report of the nutrition kiosk providing consultations and assisting enquires at the Beijing 2006 OG (Burke, 2009), there is no published data available on the number of individuals assisted at this event. The total of 443 occasions of service in Delhi may be due to a larger increase in requests from officials than athletes; however this still highlights a potential increase in kiosk activity and warrants further investigation.

If the use of the kiosk is actually increasing, there may be a number of reasons for this. These include; an increased awareness of the kiosk and of the importance of nutrition on performance, an increase in the number of athletes or officials following dietary regimens and the host location. The nutrition kiosk is now mandatory at all Summer and Winter OG events, and has been present at the Melbourne 2006 CG and Delhi 2010 CG. Although a large proportion of athletes who completed the dining hall questionnaire and who approached the kiosk reported that this was their first experience at this type of event, athletes may be aware of the nutrition kiosk set-up from information provided by other athletes, or from support staff (e.g. coaches) who are often present at consecutive events. It may also be that after recommendations made by
Pelly (2006a) that the kiosk be placed in a more visible location, that it is now more visible to athletes, leading to more frequent use of this service. The suggested rise in the number of athletes following a special dietary regimen (Pelly & Burkhart, 2014) may also be responsible for a possible increase in numbers of athletes requesting assistance at the kiosk. It is also possible that the non-Western location meant more athletes had queries or questions relating to unfamiliar food, or concerns regarding food safety, than what may have been seen in a Western environment. Additionally while POC labels are provided at these events, the varied format and content between events may not provide adequate assistance for some athletes and therefore they may require extra assistance to choose appropriate foods.

In addition to the nutrition kiosk, POC labels have also been reported as being an important mode of nutrition support at major international events. The POC nutrition labels were also provided for every menu item (with the exception of drinks) throughout the games period and provided information on the nutrient composition of the item, as well as the presence of some allergens (e.g. seafood). The majority of athletes at the Melbourne 2006 CG reported that nutrition information was an important influence on their food choice in this environment. Furthermore 79% of the athletes at the Delhi 2010 CG reported that it was very important or important to provide nutrition information for each menu item in the dining hall.

5.3.1. Reasons for seeking support

It is evident that athletes request assistance at the kiosk for a number of reasons. While reports from previous events do not always provide information on the characteristics of these athletes, it is clear that athletes are likely to request assistance for food provision (e.g. information on the menu or requests for specific items), sports performance (e.g. how to make weight), and special/therapeutic dietary issues (Benardot, et al., 1996; Burke, 2009; Pelly, 2007; Pelly, et al., 2006a). For example, at the Delhi CG the majority of the enquiries at the kiosk were for assistance with food provision and special/therapeutic dietary requests, while consultations were mainly for weight management and performance nutrition.
At the Delhi CG it was evident that athletes from non-Western regions such as Kenya, India and Trinidad and Tobago required comprehensive nutrition support as they were more likely to request a consultation and made up just under half of the occasions of service. Conversely, athletes from countries such as Australia, New Zealand and the British Isles were more likely to have enquiries and request information about food provision. The noticeable need for nutrition support for athletes from non-Western regions at this event is similar to that reported elsewhere, and has important implications for dietitians working in this environment. At the Sydney 2000 OG, athletes from Western Europe made up the majority of enquiries, while athletes from Africa and Asia (Pelly, 2007) also contributed to enquiries at the kiosk. At the Melbourne 2006 CG, the majority of enquiries were from athletes representing Barbados, India and Papua New Guinea, while African athletes reported the greatest need for a nutrition kiosk (Pelly, 2006a). A total of 37 meals plans were provided for athletes at the Sydney 2000 OG, while 36 were provided at the Delhi 2010 CG. Interestingly the majority of these meal plans were provided to African athletes at both of these events further suggesting that these athletes require more comprehensive assistance in this environment.

It is possible that other non-Western athletes required assistance at this and previous events; however they may not have been able to access this at the kiosk due to the language barrier. While the dietitians based at the nutrition kiosk at the Sydney 2000 OG, the Melbourne 2006 CG and the Delhi 2010 CG were only able to assist athletes who spoke English, the inclusion of a translator, or a dietitian who can speak other languages (e.g. French or Afrikaans) may allow a greater diversity of athletes to obtain assistance at the kiosk. At the Delhi 2010 CG the inclusion of a local dietitian assisted with providing nutrition support and was able to converse with athletes in Hindu, however this was not known until near the end of the competition.

In addition to the extensive use of the nutrition kiosk at the Delhi 2010 CG, athletes from Africa and India and Sri Lanka also reported the highest use of POC nutrition labels. At the Sydney 2000 OG there was a significant difference between POC label use and region with athletes from Asia reporting that POC labels were used all of the time, whereas athletes from North and South America, Australia, Eastern Europe and Africa reported using only some of the time. The use of POC labels by
athletes from these regions may be due to the unfamiliarity of the food on offer. While
caterers aim to provide a wide range of culturally suitable items, if the athlete is
unfamiliar with many of the items they may need to use the POC labels to identify
appropriate foods. It is also possible that athletes from these regions have less access to
a dietitian/sports nutritionist when travelling and therefore rely on the nutrition support
services provided in the main dining hall. Athletes from these regions may have less
nutrition knowledge and therefore use the POC labels more often. In Delhi, athletes
with a lower level of education reported using the POC labels more frequently, however
this is in contrast to what has been noted in the general public (Nayga, 1996; Shine,
O’Reilly, & O’Sullivan, 1997). This may indicate that there are other factors
influencing food choice which need to be taken into account within this environment.
While it is clear that athletes from countries such as Africa, the Caribbean, and India
and Sri Lanka have a need for nutrition support at major international competitions,
further research is required to investigate the reasons for this.

5.3.2. Non-use of nutrition support services

Interestingly, although the number of athletes requesting assistance at the kiosk or for POC label use due to the limited literature available from previous events. While at the Delhi 2010 CG athletes from weight category sports were more likely to request a consultation for assistance with their competition plan and used the POC labels, the only other data available to compare to is that from the Sydney 2000 OG. At this event there was no association between sports category and reason for assistance at the kiosk. While this may have been due to a greater number of sports being categorised into 4 groups (skill/power, weight category, endurance and team sports), more research is required to understand the sport specific requirements of athletes and their use of the support services provided in this environment.
Chapter 5: Discussion and Recommendations

Melbourne 2006 CG (12%) (Pelly, et al., 2006a). While it appears that use of the POC labels is decreasing, it is difficult to determine if this is actually occurring. While the data on label use at all of these events was collected through the use of a questionnaire, there were variations in the participant sample. For example, at the Sydney OG a more diverse group of athletes from South America and Europe (Eastern and Western), who are not represented at the CG, completed questionnaires. Interestingly, only 29.5% of the athletes in the Sydney sample reported speaking English as a first language (Pelly, 2007), compared to 70% in the sample from the Delhi CG, suggesting that these samples may not be comparable and may account for the differences in POC label use observed.

Even if the rate of use is actually decreasing, there is no way of determining why athletes do not use POC labels as this has not been investigated in this environment. As far as the author is aware, athletes have never been asked to suggest improvements to the POC labels before the use of the dining hall questionnaire at the Delhi 2010 CG. Almost a quarter of the athletes who completed the dining hall questionnaire made suggestions as to how the POC labels could be improved, which may provide an insight into why the POC labels were not used so frequently. It is possible that athletes did not use the POC labels as they may have been unaware of these as no additional aids (e.g. posters, table toppers) were provided to promote, and assist athletes to use the labels (before or during the event). It is also possible that athletes made use of other forms of nutrition support, for example the nutrition kiosk or a team dietitian, however no data is available to verify this.

Some athletes may have believed that they could make an appropriate food choice without the need for a POC label. While it has been reported previously that nutrition composition is one of the most important influences on food choice in this environment (Pelly, et al., 2006b), it is also possible that an athlete places more emphasis on other factors. For example, an athlete may have simply selected food based on aesthetic appeal (e.g. smell, visual appeal or taste) without any regard for the nutrition composition. While there was no difference in reported use of the POC labels and sport category at the Sydney 2000 OG, athletes from team and weight category sports rated using the POC labels more often at the Delhi 2010 CG. This may indicate that these athletes are actively seeking information to assist with food choice, or that
other factors within this environment make it more difficult for these athletes to identify and locate appropriate food. While it could be expected that athletes may make more use of POC labels when the host nation is in a less developed region, athletes may have had less trust in the information because of this, and therefore used them less often. It may also be difficult for athletes to understand the name of some items when these are only provided in the local language. For example, dietitians at the kiosk at the Delhi 2010 CG noted having to provide English translations for some athletes to assist with food choice. More research is required to understand why athletes do not use the POC labels provided, and may help to design a standardised label for use at CG and OG events.

5.3.3. Nutrition support services in the future

Information on the characteristics of those athletes who are most likely to seek assistance at the nutrition kiosk, as well as the reasons for assistance provides important information for dietitians working in this environment and the organisation of the nutrition kiosk for future events. It is likely that dietitians working at the nutrition kiosk in the future will be expected to provide assistance for similar reasons as more athletes become aware of the potential of nutrition to influence athletic performance. However, the popularity of ‘fad’ diets and supplements may also lead to more enquiries about these topics. If the number of athletes following a dietary regimen is in fact increasing this may also lead to more specialised enquiries at the kiosk. It is also possible that there may be more food provision enquires when events are held in certain locations where the availability of special dietary items (e.g. gluten free foods), or food safety may be of more concern. It is, however, possible if more athletes/teams have the opportunity to travel with a sports dietitian or nutritionist, the number of enquiries and request for consultations at the kiosk may decrease. As the importance of nutrition on athletic performance becomes more widely recognised, nations may place more importance on the role of a dietitian and the support they can offer athletes. This may therefore lead to further opportunities for the dietitian to work with athletes before travelling, or to travel with teams to these types of event.
If demand for services at the kiosk is in fact increasing, more dietitians may need to be available at the kiosk. The number of dietitians available at any one time is likely to be dependent on the event and location. For example more dietitians are likely to be required at the OG due to the larger and more diverse group of athletes present. However at events held in smaller, less developed areas (e.g. some areas of the Commonwealth) more dietitians may also be required to assist with enquiries regarding food provision and food safety. If more dietitians are required at the kiosk it is important that they are adequately prepared to work in this environment with training in clinical nutrition and sports dietetics, and an understanding of large scale food provision and the host nation’s food supply. Additionally, the development of resources, particularly those that are designed to be culturally suitable for specific groups may assist dietitians to provide suitable advice in this environment. Further research on the services provided at the kiosk can help to assist dietitians with planning for the kiosk at future events.

While POC labels and the nutrition kiosk were the main nutrition support services offered at the Delhi 2010 CG, there are a number of other methods of support that could be investigated in this environment. In non-athletic populations the use of additional marketing aids (Peterson, Poovey, Duncan, Null, Roth & Gill, 2010; Buscher, Martin & Crocker, 2001), and placement of labels (Buscher et al., 2001), have been shown to be effective in assisting individuals to make appropriate food choices. Furthermore, it is possible that labels may be more successful in assisting athletes in a dining hall environment when used in conjunction with other marketing materials such as a website previously implemented at the Sydney OG (Pelly, 2007), technology such as smart phone applications, or education to assist athletes to understand labels (Pohlmeier, Reed, Boylan & Harp, 2012). Websites (as used at the Sydney 2000 OG and the London 2012 OG) can also provide detailed information on the menu and may be used ahead of the event to plan meals and become familiar with the foods that will be on offer. The use of mobile devices (smartphones, tablets) may further assist athletes with food choice in this environment. It is possible that athletes may believe that POC labels used in isolation may not be of value, however if POC labels were used in conjunction with, or incorporated into a website or ‘app’ where total dietary intake can be recorded, this may be seen as of more value and athletes may use these more
frequently. This may also be a way to provide more detailed nutrition information that may not otherwise fit on the tangible POC label. Additionally, search engines/tools (e.g. Quick Response [QR] codes) could be incorporated into the ‘app’/website that allow athletes to search foods that meet their specific requirements ahead of time. A website or app could also provide a convenient way to invite athletes to take part in further research within this environment. Touch screen terminals to access information have been suggested for use in this environment but to date have not been used (Pelly, 2007). These may provide a valuable way of accessing the menu prior to lining up at each station, and therefore reducing time. In the future, research should investigate the feasibility of including technology based aids, and evaluate the effectiveness of these in assisting athletes in this environment.

5.3.4. Summary of nutrition support services and potential outcomes

Based on the findings presented and discussed in this section, the nutrition kiosk at the Delhi 2010 Commonwealth Games appears to have met the requirements of the diverse range of English speaking athletes present at this event. It is evident that athletes from non-Western regions (particularly Africa, India and Sri Lanka and the Caribbean) require more comprehensive assistance in this environment. Dietitians played an important role in assisting athletes through enquiries and consultations, as well as liaising with caterers to provide suitable items when required. Only a small number of athletes reported using labels all of the time, however it is unclear why this occurred.

Further improvements to the nutrition support services at this and similar events may include the use of a standardised POC label and culturally suitable resources at the kiosk. The inclusion of a local dietitian, as well as dietitians who can speak languages other than English may allow more athletes to access support at the kiosk. Additionally, providing information on the nutrition support services to teams through the dietitian or Chef de Mission (as detailed in Section 5.2.2.) may also inform more athletes of the nutrition kiosk and the services it provides, as well as the format and content of the POC labels ahead of the competition. Technology such as ‘apps’ and a website may further assist athletes with food choice and reduce the time taken to find items in the main dining hall.
5.4. Further opportunities for dietitians at major international events

While not examined within this thesis, there are a number of other roles that the dietitian may undertake relating to food provision and nutrition support in the main dining hall of a major international competition. Kiosk dietitians can provide training to service staff to assist them to undertake their duties within the dining hall. This can ensure that they are aware of the importance of food on performance and how to refer athletes with specific dietary requirements to the kiosk. This training can also educate service staff about food safety and potential issues regarding cross contamination of foods with allergens. Recipe adherence is important to ensure that the POC labels provided are accurate and dietitians can therefore provide training to assist serving staff to adhere to recipes and make sure they are aware of the standard serving sizes. This has been instigated at previous events (Pelly, 2007; Pelly, et al., 2006a) with dietitians experienced in both food service and sports dietetics providing in-service training for staff at the Sydney 2000 OG (Pelly, et al., 2009). While these are important roles of the dietitian in this environment they are outside of the scope of this thesis. Further investigation of these roles is however warranted.

While it was not investigated in this thesis, but highlighted in findings from a survey of nutrition experts at the London 2012 OG, environmental sustainability is an important consideration for events of this size (Pelly, et al., In press). While it is easy to place a focus on providing a diverse range of items to meet the varied requirements of athletes at each CG and OG event, this may be difficult to do sustainably in some areas. For example, when the host nation is poor, or a number of its residents experience food insecurity (i.e. Delhi, India), the amount of food used to prepare meals, and consequently the waste that may be left over may be in stark contrast to the needs of local residents. There is potential for dietitians to play an important role in the design and implementation of environmentally sustainable practices at future events. This could be through the development of sustainability guidelines that may be presented in the form of a food charter for each event. In fact, the OC for the Glasgow 2014 CG has developed a Food Charter (Glasgow 2014 Ltd, 2013), based on information from the London 2012 OC’s Food Vision, to not only promote the use of Scottish food, but also to provide guidelines around environmental sustainability for those involved with food
provision at this event (Glasgow 2014 Ltd, 2013). For example, one of the benchmark standards is that all bananas at this event must be fair trade (Glasgow 2014 Ltd, 2013). While it unknown if dietitians had a role in developing this food charter, there is potential for dietitians to be involved in this process at future events.

Dietitians can also help to implement and promote sustainable practices in the dining hall. For example dietitians can encourage and promote the use of biodegradable and reusable serving ware (plates, cutlery, cups, and water bottles), promote recycling, assist with creative ways to use food waste and educate individuals in the dining hall on sustainable practices. Research regarding plate waste may be one way to investigate sustainable practices, and assist caterers to plan for future events. While data on plate waste was collected at this event, and at the Melbourne 2006 CG, this is outside the scope of this thesis. Due to the large scale of food provision required and the importance of environmental sustainability, particularly in some of the poorer, less developed areas that CG events can be held in, further research should focus on the role of dietitians and how environmental practices can be improved at these events.

Environmental sustainability strategies may also be part of the catering and nutrition services contribution to the legacy of an event. As detailed in Section 5.2., dietitians can play a role in further enhancing the legacy of a competition, however the up skilling of dietitians seems to be the only apparent contribution of nutrition to the legacy. Investigation into sustainable practices can improve the food system not just within the games village, but also within the local community (e.g. the Glasgow 2014 CG Food Charter), and can contribute to an event legacy. For example, while the Glasgow 2014 CG Food Charter document is designed for this event, it is hoped that it will be used at other major events held in Scotland (Glasgow 2014 Ltd, 2013). Other sustainable practices may also leave a legacy.

Clearly there is also scope for dietitians to be involved in further research in this environment. While providing a comprehensive menu, along with nutrition support services (e.g. the POC labels and a nutrition kiosk) is reported to be of value to athletes in this environment, further research focusing on the factors that may influence food choice (e.g. knowledge, education level) in this unique environment would also be of benefit to both dietitians working with these athletes, and caterers.
5.5. Directions for future research

Throughout Chapter 5, ideas for future research have been identified. This section summarises these research directions.

5.5.1. Summary of the directions for future research

It is difficult to compare findings from different international events due to the change in location, food supply and the caterers at each event. However, due to the importance of providing an adequate menu and nutrition support services for athletes at a crucial time, further research should:

- Clearly identify the cultural staple items for athletes from the nations of Africa, the Caribbean, as well as Eastern and Western Europe. It is also important to distinguish between the cultural needs of athletes at the CG vs. the OG.

- Identify culturally suitable sports foods and snack options for inclusion on the menu at both CG and OG events. This would ensure that caterers are aware of these items and to ensure that they, or an appropriate substitute, are included on the menu.

- Investigate the development of culturally suitable resources for use at the kiosk. These may assist dietitians to provide appropriate advice to athletes, particularly when they come from a non-Western region or are requesting specific sports related advice (e.g. how to make weight)

- Further investigate the prevalence of dietary regimens reported by elite athletes, including the athletes’ reasons for following these regimens. This information would assist caterers in developing a suitable menu, and kiosk dietitians to plan support services at the kiosk.
• Investigate the potential challenges of the procurement and preparation of special dietary items (for example gluten free items) in each event location and provide specific recommendations to the caterers for this event. This should include the specific types of foods that may be limited, what alternatives may be available, and guidelines for the preparation of these items.

• Further investigate the format and content of the nutrition label both from the athletes, and sports dietitians/nutritionists perspective. There is potential for a standardised label to be used at CG and OG events, however the design and development of this label must carefully considered and evaluated in this environment.

• Identify reasons for limited use of labels to understand why certain individuals may not use these. This may help to identify what changes may need to be made to the actual label, or what additional aids may assist these athletes to use the labels.

• Investigate the feasibility of incorporating innovative methods of nutrition support including QR codes, ‘apps’, websites, and touch screen terminals to be used in conjunction with the POC labels and the services provided at the nutrition kiosk, and evaluate these within this environment.

• Further investigate the level of nutrition support that an athlete has access to prior to, and at, this type of competition. This would allow kiosk dietitians to tailor the nutrition services provided to assist these athletes (e.g. specialised resources). This may also assist with marketing of the nutrition kiosk and ensuring that athletes who are unable to access a dietitian/sports nutritionist are aware of the nutrition kiosk and the services they can access at the event.

• Investigate the feasibility of providing nutrition information to the dietitian or Chef de Mission of each team in a ‘nutrition support services welcome pack’ as this can provide a way to promote the nutrition services in the main dining hall
ahead of the event and provide information about the event menu. This may through the use of a specialised committee.

- Investigate ways to incorporate sustainability into catering practices at CG and OG events as a means of minimising the environmental impact of such a large scale event on the host area. Designing and incorporating sustainable practices can also contribute to an event legacy.

- Investigate the factors that influence food choice in this environment as this may assist with further development of nutrition support resources. This may also assist caterers to further improve the dining hall environment (e.g. information on the layout of food items).

- Investigate the nutrition knowledge of these elite athletes and the role that this may play in food choice in this environment.

5.6. Limitations of the studies

The specific limitations of each study are presented within each Chapter, however a summary of the research limitations is provided in the following section.

5.6.1. Summary of the limitations of the thesis

As detailed in Section 1.1.3., it is difficult to conduct research in this environment due to the requirements of accreditation and gaining permission from the OC and the caterers. It is also difficult to find survey instruments to use in this environment. While the dining hall questionnaire was adapted from a questionnaire previously developed for use at the Melbourne 2006 CG, and underwent content analysis by three expert dietitians before use at this and the Delhi 2006 CG, the unique environment in which this is distributed meant that test-retest reliability is not possible.
In order to analyse the data in Chapters 2 – 4, athletes were classified into groups based on the region that they were representing, and the sport that they were competing in. The region categories were based on location and cultural style of eating, while the sports categories were based on physiological requirements. Although this classification allowed for comparison between the groups, individual differences may not have been identified. In addition, while athletes were categorised by the region they were representing, there is a possibility that they do not permanently live in this region. For example, athletes of Pacific Island descent often live in Australia or New Zealand, yet represent their home nation at major international events. For example, an athlete from Samoa may live in Australia, yet have been classified in the South East Asia and Pacific Islands group. This would assume that they follow the cultural style of eating of the Pacific Islands, yet they may in fact follow an Australian cultural style of eating. While this may have occurred in the study sample, we cannot determine this as the dining hall questionnaire asked athletes to report their country of birth and country representing at this event. In future it would be advantageous to be able to determine if athletes do live in the country they represent permanently by including a question on ‘normal country of residence’. In regards to the sport category classification, there is the possibility that athletes may fit into two groups. An example of this is the classification of light weight boxers. As it was not possible to determine what weight category event, these athletes were competing in (e.g. <59kg event), they were classified as weight category athletes. Additionally, due to increased number of nations competing at the OG, as well as increased number of sports on offer, the groups used in this research may not be representative of similar groups at the OG. For example, at the OG, the category ‘Africa’ would include more athletes from African nations than the same category would at the CG.

Only English speaking athletes were able to take part in this study. While athletes at the CG could be assumed to be fluent in English as they are part of the British Commonwealth, athletes unable to converse with the kiosk staff were unable to participate in a consultation or in the dining hall questionnaire. Athletes or officials who did not speak English were also exempt from making enquiries at the kiosk as none of the kiosk staff were able to speak any other language (apart from the local Indian dietitian). Consequently, the results of the studies in Chapters 2 – 4 can only be
attributable to English speaking athletes. This may limit the results of this research to that of the CG as it is known that, due to the increased diversity of nations at the OG, even less of these athletes are likely to report having English as a first language. At future events, provisions should be made so that athletes can participate in the dining hall questionnaire, through the distribution of questionnaire in other languages (e.g. French, Mandarin, Hindu), and have access to dietitians who can converse in other languages at the kiosk.

This research was undertaken in the dining hall of the Delhi Commonwealth Games. While this environment is similar to the OG, there are differences between these events and therefore some of the results may not be transferrable to OG and other CG events. This event was held in a non-Western region which may have influenced results, particularly regarding the evaluation of the menu. For example, the food supply in a particular area may not allow for the variety of choice that may be possible in other locations. As the region and OG change for each event, the caterers can also differ. Therefore while these results provide important information on the menu and nutrition support services provided at this event, these may vary at other events where these services may differ.

5.7. Recommendations for the future

Based on the discussion of this thesis, there are a number of recommendations that may assist caterers and dietitians planning for similar events in the future. These include the development of a catering manual, development of a comprehensive nutrition support services pack, development and evaluation of a standardised POC label, development of culturally suitable resources for use at the kiosk and extra resources for use within the dining hall and focusing on environmental sustainability.

It is recommended that a catering manual be developed for future OG and CG events. While the caterers that are used at the OG and CG have extensive experience in catering at these types of events, a catering manual can provide more information on the cultural, sporting and special dietary requirements of athletes competing at CG and OG events and assist with planning. This manual should also include information on the support services that should be provided for athletes in the main dining hall.
A welcome ‘nutrition support services’ pack could be provided to dietitians or the Chef de Mission of each country prior, or on arrival at the village. This could include information on the nutrition kiosk, including the services provided, location, opening hours and the expertise available at the kiosk. Additionally this pack should contain information on the menu. It is possible that the dissemination of information, such as the menu and the extent to which special dietary items are catered for, may assist athletes with special requirements with their planning prior to arrival (e.g. will appropriate food be provided, or does the athlete need to travel with some items).

Research regarding the most appropriate format for a POC label in this environment should be conducted, and evaluated. A standardised label may also work in conjunction with other technology, such as the use of applications (‘apps’), websites or QR codes that allow athletes to scan a barcode and then be directed to further information on the product. Further information on how to read labels (such as posters, handouts, a webpage) may assist athletes to be able to use these more frequently and should be developed and evaluated for this environment.

Development of culturally suitable resources may assist athletes with food choice in this environment. A collection of culturally suitable resources could be produced for use at CG and OG events to ensure consistency of information. In addition to culturally specific resources, sport specific resources should also be developed. These resources have potential to assist athletes from a variety of sports, particularly those who are making weight. Extra resources, for example a sign with information and pictures of daily menu items at the beginning of the food service area, and upon entrance to the dining hall may save the athlete time. Providing the menu online has been successful at the Sydney 2000 OG and may assist athletes at similar events in the future. Posters or table toppers that promote the nutrition kiosk, and provide information on how to read labels should also be developed and evaluated.

Further research should investigate the development and incorporation of sustainability guidelines and the role that the dietitian can play in this area. Plate waste should be investigated as a means of identifying waste producing practices, and developing innovative ways to minimise, or use food waste in this environment. As sustainability may play a role in the legacy of an event, dietitians should investigate
how the catering and nutrition services can continue to contribute to this legacy, as well as how mentoring and training can upskill and provide training to local dietitians.

5.8. Summary

This thesis contributes to the limited body of research on the nutrition support provided in the main dining hall of major international competitions. The dining hall environment is a unique setting and dietitians based at the nutrition kiosk play an integral role in not only assisting athletes with food choice, but supporting the caterers to provide an appropriate menu. It is clear that the menu and nutrition support services provided at these events is well valued and utilised by athletes.

While research is limited in this area, the little research that has been done to date has had a significant impact on the food provision and nutrition support practices at these events. While the nutrition kiosk and POC labels were introduced prior to the Sydney 2000 OG, Dr Pelly’s environmental nutrition intervention at this event has paved the way for dietitians to play an important role in assisting athletes at the CG and OG. Dietitians are now an integral part of the catering team for all OG, and most CG events. Dietitians can not only provide assistance for immediate nutrition needs within the dining hall, but this provision of information has the potential to improve the athletes nutrition practices at home, potentially translating to an improved health status.

While this thesis focused on nutrition support in the form of the menu, the nutrition kiosk and POC nutrition labels, there are many potential opportunities for dietitians to be involved with assisting athletes at these events. Given the large scale of these events, and an increasing focus on environmental sustainability, dietitians may play an important role in designing and implementing strategies to minimise environmental impact on the host nation at future events. While the number of dietitians experienced in working in this type of environment is limited, there is potential for these dietitians to share their knowledge and experience by mentoring other dietitians. In conjunction with addressing sustainability, mentoring less skilled or experienced dietitians can contribute to the legacy of an event.
While it is likely to be difficult to meet the requirements of every individual athlete at the CG and OG, the development of a number of additional tools may further improve services in the future. Dietitians may play an important role in the development of a catering manual, standardised POC labels, as well as other resources and technology that may assist athletes in this environment. Additionally dietitians can play an important role in undertaking further research at events in the future to add to this small pool of literature.

In summary, while dietitians are already playing an important role in assisting caterers and athletes at CG and OG events, there is still scope to improve these services through collaboration, further research and the development of specialised resources.
References


Appendices
Appendix 1:
The dining hall questionnaire
“Nutrition knowledge, dietary intake and competition eating practices of elite athletes competing at the Delhi 2010 Commonwealth Games”

DINING HALL QUESTIONNAIRE

Information about you

1. Gender: ☐ Female ☐ Male

2. Age (at last birthday): __________ years Date of birth: ........../........./.........


4. Please tick one of the following:
   ☐ Athlete Sport: ______________ Event: ______________
   ☐ Coach Sport: ______________
   ☐ Other official Title: ______________ Sport: ______________
   ☐ Guest ☐ Other, please specify: ______________

5. What phase of competition are you in?
   ☐ More than 2 days before competition
   ☐ Day before event
   ☐ Day of event
   ☐ Between events
   ☐ Event completed

6. What is your highest level of education?
   ☐ Never attended school
   ☐ Intermediate/middle school
   ☐ Some senior school
   ☐ Completed senior school
   ☐ Attended university or other tertiary institution

7. Is this your first experience competing at a Commonwealth or Olympic Games?
   ☐ Yes ☐ No

If NO, please tick the years you have previously competed:

8. Is this your first experience in living in the athlete’s village?
   ☐ Yes ☐ No ☐ Not staying in the athlete’s village
9. What is your usual cultural style of eating?
☐ Western (N. America, U.K, New Zealand, Aus)
☐ Indian (Pakistani, Sri Lanka)
☐ Asian (Malaysian, Singaporean, Hong Kong)
☐ African
☐ Pacific Island
☐ Mediterranean
☐ South American
☐ Middle Eastern
☐ Other (please specify) __________________________

10. Do you routinely follow any of these diets?
☐ Vegetarian (no red meat or white chicken)
☐ Vegan (no animal products)
☐ No red meat (chicken and fish only)
☐ Diabetic diet

Allergens
☐ Gluten free
☐ Wheat free
☐ Nut free
☐ Low/no lactose
☐ Dairy free
☐ No additives

Sports nutrition
☐ Low glycaemic index
☐ Low energy (kilojoules/calories)
☐ High carbohydrate
☐ Low fat
☐ High protein
☐ High fibre
☐ No spices
☐ Low sodium (salt)

Religious
☐ Halal
☐ Kosher
Other: ___________________________

Dining hall experience (please tick one per line)

10. How would you rate the CUSTOMER SERVICE in the main dining room?

<table>
<thead>
<tr>
<th></th>
<th>Very poor</th>
<th>Poor</th>
<th>Average</th>
<th>Good</th>
<th>Very Good</th>
</tr>
</thead>
<tbody>
<tr>
<td>Personal presentation of the staff</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Politeness of the staff</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Staff knowledge of the menu</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Speed of service</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

11. How would you rate the CLEANLINESS in the main dining hall?

<table>
<thead>
<tr>
<th></th>
<th>Very poor</th>
<th>Poor</th>
<th>Average</th>
<th>Good</th>
<th>Very Good</th>
</tr>
</thead>
<tbody>
<tr>
<td>General tidiness of the dining hall</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Cleanliness of tables &amp; service areas</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

12. In general, how would you rate the FOOD and BEVERAGE provided in the main dining room?

<table>
<thead>
<tr>
<th></th>
<th>Very poor</th>
<th>Poor</th>
<th>Average</th>
<th>Good</th>
<th>Very Good</th>
</tr>
</thead>
<tbody>
<tr>
<td>Menu variety</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Presentation</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Temperature</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Portion size</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Taste</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Freshness</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Cultural requirements</td>
<td>N/A</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>
13. In your opinion, do you think there were enough of the following items on the menu?

<table>
<thead>
<tr>
<th>Item</th>
<th>Very poor</th>
<th>Poor</th>
<th>Average</th>
<th>Good</th>
<th>Very Good</th>
<th>Unsure/ didn’t eat</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low fat items</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>High carbohydrate items</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>High protein items</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Vegetarian items</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Low energy (kilojoule)</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Gluten free</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Low lactose</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Sports foods</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td></td>
</tr>
</tbody>
</table>

What else would you like to see on the menu? ____________________________

14. How easy is it to find items on the dining hall menu that meet your particular diet/ nutrition needs?

☐ Very easy  ☐ Easy  ☐ Average  ☐ Difficult  ☐ Very difficult

15. How useful were the following in assisting you to find dishes/items that met your nutrition needs?

<table>
<thead>
<tr>
<th>Issue</th>
<th>Very useful</th>
<th>Not useful at all</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nutrition card information</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Assistance at nutrition kiosk</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Help from team mates or coach</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Serving staff</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Other (specify below)</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

What else would help you to locate items that meet your nutrition needs? ________________________________

16. How would you rate the NUTRITION CARDS used to display nutrition information in the main dining room?

<table>
<thead>
<tr>
<th>Item</th>
<th>Very poor</th>
<th>Poor</th>
<th>Average</th>
<th>Good</th>
<th>Very Good</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall impression of the nutrition card</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Presentation</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Information provided on the nutrition cards</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Information about the nutrients</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Information about allergens</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Your understanding of the nutrition cards</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Information about serving size</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

17. How often did you use the nutrition information displayed above each dish?

☐ All the time  ☐ Some of the time  ☐ Never

18. In your opinion, how important is it to provide NUTRITION INFORMATION for each menu item in the dining hall of a Commonwealth or Olympic Games?

☐ Not important  ☐ Somewhat important  ☐ Not sure  ☐ Very important  ☐ Essential
19. Would you like to see more nutrition information would you like to see displayed on the nutrition cards
☐ No, okay as they are
☐ Yes, please give details____________________________________________________
☐ Unsure

20. Have you visited the NUTRITION INFORMATION KIOSK located in the main dining room?
☐ No  ☐ Yes, number of times ____  ☐ Unsure

21. IN YOUR OPINION, How important is it to provide a NUTRITION INFORMATION KIOSK in the dining hall of a Commonwealth Games?
☐ Not important  ☐ Somewhat important  ☐ Not sure  ☐ Very important  ☐ Essential

22. How important are the following factors in influencing your food choice in the main dining room?

<table>
<thead>
<tr>
<th>Factor</th>
<th>Not important</th>
<th>Very important</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time of day</td>
<td>1 2 3 4 5</td>
<td></td>
</tr>
<tr>
<td>Proximity to the entrance</td>
<td>1 2 3 4 5</td>
<td></td>
</tr>
<tr>
<td>Visual appearance</td>
<td>1 2 3 4 5</td>
<td></td>
</tr>
<tr>
<td>Nutrition composition</td>
<td>1 2 3 4 5</td>
<td></td>
</tr>
<tr>
<td>Familiar food</td>
<td>1 2 3 4 5</td>
<td></td>
</tr>
<tr>
<td>Smell</td>
<td>1 2 3 4 5</td>
<td></td>
</tr>
<tr>
<td>Stage of competition</td>
<td>1 2 3 4 5</td>
<td></td>
</tr>
<tr>
<td>Presence of your team mates</td>
<td>1 2 3 4 5</td>
<td></td>
</tr>
<tr>
<td>Presence of your coach</td>
<td>1 2 3 4 5</td>
<td></td>
</tr>
</tbody>
</table>

23. Where do you get most of your nutrition/diet information? (you can tick more than one answer)

☐ Local doctor  ☐ Partner/spouse
☐ Sports doctor  ☐ Mother/Father/Family
☐ Conditioner/sports scientist ☐ Magazine/fliers
☐ Physiotherapist ☐ Other athletes
☐ Sports dietitian  ☐ Books
☐ Naturopath/herbalist  ☐ Scientific research articles
☐ Coach  ☐ World wide web (internet)
☐ Team trainer  ☐ Other (please specify)________________________
24. For your MOST RECENT MEAL in the dining hall could you please indicate how much of the food on your plate you actually ate. For EACH plate of food, please place an “x” on the amount you ate

<table>
<thead>
<tr>
<th>PLATE</th>
<th>I ate none of it</th>
<th>I just tasted it</th>
<th>I ate a little</th>
<th>I ate half of it</th>
<th>I ate a lot</th>
<th>I ate all of it</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.  Chicken curry and rice</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.  Another dish</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.  Another dish</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

25. If you didn’t eat all the food on your plate, please tick the reasons why (you can tick more than one answer)
- [ ] I had eaten enough and felt satisfied
- [ ] I didn’t like the taste of the food
- [ ] I was served too much food by the service staff
- [ ] I didn’t like the look of the food
- [ ] I served myself too much food
- [ ] I ran out of time
- [ ] I wanted to leave room for other foods
- [ ] I didn’t like the smell of the food
- [ ] I had too many different foods on my plate
- [ ] The food was not the right temperature (too hot, too cold)
- [ ] Other: ________________________________________________________________

THE END OF THE QUESTIONNAIRE
THANK YOU FOR YOUR TIME

155
Appendix 2:

Kiosk enquiry form
“Nutrition knowledge, dietary intake and competition eating practices of elite athletes competing at the Delhi 2010 Commonwealth Games”

**Nutrition Kiosk Questions**

**Gender**  □ Female □ Male  
**Country representing:** ______________________________

Please tick one of the following:

- □ Athlete  Sport_________________  □ Guest
- □ Coach  □ Medical
- □ Other official

Which of these categories does the question relate to?

- □ Foodservice/Menu  □ Sports nutrition
- □ General nutrition advice  □ Other, please specify__________
- □ Ordering special diet

Please record the question and answer given for enquires at the nutrition kiosk

<table>
<thead>
<tr>
<th>Question:</th>
<th>Answer given:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</table>

<table>
<thead>
<tr>
<th>Question:</th>
<th>Answer given:</th>
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</table>

<table>
<thead>
<tr>
<th>Question:</th>
<th>Answer given:</th>
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</tbody>
</table>
Appendix 3:

Kiosk consultation form
“Nutrition knowledge, dietary intake and competition eating practices of elite athletes competing at the Delhi 2010 Commonwealth Games”

NUTRITION KIOSK QUESTIONNAIRE / 24 HOUR RECALL

DIETITIAN ________

Information about the ATHLETE (please ask the following questions as part of your consultation)

Gender: ☐ Female  ☐ Male
Age (at last birthday: _________ Date of birth: _________/_______/_______
Sport: ___________________ Event: ___________
Country representing: ___________________ Zipcode/Postcode: ____________
Country of birth: ________________________ First language: ______________

1. What is your highest level of education?
☐ Never attended school  ☐ Intermediate/middle school  ☐ Some senior school
☐ Completed senior school  ☐ Attended university or other tertiary institution

2. Is this your first experience at a Commonwealth or Olympic Games?
☐ Yes  ☐ No

If NO, please tick the years previously attended:

☐ 2000 Sydney

3. Is this your first experience in living in the athlete’s village?
☐ Yes  ☐ No  ☐ Not staying in the athlete’s village

Anthropometry

4. Are you trying to lose or gain weight?
☐ Gain weight  ☐ Lose weight  ☐ Unsure  ☐ Neither
If YES, how much do you have to gain or lose?
☐ Less than 3kg  ☐ 3 – 5 kg  ☐ More than 5 kg

5. What is your ideal competition weight? _______ kg

6. Current measurements:

Weight: _______ kg
☐ Actual  ☐ Estimated

Height: _______ cm
☐ Actual  ☐ Estimated

Estimated skin folds (if known)______________________ ☐ sum of 7  ☐ sum of 8

Training
7. Type 1: ____________________________ Type 2: ____________________________

8. Duration: ____________________________ Duration: ____________________________

9. Do you usually train more than once a day? ☐ Yes  ☐ No
If YES, on how many days do you do more than once a day? ________________________

Dietary intake

10. Which of the following diets do your routinely follow? (you can tick more than one)

☐ Vegetarian (no red meat or white chicken)
☐ Vegan (no animal products)
☐ No red meat (chicken and fish only)
☐ Diabetic diet

Allergens
☐ Gluten free
☐ Wheat free
☐ Nut free
☐ Low/no lactose
☐ Dairy free
☐ No additives

☐ None of these – standard diet

Sports nutrition
☐ Low glycaemic index
☐ Low energy (kJ/cal)
☐ High carbohydrate
☐ Low fat
☐ High protein
☐ High fibre
☐ No spices
☐ Low sodium (salt)

Religious
☐ Halal
☐ Kosher
Other: ________________________
11. **What is your usual cultural style of eating?**
   - [ ] Western (N. America, U.K, New Zealand, Aus)
   - [ ] Indian (Pakistani, Sri Lanka)
   - [ ] Asian (Malaysian, Singaporean, Hong Kong)
   - [ ] African
   - [ ] Pacific Island
   - [ ] Mediterranean
   - [ ] South American
   - [ ] Middle Eastern
   - [ ] Other (please specify) ____________________

12. **Have you been diagnosed with any nutritional deficiencies in the past 6 months?**
   - [ ] No
   - [ ] Unsure
   - [ ] Yes
   - What was the deficiency? ________________

13. **Do you take any vitamins, minerals, sports supplements?**
   - [ ] Liquid meal drinks (e.g. ‘Sustagen’)
   - [ ] Sports drinks (e.g. PowerAde, Gatorade)
   - [ ] Protein powders
   - [ ] Sports bars (e.g. Powerbars)
   - [ ] Carbohydrate gels (e.g. Gu, Leppin)
   - [ ] Energy drinks (e.g. Red Bull, V)
   - [ ] Weight loss shakes (e.g. Optifast etc)
   - [ ] Herbal supplements
   - [ ] Electrolyte replacement
   - [ ] Caffeine
   - [ ] Glycerol
   - [ ] Bicarbonate/Citrate
   - [ ] Creatine
   - [ ] Colostrum
   - [ ] Amino Acids
   - [ ] HMB
   - [ ] Other, please specify ____________

14. **Did you receive any nutrition support (for example; education, consultations) before you attended the Delhi Commonwealth Games?**
   - [ ] Yes
   - [ ] No
   - [ ] Unsure
   - If yes, who provided you with this support? __________________________________________

15. **Do you have a competition nutrition plan for your event?**
   - [ ] Yes
   - [ ] No
   - [ ] Unsure
   - **If YES, have you used your competition nutrition plan while you have been at this event?**
   - [ ] Yes
   - [ ] No
   - [ ] Some of the time

16. **In your opinion, what factors in the dining hall make it easy /difficult to follow your competition nutrition plan?**
    ____________________________________________________________________________________
17. How confident do you feel about your nutrition knowledge?

☐ Not confident at all  ☐ A little confident  ☐ Reasonably confident  ☐ Very confident

18. How would you rank your ability to put into practice what you know about eating well?

☐ Excellent – I apply what I know in practice nearly all of the time
☐ Above average – I apply what I know most of the time
☐ Average – I apply what I know half of the time
☐ Below average – I apply what I know only some of the time
☐ Poor – I rarely follow the diet I know is right

19. Current diet (as reported by athlete)

☐ Carbohydrate loading
☐ Making weight
☐ Weight loss
☐ Weight gain
☐ General
☐ Other __________________

20. What competition phase are you currently in?

☐ More than 2 days before competition
☐ Day before event
☐ Day of event
☐ Between events
☐ Event completed

Please turn over for 24 hour recall form
**24 hour recall record: please record athletes intake over past 24 hours**

Date of 24hr recall: __________________________

<table>
<thead>
<tr>
<th>Meal</th>
<th>Time</th>
<th>FOOD and FLUID</th>
</tr>
</thead>
<tbody>
<tr>
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<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Meal | Time | FOOD and FLUID
--- | --- | ---

Checklist for 24 hour recall - Did you remember to ask about:

☐ Foods consumed during training (including sports drinks, bars, gels, fruit, water etc)

**Breads & Cereals**
- ☐ Bread/bread products (muffin, crumpets etc.)
- ☐ Breakfast cereals
- ☐ Crackers/biscuits
- ☐ Rice, noodles, pasta, couscous
- ☐ Other - cereal bars, pikelets, scone, raisin bread

**Fruit and vegetables**
- ☐ Fresh fruit
- ☐ Fruit juice
- ☐ Dried or canned fruit
- ☐ Cooked vegetables
- ☐ Salad vegetables

**Dairy**
- ☐ Milk
- ☐ Yoghurt, custard, dairy desserts
- ☐ Cheese

**Meat and alternatives**
- ☐ Red meat
- ☐ White meat
- ☐ Luncheon/deli meats
- ☐ Meat alternatives (legumes, tofu, nuts and seeds)

**Extras**
- ☐ Cakes, biscuits, chocolates, ice cream, lollies etc
- ☐ Savoury snacks (chips, pretzels, etc)
- ☐ Hot savoury snacks (pies, hot chips, fried foods, pizza, garlic bread)
- ☐ Supplements
- ☐ Non alcoholic drinks (soft drinks, cordials)
- ☐ Alcohol

Please turn over for sports dietitians' assessment of athlete
SPORTS DIETITIANS ASSESSMENT OF ATHLETE

1. In your opinion how would you describe the following in respect to this athlete?

<table>
<thead>
<tr>
<th></th>
<th>Very poor</th>
<th>Poor</th>
<th>Average</th>
<th>Good</th>
<th>Very good</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dietary intake</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Nutrition knowledge</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

2. Please identify what advice this athlete received (you can tick more than one response)

- ☐ Competition nutrition
- ☐ Training nutrition
- ☐ Advice about weight (making weight, weight loss, gain)
- ☐ Clinical nutrition for ____________________________ (eg, diabetes)
- ☐ General nutrition (healthy eating)
- ☐ Food service advice (eg. Where to find a menu item, can they order specific item)
- ☐ Other ____________________________

3. Did you provide a meal plan? ☐ Yes ☐ No

4. What type of meal plan did you provide?

- ☐ Plan for single meal (eg. Dinner)
- ☐ One day plan
- ☐ 2 – 3 day plan
- ☐ Plan for greater than 3 days
- ☐ Other

Please specify/explain the advice that was given to this athlete:
Appendix 4:

Research information sheet
“Nutrition knowledge, dietary intake and competition eating practices of elite athletes competing at the Delhi 2010 Commonwealth Games”

We would like to invite you to participate in a research project being conducted on the nutrition knowledge, dietary intake and competition eating strategies of elite athletes competing at the 2010 Delhi Commonwealth Games. This research project has been given ethics clearance by the Human Research Ethics Committee of the University of the Sunshine Coast, ethics approval number XYZ. Participation is voluntary and information is supplied below to enable you to decide whether to participate. Completion of either of the questionnaires or the 24 hour recall will be taken as consent to participate in the research study. Should you choose not to participate, your decision will involve no penalty or loss of benefits to which you might otherwise be entitled. You do not need to give any reason if you decide not to participate. If you decide to take part, you may discontinue participation at any time without penalty or the need to provide an explanation, in which case any information about you will be excluded from the analysis.

What is the Purpose of this Study?

The purpose of this study is to gather information about the nutrition knowledge, dietary intake and the eating strategies that athletes use at the athletes’ village dining hall at the 2010 Delhi Commonwealth Games. The provision of appropriate menu items and nutrition information could potentially influence athletes to improve their food selection at a critical time in their sporting career. It will also assist caterers in providing suitable food choices for athletes at competition venues. This project is supported with funding from Delaware North Companies Australia, the official caterers to the athletes’ village dining hall.
Description of the study

There are three ways in which you can choose to participate in this study. You are not obligated to participate in all three of these if you do not want to. The three methods we are collecting data with are as follows:

1. A short questionnaire consisting of approximately 16 questions about your dining experience, food choices, dietary intake and your pre competition eating strategies. It will take approximately 10 minutes to complete. We require some personal details (eg. nationality, gender, age, date of birth) however your name and address are not required.

2. A 24 hour dietary recall conducted by an accredited dietitian located at the Nutrition kiosk within the dining hall. The dietitian will ask you some brief questions about your eating patterns and to recall what you have consumed over the past 24 hours. The dietitian can provide you with feedback on your competition eating and a suitable meal plan if desired. The dietary recall will take approximately 20 to 30 minutes to complete. This process also requires some personal details (eg. nationality, gender, age, date of birth) but your name and address are not required.

3. An online questionnaire available for athletes to access on the internet or in hard copy from the nutrition kiosk. This questionnaire is designed to investigate your nutrition knowledge and competition nutrition strategies in more depth. It will take approximately 15 to 20 minutes to complete in your own time. This questionnaire also requires some personal details (eg. nationality, gender, age, date of birth) but your name and address are not required.

Are There Any Risks or Benefits to Participating?

There is no foreseeable risk associated with completion of the questionnaire. There will be no judgements made on your responses and your responses will be kept private and confidential. Your privacy will be respected at all times. You will be able to withdraw from the study at any time without giving reasons, in which case any information pertaining to you will be excluded from the data analysis.
Any information obtained or provided by you during the course of the study will be used only for the purposes of the research project. All information that is provided for this research project will be de-identified and stored under lock for confidentiality of information. This information will only be accessible by the research team.

The research team expects to use the outcomes of the survey to develop recommendations for the organising committees of subsequent Olympic and Commonwealth games. This will put an onus on caterers of future competitions will provide the optimal food supply to elite athletes prior to competition.

**Who are the Research Investigators?**

The principal investigator, Fiona Pelly, is a Senior Lecturer in Nutrition and at the University of the Sunshine Coast. She has 20 years experience as an Accredited Practising Dietitian. Her contact details are:

Phone: B/H: (07) 5430 2898

MOB: 0418 865 180

E-mail: fpelly@usc.edu.au

The co-investigators are:

Name: Ms Sarah Burkhart

Position: Research assistant, PhD Student Faculty of Science, Health and Education, USC

E-mail: sarah@sportsnutritionist.co.nz

Expertise: Sarah has a Bachelor of Science and has recently completed her Master’s degree. Data collected within this research project will be used to complete her PhD.

Name: Dr Helen O’Connor

Position: Lecturer in Exercise Science, School of Exercise & Sport Science, Uni Sydney

Phone: 02 9351 9625

E-mail: H.OConnor@fhs.usyd.edu.au

Expertise: Dr O’Connor has significant expertise in working with elite athletes
Further Information

The research findings from this project will be prepared as a summary report. You will be provided with a summary report of the findings of the survey questionnaire, if requested. It is also possible that the research findings will be published in a scientific journal.

If you have any concerns about this research, or if you would like any further information regarding the research topic, then please feel free to call any of the research team on the contact number/e-mail addresses provided above. We would be very happy to answer any questions that you may have.

You are able to take your time to think about whether you wish to participate in this study and which parts you would like to participate in. If after having some time to think about it you decide you would like to participate, you will then be provided with the in person and/or online questionnaire and/or can take part in the 24 hour recall with an accredited dietitian as requested. Completion of the questionnaire will be taken as consent to participate in the research study.

On behalf of our research group and the University of the Sunshine Coast, I would like to thank you for assisting in this project.

Yours sincerely

Fiona Pelly

If you have any complaints about the way this research project is being conducted you can raise them with the Principal Researcher or, if you prefer an independent person, contact the Chairperson of the Human Research Ethics Committee at the University of the Sunshine Coast: (c/- the Research Ethics Officer, Teaching and Research Services, University of the Sunshine Coast, Maroochydore DC 4558; telephone (07) 5459 4574; facsimile (07) 5430 1177; email humanethics@usc.edu.au).
Appendix 5:
Related publication not included in the body of the thesis
Abstract
The aim of this study was to investigate the dietary regimens reported by athletes competing at a major international competition and report whether these were based on nutrient composition, religious beliefs, cultural eating style, food intolerance or avoidance of certain ingredients. A questionnaire was randomly distributed to 351 athletes in the main dining hall of the athletes’ village over the three main meal periods during the Delhi 2010 Commonwealth Games (23rd Sept – 14th Oct, 2010). The majority (n=218, 62%) of athletes reported following one or more dietary regimens, with 50% (n=174) following a diet based on the nutrient composition of the food. Significantly more athletes from weight category and aesthetic sports (28%, p=0.005) and from power/sprint sports (41%, p=0.004) followed low fat and high protein regimens respectively. Other specialised dietary regimens were followed by 33% of participants, with avoidance of red meat (13%), vegetarian (7%), Halal (6%), and low lactose regimens (5%) reported most frequently. Significantly more athletes from non-Western regions followed a vegetarian diet (p<0.001), while more vegetarians reported avoiding additives (p=0.013) and wheat (p<0.001). A Western style of eating was the most commonly reported cultural regimen (72% of total with 23% from non-Western regions). Those following a Western diet were significantly more likely to report following a regimen based on nutrient composition (p=0.02). As a high proportion of athletes from differing countries and sports follow specialised dietary regimens, caterers
and organisers should ensure that adequate nutrition support and food items are available at similar events.

**Key words:** Dietary regimen, athlete, Commonwealth Games, culture, performance, nutrient composition

**Introduction**

It is well established that dietary intake can play a significant role in sports performance and post-exercise nutrition recovery (Rodriquez, DiMarco & Langley, 2009), which has led to specific evidence-based guidelines for eating before, during and after competition (for example; Rodriquez, DiMarco & Langley, 2009; Burke, Hawley, Wong & Jeukendrup, 2011; Jeukendrup, 2011; Stellingwerff, Boit & Res, 2007; Slater & Phillips, 2011). However, performance-based eating is not always the primary focus of an athlete. Other factors, such as therapeutic requirements, religious beliefs, cultural background, personal preferences (e.g. avoidance of red meat) or aesthetic qualities such as taste (Nestle, Wing, Birch, Di Sogra, Drewnowski, Middleton, et al, 1998) and familiarity (Kittler, Sucher & Nahikian-Nelms, 2012) also influence an athlete’s food choices. Therapeutic conditions such as coeliac disease or a food allergy may restrict menu options while the consequences of choosing the wrong food may be of greater concern to the athlete than eating for performance. Culture has also been described as one of the most significant influences on an individual’s food choice (Nestle et al, 1998; Dindyal & Dindyal, 2004) and is commonly linked to religious beliefs that may centre on the preparation (e.g. the slaughtering of animals), or avoidance of certain foods (e.g. swine or by-products of pork), or fasting periods (e.g. Ramadan) (Kittler et al, 2012). Vegetarianism may also stem from religious beliefs (Kittler et al, 2012), or alternatively an individual may avoid animal products for health or ethical reasons (Fox & Ward, 2008), or simply personal preference (Hoek, Pieters, Staefle & de Graaf, 2004; Lea & Worsley, 2001). Depending on the level of acculturation (the acquisition of new beliefs, behaviours and attitudes in line with a new culture after moving to a new country) (Kittler et al, 2012), an individual may follow all, or only some cultural or religious dietary practices (Dindyal & Dindyal, 2004).
At major international competition events, such as the Commonwealth and Olympic Games (CG and OG), athletes from a range of countries live in a purpose built village and eat the majority of their meals in a large communal dining hall. To date, there has been a focus on evaluating broad opinion of the food provision and nutrition support, with little emphasis on the specific needs and preferences of the individual athlete. Although food provision has been rated highly at this (Burkhart & Pelly, 2013), and previous major international events (Pelly, 2007; Pelly, O’Connor, Denyer & Caterson, 2011), requests for specific food items which are commonly related to individual dietary preferences have been reported (Burkhart & Pelly, 2013), suggesting a shortfall in the provision of specialised items. Past competition events have focused on catering for Halal, vegetarian and vegan items in particular (Pelly, O’Connor, Denyer & Caterson, 2009). Despite this, there is little evidence to what extent athletes at these events follow these and other individual dietary regimens.

As the CG and similar events cater for a large volume and diversity of athletes (eg. Delhi 2010 CG’s included 4352 athletes from 71 nations competed in 17 sports (The Commonwealth Games Federation, 2011), both caterers and support staff (coaches, trainers, dietitians and medical staff) can benefit from knowledge of the number and characteristics of athletes following specific dietary regimens in order to provide a more appropriate range of specific menu items that meet cultural needs, budgetary constraints and sustainability guidelines. Hence, the aim of this study was to investigate the various dietary regimens (based on nutrient composition, therapeutic requirements, religious beliefs, cultural eating style or personal preference) reported by athletes competing at the Delhi 2010 CG’s and describe differences across sports and countries.

Methods
Survey instrument
A questionnaire previously developed to investigate the dietary behaviours of athletes and nutrition support provided at the Sydney 2000 OG and Melbourne 2006 CG (Pelly, Inge, King & O’Connor 2006) formed the basis for data collection. Further detail on this instrument and the content evaluation process may be found in Burkhart & Pelly (2013). The questionnaire contained 25 questions, divided into 4 broad topic areas. Two sections were designed to assess athletes’ dietary regimens as outlined below.
Participant characteristics
Participants were asked to provide demographic information including gender, date of birth, country of origin, country representing, postcode/zip code, native language and level of education. Previous experience competing at a Commonwealth or Olympic Games and living in an athlete’s village, as well as stage of competition (more than two days before competition, day before event, day of event, between events or event completed) was also investigated.

Style of eating and reported dietary regimen
To obtain information on cultural style of eating, participants were asked to indicate their usual style(s) of eating categorised into Western (based on the eating styles of Australia/New Zealand, British Isles, and North America), and Indian, Asian, African, Pacific Island, Mediterranean, South American, and Middle Eastern, and any dietary regimens they followed grouped into the following categories: 1) diets based on the energy or nutrient composition of the food (high/low carbohydrate, high/low protein, low fat, low sodium and high fibre, or other); and, 2) Specialised regimens: allergy/avoidance (wheat dairy, nut or gluten-free, no/low lactose, no spices and no additives, or other), vegetarian, vegan or red meat avoiders, religious beliefs (Halal, Kosher, Christian, Catholic, or other), and other dietary regimens (low glycemic index and diabetic).

Participant selection
The target population were athletes competing in the 2010 Delhi Commonwealth Games (n=4352) living within the athletes’ village, and eating meals within the main dining hall. Nutrition kiosk staff distributed the questionnaire to athletes over the three main meal periods of breakfast, lunch and dinner throughout the games period (23rd September – 14th October, 2010). Athletes were approached to take part in the research, and therefore the sample was based on the convenience and availability of individuals at each meal period; however, in an attempt to recruit a range of participants, the questionnaire was distributed to a variety of athletes representing various regions and sports. Although the majority of the Commonwealth nations speak English as a first language, athletes who were not fluent in English were unable to take part (n=2).
Athletes who had previously completed the dining hall questionnaire were excluded from completing it on a second occasion. Athletes needed to be over the age of 16 years to participate unless they had consent of a parent or guardian. Ethics approval was granted by the University of The Sunshine Coast Human Research Ethics Committee.

Data analysis
The participants were classified into sports groups (weight category, endurance, racquet, power/ sprint, team, aesthetic and skill) based on the physiological needs of their sport and a region category (Australia and New Zealand, British Isles, Canada, SE Asia and Pacific, India and Sri Lanka, Caribbean and Africa) based on country location. The results were analysed with Statistical Package for the Social Sciences (SPSS Inc., Chicago, IL. Version 19, 2011). One questionnaire was received with more than five unanswered questions and was excluded from analysis. Depending on the normality of data, associations were calculated with the Chi-Square statistic, Kruskall-Wallis ANOVA and Mann-Whitney U tests. Significant confounders (sport and region) were identified with analysis of covariance (ANCOVA) within parametric data. Statistical significance was set \textit{a priori} at \( p<0.05 \). Post hoc analysis was calculated with Bonferroni for significant relationships in order to determine the location of the effect, based on \( p \)-values adjusted for multiple comparisons across region, sport and regimen. Data is presented as frequency and proportion of relevant category.

Results

\textit{Participant characteristics}
A total of 351 athletes (183 males, 52%; 166 females, 48%; mean age 24 + 6 years) competing at the Delhi CG returned completed questionnaires. This represented 8.1\% of the target population (n=4352), and included a broad representation of athletes across countries (n=53, 75\% of all competing nations) and all CG sports (n=17, 100\%)2. There was a significant association between gender and vegetarianism with females more likely to report following this type of dietary regimen (\( p=0.014 \)). There was no association between gender and age for any other dietary regimen.
**Reported style of eating and dietary regimen(s)**

A Western style of eating was reported to be the most popular cultural dietary regimen (n=249, 72% of all participants) with half (n=175, 51%) of all respondents reporting that they only follow this style of eating, including 23% (n=40) from non-Western regions. An additional 21% (n=74) reported following a Western and at least one other style of eating (Asian, Pacific Island, Indian or African), while 28% (n=93) reported following a style other than Western, which included African (n=31, 33%), Indian (n=20, 24%), Asian (n=17, 17%), Pacific Island (n=13, 14%), Mediterranean (n=5, 5%), South American (n=5, 5%) and Middle Eastern (n=2, 2%). Style of eating generally represented the region the athlete came from (Figure 1).

![Figure 1. Reported styles of eating followed by athletes from different regions.](image)

The majority (n=218, 62%) of all participants reported following one or more dietary regimens related to religious beliefs, allergen/avoidance, vegetarian/vegan, diabetic, low glycemic index, or energy/nutrient composition (low energy,
macronutrient composition, high fibre and low sodium) of their food (Table 1). A total of 154 (71% of the total following a regimen) reported following more than one regimen concurrently. Of the 218 on dietary regimens, 33% (n=73) were vegetarian or meat avoiders, 28% (n=62) avoided certain food components such as gluten or nuts, and 19% (n=41) followed religious regimens. The highest proportion of athletes reporting a religious regimen followed a Halal diet (n=22, 52%). Religious regimens were significantly associated with avoiding food additives (p=0.002). In addition, 5 athletes (from Australia, Kenya, Niue, Scotland and Tonga) reported following a gluten free dietary regimen.

A low fat diet (n=36, 20%), and high protein diet (n=31, 17%) were the most commonly reported regimens based on nutrient composition (Table 1). High fibre, low sodium and low energy diets tended to be followed in conjunction with other nutrient-based regimens. Those who reported being vegetarian (n=47, 65%) or avoided allergens (n=49, 79%), were significantly more likely to follow a regimen based on the nutrient composition of the food than those who did not (p=0.003 and p=<0.001 respectively). While a higher proportion of vegetarians (n=48,66%) reported not avoiding allergens, there was an association between vegetarians and avoiding additives (p=0.013) and wheat (p<0.001). Athletes who reported following a Western style of eating (n=161, 65%) were also significantly more likely to report following a dietary regimen based on nutrient composition than those following a non-Western style (p=0.020).

**Associations between reported dietary regimen(s), region and sport**

After accounting for confounders, significant associations between both region and sport, and some of the reported dietary regimens were identified (Figure 2). Athletes from the non-Western regions of Africa, the Caribbean, India and Sri Lanka, South East Asia and the Pacific Islands (n=52, 31%) were significantly more likely (p<0.001) to report following a vegetarian/vegan dietary regimen than athletes from Western regions (n=7, 4%). Similarly, athletes from weight category sports (n=18, 42%) were more likely to follow a vegetarian/vegan dietary regimen than athletes from most other sports (p=0.003). Athletes from Australia and New Zealand, South East Asia and the Pacific Islands (n=12, 10%) were more likely to follow a low or no lactose diet (p=0.003) than others, while religious dietary regimens were more likely to be followed by athletes...
from Africa, India and Sri Lanka, South East Asia and the Pacific Islands (n=33, 23%) than athletes from other regions (p=<0.001).

A higher proportion of endurance athletes (n=43, 54%) reported following diets based on energy or nutrient composition in comparison to others, although athletes from weight and power/sprint sports (n=58, 65%) were significantly more likely (p=0.001) to report following a regimen based on nutrient or energy composition than athletes from skill and team sports (n=29, 31%). Power/sprint athletes (n=19, 41%) were significantly more likely to follow a high protein diet (p=0.004), while athletes from weight and aesthetic sports (n=19, 28%) were more likely to report following a low fat regimen than athletes from other sports (p=0.005). High fibre dietary regimens were reported by athletes from all sport categories except skill sports, with the majority reported by athletes competing in racquet (n=10, 6% of those following a regimen based on energy and nutrient composition), endurance (n=9, 5%), weight category (n=8, 5%), and power/sprint events (n=7, 4%). Low sodium diets were reported by athletes from all sports except those competing in aesthetic events. A representation of the energy and nutrient composition based dietary regimens by sport is provided in Figure 2.
Figure 2. Reported energy and macronutrient-based dietary regimens classified by sports group*.

*Athletes were able to select from a number of predetermined categories.
Table 1: Dietary regimens followed by participants (n = 218, 62% of 351 participants)"  

<table>
<thead>
<tr>
<th>Dietary regimen category</th>
<th>Total number (n) of participants following dietary regimen (n=218)</th>
<th>Proportion (%) of those following a dietary regimen</th>
<th>Proportion (%) of total participants (n=351)</th>
<th>Proportion (%) of dietary regimen category</th>
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</thead>
<tbody>
<tr>
<td><strong>Nutrient based</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Macronutrient content</td>
<td>115</td>
<td>53</td>
<td>33</td>
<td>63</td>
</tr>
<tr>
<td>High fibre</td>
<td>38</td>
<td>17</td>
<td>11</td>
<td>21</td>
</tr>
<tr>
<td>Low sodium</td>
<td>18</td>
<td>8</td>
<td>5</td>
<td>10</td>
</tr>
<tr>
<td>Low energy (kilojoule)</td>
<td>10</td>
<td>5</td>
<td>3</td>
<td>5</td>
</tr>
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<td>Low carbohydrate</td>
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<td>1</td>
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<tr>
<td><strong>TOTAL</strong></td>
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<td><strong>80</strong></td>
<td><strong>50</strong></td>
<td><strong>100</strong></td>
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<tr>
<td><strong>Specialised regimens</strong></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>i). Vegetarian/vegan</strong></td>
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<tr>
<td>No red meat</td>
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<td>20</td>
<td>13</td>
<td>62</td>
</tr>
<tr>
<td>Vegetarian (lacto and lacto ovo)</td>
<td>26</td>
<td>12</td>
<td>7</td>
<td>36</td>
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<td>Vegan</td>
<td>2</td>
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<td>1</td>
<td>2</td>
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<tr>
<td><strong>Sub-total</strong></td>
<td><strong>73</strong></td>
<td><strong>33</strong></td>
<td><strong>21</strong></td>
<td><strong>100</strong></td>
</tr>
<tr>
<td><strong>ii). Allergen/avoidance</strong></td>
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<tr>
<td>No/low lactose</td>
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<tr>
<td>No additives</td>
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### No spices

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### Nut free

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### Gluten free

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### Sub-total

|          | 62 | 28| 18| 100 |

### iii). Religious

#### Halal

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#### Christian

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#### Catholic

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#### Other

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#### Kosher

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### Sub-total

|          | 41 | 19| 7 | 100 |

### iv). Other

#### Low glycemic index

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<th>7</th>
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### Diabetic

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<th></th>
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<th>1</th>
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### TOTAL

|          | 117| 54| 33|     |

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*130 participants reported following no dietary regimens, 154 participants (71%) followed more than one dietary regimen in total. 87 (50%) followed more than one nutrient based dietary regimen, 11 (18%) followed more than one allergen/avoidance dietary regimen, 1 (2%) followed more than 1 religious dietary regimen. Includes combinations of high carbohydrate, low fat, and high protein. Includes Sikhism, Pilgrims Holiness Church, Congressional Church, Islamic and Seventh day Adventist.
Discussion

The Delhi 2010 CG provided the opportunity to investigate the dietary regimens reportedly followed by internationally competitive athletes. While we recognise that this is a small sample of the entire athlete population, it provides unique data across a broad range of cultural groups and sports that has not previously been reported in the literature. Our results indicate that the majority of athletes reported following one or more dietary regimen of some nature, with the largest proportion related to the nutrient composition of the food. Although limited data are available on the specialised dietary regimens reported by athletes at similar events, a comparison to a sample of athletes visiting a nutrition desk at the Sydney 2000 Olympic Games would suggest that there has been an increase in the proportion of athletes following a specialised dietary regimen over the past decade (16% in 2000 to 33% in 2010) (Pelly, 2007). While variation in the demographic characteristics of participants in each sample may account for these differences, previous reports on the scope of nutrition consultations and information provided by experts within the dining hall over the past decade suggests that there are a significant number of athletes with specific dietary needs which require specialised catering (Pelly, 2006). An increase in the proportion of athletes following specialised dietary regimens may be due to several factors including, but not limited to, an awareness of the impact of diet on health and performance (Rodriquez, DiMarco & Langley, 2009), an increase in diagnosed clinical conditions which require a therapeutic dietary regimen (CDC, 2009; CDC 2011), a number of diets becoming more socially popular (for example gluten free diets), and a greater diversity of athletes competing at this type of event. Anecdotally, through communication with caterers and dietitians working in this environment, it is apparent that there is increased demand for specialised food to meet the demands of athletes and other patrons.

The increase in the number of representative nations, particularly from less industrialised countries, and their associated culture and beliefs, may account for a higher proportion of athletes who report following specialised dietary regimens at the Delhi CG’s. We found athletes from non–Western countries were more likely to report following a diet based on religious beliefs (predominately Halal) or a vegetarian diet, which in some cases linked back to religion. For example, a high proportion of the
Indian population follow the Hindu religion and as part of their beliefs consider the cow a sacred animal that cannot be slaughtered and consumed (Kilara & Iya, 1992). African athletes, in particular, were more likely to follow a vegetarian diet, similar to results from other competition events that suggest that these athletes rarely eat meat based meals (Pelly, 2007). The high incidence of vegetarianism at this event may not necessarily be reflective of all major competition as the cultural mix at the Delhi CG’s included a high proportion of Indian and African athletes. Furthermore, athletes from Western regions may have decided to follow a vegetarian regimen once in the village as the predominant meat sources were buffalo and goat, both less familiar to a Western style of eating.

A high proportion of athletes from our sample reported following a Western style of eating, although close to a quarter (22%) of athletes from a variety of regions across the world exclusively followed a cultural style of eating representative of their country. Furthermore, results from a study on the same cohort indicate that athletes made specific requests for culturally relevant items to be included on the menu (Burkhart & Pelly, 2013) suggesting that the menu may not have been adequate to meet their needs. Therefore, it would be prudent for caterers to include an adequate representation of a broad range of cultures when planning the menu. Interestingly, we also found that athletes who reported following a Western style of eating were significantly more likely to report following a specialised dietary regimen or one based on the energy or nutrient composition. It is feasible that athletes from Western regions may have a better knowledge and awareness of performance nutrition and the macronutrient content of foods, which may be indirectly associated with their level of education. Although African athletes in our sample reported a significantly lower level of education than other regions, it may be feasible that athletes from African and other non-Western regions place more importance on following a diet based on religious beliefs than the macronutrient content of their diet. Investigation of the reasons why individual athletes follow specific dietary regimens is warranted.

Interestingly, we did not find any relationship between gender or age and reported dietary regimens, with the exception of females and vegetarianism. This is supported by evidence from the non-athletic population that suggests that females report greater incidence of vegetarianism than males (Hoek et al, 2004). We also expected to
find that dietary regimens based on nutrient composition or other factors would be followed by a higher proportion of females given that, for the same cohort, we found that females place more emphasis on nutrition factors in influencing their food choice (unpublished data). Furthermore, previous studies have shown that females value the provision of nutrition information more than males (Guthrie, Fox, Cleveland, & Welsh, 1995; McLean-Meyinsse, 2001; Wang, Fletcher, & Carley, 1995). Our results may be related to the particular sample of athletes that participated in this study and we suggest that further studies with larger samples of both male and female athletes would be of benefit.

It is apparent from our results that dietary regimens that involve avoiding particular ingredients or components of food, in particular gluten or wheat, are becoming increasingly popular amongst athletes. We found that five athletes from a sample of 351 (1 in 70) reported following a gluten free diet, in comparison to 2 athletes in a sample of 414 (1 per 200) at the Sydney 2000 OG (Pelly, 2007). In addition, we found that 15 individuals from a range of regions reported avoiding wheat. Although there is currently no research available on the incidence of coeliac disease in athletes, it has been reported that 1 per 133, 1 per 100 and 1 per 251 cases have been reported in the United States, United Kingdom and Australia, respectively (Fasano, Berti, Gerarduzzi, Not, Colletti, Drago, et al., 2003; Cataldo & Montalto, 2007). Interestingly, a higher incidence (approximately 1 case per 18 people) has been reported in the Saharawi people from North Africa (Lionetti, Favilli, Chiaravalloti, Ughi, & Maggiore, 1994), which may explain the higher rate in our culturally diverse sample. There is also evidence for increased diagnosis of coeliac disease and wheat intolerance internationally (Mancini, Trojan & Mancini, 2011; Telega, Rivera Bennet & Werlin, 2008; Lohi, Mustalahti, Kaukinen, Laurila, Collin, Rissanen, et al., 2007). The increase of reported gluten free diets is supported by the number of enquiries (n=64) about the provision of gluten free items received by dietitians located at the nutrition kiosk in the dining hall at the same event (unpublished data), however, it is not clear whether these athletes are following a gluten or wheat free diet due to appropriate diagnosis of coeliac disease or wheat intolerance, or simply by choice. Furthermore, we found that athletes from South East Asia, the Pacific Islands, and Australia and New Zealand were more likely to report following a diet containing no or low lactose. This is not surprising as Asian
populations have been reported to have a higher prevalence of lactose intolerance (Scrimshaw & Murray, 1998).

Specific dietary practices tend to be associated with certain sports (Grandjean, Ruud & Reimers, 2001), and therefore we expected to observe relationships between sport and dietary preferences, particularly those related to the energy or nutrient content of the food. Across all entire cohort, the most commonly reported nutrient-based dietary regimens were low fat (20%) and high protein (17%) diets, with athletes from power/sprint sports and those competing in aesthetic or weight category sports more likely to follow a high protein diet or low fat diet respectively. This is not surprising given the emphasis that power/sprint sports tend to place on protein (Phillips, 2004; Tscholl, Alonso, Dolle, Junge, & Dvorak, 2010; Ronsen, Sundgot-Borgen, & Maehlum, 1999), and the focus aesthetic or weight category sports place on body weight (Hassapidou & Manstrantoni, 2001; Loucks, 2004; Morton, Robertson, Sutton, & MacLaren, 2010). Similarly, a sample of weight category athletes competing at the Sydney OG were more likely to report following a specialised diet than endurance, power/skill and team sport athletes (Pelly, 2007). We also found that athletes from weight category sports were more likely to avoid allergens or other constituents. Although not significant, a higher proportion of athletes from weight category sports reported following a vegetarian dietary regimen, or a diet where white meat was consumed, but not red which may be due to a belief that this will limit their overall fat and total energy intake.

In general, athletes from endurance sports were more likely to follow a diet based on the nutrient composition of the food than other athletes. This may be due to more established guidelines for macronutrient intake to enhance performance in endurance events (Grandjean et al, 2001; Maughan, 2002). Previous studies suggest that endurance athletes are more focused on the long term health implications of what they consume, read more widely on the topic of nutrition, and are more likely to be involved in food preparation (Burke, Gollan, & Read, 1991). Furthermore, elite endurance athletes have been shown to be more likely to consume carbohydrate during and after exercise, and have a higher daily intake of carbohydrate relative to body mass than other athletes (Burke, Slater, Broad, Haukka, Modulon, & Hopkins, 2003).
**Future research.** Investigation of the specific reasons why athletes follow certain dietary regimens and the level of importance they place on these pre, during and post competition, would be of benefit to both caterers and nutrition support staff to better provide for individual needs. Eating behaviours such as distribution of food through the day, and choices at each meal period, particularly in relation to the athlete’s stage of competition, as well as intake of culturally specific food, would also be of value. To increase study numbers for better representation of all nations and sports, distribution of surveys through team nutrition advisors/sports dietitians, and managers in advance of the event is recommended.

**Limitations.** This sample was based on convenience and relied on self-reported responses. Due to the unique nature of the environment in which this survey is distributed, test-retest reliability evaluation was not possible. Our study was also limited to English speaking athletes and therefore our results and discussion can only be attributed to this group. We grouped athletes based on their overall cultural style of eating and sport category so specific individual differences may not have been identified. Furthermore, as only certain nations are permitted to compete at the CG’s, these results should not be generalised to other international competition events.

**Conclusions.** This study has highlighted the diversity of reported dietary regimens across different sports and cultures, and emphasise the need for specialised food provision and adequate nutrition support in this environment. Although evidence-based guidelines exist for pre, during and post competition, it is evident that athletes may preferentially choose to eat food that is culturally familiar, and fits with their religious beliefs and personal preferences. While the majority of reported diets in this study were nutrient based, it is apparent that an increasing proportion follow a specialised regimen based on religion (predominately Halal), or the avoidance of meat or specific allergens. A Western style of eating was the most commonly reported culture style of eating, however, a number of athletes reported only following the style of eating from their home country.

It is clear that there are future challenges for caterers and organisers in providing a culturally diverse, high quality menu while still considering issues of sustainability.
and cost. A reduction in total variety with increasing use of local produce and the integration of key cultural, sports and specialised items should be considered. An understanding of the number and characteristics of those following special dietary regimens can benefit food service providers and nutrition experts in planning for similar events, especially when held in regions where the availability of suitable items may be limited.

References


Appendix 6:
Other relevant results not yet published
Dietary intake of athletes in the dining hall of a major international competition

Sarah J. Burkhart and Fiona E. Pelly

The following results are applicable to the Thesis and are currently being prepared for submission for publication.

Methods of data collection

Registered dietitians (RD) based at the main dining hall nutrition kiosk at the Delhi 2010 Commonwealth Games (n=4) recorded all consultations on a predesigned questionnaire. At the start of the consultation athletes were asked to provide demographic details including gender, sport (and event if appropriate), country representing, country of birth, and highest level of education (no schooling, primary/middle school, senior school, University or other tertiary institution). They were also asked about previous experience at similar events and their current stage of competition (more than 2 days before event, day before event, day of event, between events or event completed), as well as any form of previous nutrition support and if the athlete had a competition plan to follow at this event. Dietitians also recorded the purpose of the athletes visit to the kiosk (e.g. advice for weight loss, making weight, performance nutrition etc.).

Athletes were also asked to provide details of any diagnosis of nutritional deficiency in past 6 months, and whether they took any supplements from a predetermined list. Any supplement(s) reported by the athlete not on the predetermined list was recorded by the dietitian. The dietitian then collected a recall of all food and fluids consumed by the athlete over the previous 24 hour period, and verified intake of all food groups from a provided checklist. Dietitians asked athletes to confirm timing of intake and which were consumed as meals or snacks. Upon completion of the 24hr recall, dietitians were asked to provide an assessment of the athlete regarding their opinion of the athletes’ dietary intake on a Likert scale of 1 (very poor) to 5 (very good).
Data Analysis

Participants were classified into a sport category (endurance, power/sprint, racquet, skill, team and weight category) based on the physiological needs of their sport and a region (Africa, Australia, British Isles, Caribbean, India and Sri Lanka, and the Pacific Islands) based on location and cultural style of eating.¹ For further analysis based on region and sport, athletes were also grouped into Western (Australia and the British Isles) and non-Western regions (Africa, Caribbean, India and Sri Lanka, and the Pacific Islands), and Power/Sprint, Weight category and all other sports (Endurance, Racquet, Skill and Team). Athletes were also grouped based on the reason for requesting advice at the kiosk including; weight loss (not related to performance at this event), weight gain, making weight, performance/training nutrition and food intolerance/allergy and other dietary issues (e.g. Coeliac disease).

The 24 hour recall data was coded and inputed into FoodWorks Premium Edition (Xyris, AUS., Version 7, 2013) (FoodWorks). Recipes were provided by the Delhi CG athletes’ village caterer (Delaware North Companies Australia Pty. Ltd.). All data was cross checked to ensure consistency and accuracy of coding. For the analysis of diet quality, food items were coded into food groups based on the Australian Dietary Guidelines (ref) of grain and cereal foods; vegetables and legumes/beans; fruit; milk, yoghurt, cheese and/or alternatives; lean meats, poultry, fish, eggs, tofu, nuts and seeds, and discretionary foods. As some discretionary foods contribute similar macro- and micronutrient content to dietary intake, as would others from a particular group (e.g. flour base in pizza and the grains and cereal foods), these foods were coded as a discretionary food item, and as an item in the corresponding food group.

All data was further coded and input into IBM SPSS Statistics (IBM Corp., Armonk, NY. Version 21, 2012) for analysis. Due to the small number of athletes (n = 44), limited inferential tests were applicable. Data is presented as grams per kg of bodyweight (g.kg BW) and as a percentage of total energy intake (% Total E.). Each athlete’s 24 hour recall data was then compared to published recommendations (ADA/CDA/ACSM, 2009; Burke, et al., 2011; Burke, et al., 2007; Jeukendrup, 2011;

¹ For more detail see Burkhart & Pelly, 2013.
Slater & Phillips, 2011; Stellingwerff, et al., 2011; Tipton, et al., 2007) for carbohydrate, protein and fat intake, based on sports requirements and demographic information (for example; height, weight, age, gender).

**Ethical approval**

Ethical approval was granted by the University of the Sunshine Coast Human Ethics committee. A research information sheet was available for all participants. Participation was voluntary and participants were considered to have given consent to participate by taking part in a consultation.

**Results**

**Participant characteristics**

Valid 24hr recalls were recorded for 44 athletes requesting assistance at the nutrition kiosk. The most prevalent reason for requesting a consultation was for advice regarding weight loss not related to competition at this event (n = 16, 36%), while 10 (23%) athletes requested advice for making weight and 9 (21%) for performance/training nutrition. Five athletes (11%) requested assistance for clinical issues, while 4 (9%) requested advice for weight gain.

Overall athletes were predominately from non-Western regions (n = 38, 86%), and reported competing in 13 sports. The mean age was 26.6 years (range = 16 – 46) and the majority were males (n= 26, 59%). The mean weights of male and female athletes were 74kg and 65kg, respectively. Over half of the athletes reported being in a pre-competition stage (n = 30, 68%) with the majority of these athletes greater than 2 days away from competition (n = 28, 82%), while 2 (6%) attended a consultation the day before competition.

For 34 athletes (79%), this was their first experience at a CG or OG event, while 30 (70%) had never lived in an athletes village environment. Almost half (n = 18, 43%) of the athletes had attended University, while 17 (40%) and 7 (17%) had completed senior school and middle/intermediate school, respectively. Six athletes (14%) reported that they had received nutrition education prior to attending this event, with four athletes (10%) reporting having a competition plan to follow.
### Dietary intake and eating behaviours

#### Overall subject group

Overall, athletes reported consuming a mean total daily energy intake of 9252 kJ (range 2384 – 18,009 kJ), with carbohydrate within the range of 1 – 9.0 g.kg BW (M = 4.0) and contributing to 49% TE (range 14 – 80%). Protein intake ranged from 0.3 – 4.3 g.kg BW (M = 1.7) and contributed to 23% TE (range 8 – 48%), while total fat intake ranged from 9.5 – 138g (M = 66g) and contributed to 25% TE (range 8 – 44%). Overall, the highest contribution to total energy intake was at breakfast and lunch meal times, with 31% and 30% respectively, of TE intake consumed at these times. The energy contribution of carbohydrate was higher at breakfast (M = 56%, range 22 – 87%), however similar at lunch and dinner meal periods (M = 45%, range 4 – 94%, and M = 45%, range 12 – 85%, respectively). The energy contribution of protein was higher at lunch (M = 28%, range 2 – 66%), and dinner meal periods (M = 26%, range 5 – 62%), while snacks contributed to 14% of TE and were predominately carbohydrate (M = 67%, range 35 – 100%) and fat (M = 20%, range 0 – 56%) based.

Dietary analysis showed that 35 athletes did not meet the EAR (Estimated Average Requirement) for at least one micronutrient, with 11 athletes not meeting the EAR for 5 or more. The most prevalent micronutrients not meeting EAR were calcium (n = 29, 69%), iodine (n = 18, 43%), zinc (n = 15, 36%), and magnesium (n = 15, 36%). Overall, n = 22 (50%) reported using at least one type of supplement, with almost half (n = 19, 43%) of all athletes reporting the use of a vitamin or multivitamin supplement. Five athletes (11%) reported that they had been previously diagnosed with a nutrient deficiency (n = 1 from team, skill, power/sprint, weight and endurance), of which 4 of these reported was iron/anaemia.

#### Athletes in pre-competition stage

Dietary intake varied according to sport category and gender for athletes in the pre-competition stage. Athletes in power/sprint sports (n = 8) reported the highest energy intake (M = 11,109kJ, range 7413 – 18,009kJ), which was higher than athletes in weight category sports, and highest protein intake (M = 2.2 g.kg BW, SD = 1.1, 19% TE). Athletes in weight category sports (n = 9) reported the lowest energy intake (M =
6909kJ, range 2384 – 14,560kJ), and the lowest contribution of energy from carbohydrate (M = 2.9 g.kg BW, 48% TE), and fat (M = 48.8g, 23% TE). Weight category athletes also consumed less CHO than power/sprint athletes. Generally female athletes reported a higher consumption of carbohydrate and protein per kilogram of bodyweight.

Overall, carbohydrate contributed to 49% TE (range 41 - 58%), protein 22% TE (range 16% - 26%) and fat 26% TE (range 23 – 37%). Three main meals were consumed by the majority of athletes (n = 23, 77%), with only 14% of TE consumed as snacks. While the contribution of macronutrients to the total daily intake were similar between the genders (carbohydrate: males 49%, females 47%; protein: males 23%, females 20%; and fat: males 24%, females 27%), male athletes reported consuming more of their total energy intake at breakfast and lunch periods, while females consumed more of their total daily intake at the dinner period. Fourteen athletes reported consuming sports drinks as a snack, with these drinks contributing to over half of the TE consumed between meals (M = 55%, SD = 32), while 5 athletes reported not consuming any snacks in the pre-competition period.

**Diet quality**

Overall, athletes reported consuming between 4 and 29 different food items (M = 14, SD = 5.1) in the previous 24hr period, with more items from the discretionary (M = 4), grains and cereals (M = 3.2) and meat (M = 3.0) groups. Variety was more limited with an average of 2.4 different items consumed from the grains and cereals group, 1 item from the milk, yoghurt and dairy group, 2.6 from the meat group and 3 discretionary items. Variety of vegetable and bean items, and fruit items (3.0 and 2.5, respectively) overall was higher.

Athletes in the pre-competition stage reported consuming less grain and cereal items than the overall mean, (M = 2.5 vs. 3.2), but a greater variety of these items (M = 2.9 vs. 2.4), more fruit items (M = 3.0 vs. 2.5) and greater variety of these (M = 2.8 vs. 2.5).

Discretionary foods made up a number of these items, particularly for the grains and cereals group as cakes/biscuits (n = 11), pizza (n = 6), cocopops (n = 2) and muffin (n = 1) items were consumed by athletes. Juice was consumed by 20 athletes and
contributed greatly to the total number of food items consumed in the fruit group. Ice cream was consumed by 8 athletes and also contributed to the number of milk, yoghurt and dairy items.

**Dietitians rating of dietary intake**

Overall, dietitians rated the dietary intake of athletes as average (M = 2.9, SD = 0.9) with those from Western (M = 2.8, SD = 0.6) and non-Western (M = 2.9, SD = 0.9) regions rating similarly. Athletes who requested assistance for weight gain and making weight were rated as having poorer dietary intake than those requesting assistance for weight loss (M = 2.8, SD = 1.0), performance nutrition (M = 2.8, SD = 1.0) and food allergy/intolerance and other dietary issues (M = 3.3, SD = 0.6).