Cardiff School of Sport

DISSERTATION ASSESSMENT PROFORMA:

Empirical [1]

Student name: Rhys Llewelyn	**_Student ID:_** ST10001118
Programme: SPE	
Dissertation title: Does a relationship exist between level of nutritional knowledge and dietary intake application amongst football players?	
Supervisor: Karianne Backx	

Comments	Section
	Title and Abstract Title to include: A concise indication of the research question/problem. Abstract to include: A concise summary of the empirical study undertaken.
	Introduction and literature review To include: outline of context (theoretical/conceptual/applied) for the question; analysis of findings of previous related research including gaps in the literature and relevant contributions; logical flow to, and clear presentation of the research problem/ question; an indication of any research expectations, (i.e., hypotheses if applicable).
	Methods and Research Design To include: details of the research design and justification for the methods applied; participant details; comprehensive replicable protocol.
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	Discussion and Conclusions [2] To include: collation of information and ideas and evaluation of those ideas relative to the extant literature/concept/theory and research question/problem; adoption of a personal position on the study by linking and combining different elements of the data reported; discussion of the real-life impact of your research findings for coaches and/or practitioners (i.e. practical implications); discussion of the limitations and a critical reflection of the approach/process adopted; and indication of potential improvements and future developments building on the study; and a conclusion which summarises the relationship between the research question and the major findings.
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CARDIFF SCHOOL OF SPORT

DEGREE OF BACHELOR OF SCIENCE (HONOURS)

SPORT & PHYSICAL EDUCATION

TITLE: DOES A RELATIONSHIP EXIST BETWEEN LEVEL OF NUTRITIONAL KNOWLEDGE AND DIETARY INTAKE APPLICATION AMONGST FOOTBALL PLAYERS?

PHYSIOLOGY AND HEALTH

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DOES A RELATIONSHIP EXIST BETWEEN LEVEL OF NUTRITIONAL KNOWLEDGE AND DIETARY INTAKE APPLICATION AMONGST FOOTBALL PLAYERS?

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Table of contents

List of Tables

Table **Page**

Acknowledgements

I would firstly like to thank Karianne Backx for her valuable support and guidance over the past six months.

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Abstract

This study aimed to establish whether a relationship between male football players' knowledge and their dietary intakes over a three-day period existed in comparison with nutrition guidelines. Accompanying this was the purpose of identifying whether a relationship in how the athletes' rated their perceived level of knowledge to be and total knowledge scores along with actual dietary intake practices existed.

Eighteen adult male football players volunteered to participate in this study, all of whom competed for teams within Welsh League Division One (2012-2013 season). Each participant completed a nutritional knowledge questionnaire and a three-day food diary.

A spearman's correlation test was conducted to identify the significance of the relationship between total knowledge score and perceived knowledge score; also between total knowledge score and actual nutritional intake scores. T-tests were also performed to highlight the significance of difference between nutritional intake and the recommended guidelines. The whole group (n=18) scores were also compared with a high knowledge score group (n=10) and low knowledge score group (n=8).

The mean score on nutritional knowledge test was 42.89/66 (64.98% correct) and the mean total caloric intake of the participants was 2604.22 ± 366.88 calories per day. Overall, this study revealed a significant relationship did exist between total knowledge score and dietary intake application amongst the athletes ($p<0.05$). Statistical analysis reveals a strong correlation between total knowledge score and actual intake practices for the group as a whole ($r=.543$, $p<0.05$). Finally, the analysis revealed there was no significant relationship level of perceived knowledge and actual intake practices ($p>0.05$). However, there is a significant correlation between total knowledge score and the athletes perceived knowledge level ($p<0.05$).

This study suggests there are areas for improvement for both knowledge and dietary intake practices as the athletes often failed to report intakes close to the recommended guidelines and many questionnaire answers selected were often incorrect.

CHAPTER ONE

INTROUDUCTION

Introduction

Everyone has their own experience of food and food consumption, thus it is likely people will have different ideas about what is meant by the term nutrition (Barasi, 2003). Nutritional definitions can take many forms; as broadly as "The study of the relationship between people and their food" (Barasi, 2003) or as simple as "The foods you eat to fuel your body (Gatz, 2009). These definitions look at nutrition in quite a broad perspective whereas in reality it is far more complicated than this. This is because nutrition encompasses many aspects such as; individual's food selection, physiological effects of the nutrients, and the consequences for health and survival (Barasi, 2003). However, it is food or nutrient intake that has become one of the more researched aspects of nutrition (Griffin, 2001). This is especially true within the sports population and the importance of sports nutrition is apparent throughout all levels of sport (Maughan and Burke, 2002).

Karinch (2002) presents two points regarding the intake of food for athletes: (1) everybody is different; (2) you need to look at your whole nutritional picture, not just a piece of it. To address the first point, although there are many guidelines of what an athlete should consume, the athletes must remember that they are different both physically and undertake exercise differently to others. Therefore close consideration of what the athlete eats should be adapted to the individual (Barasi, 2003). With regards to the second point, Karinch (2002) suggests that outside factors such as the athletes' metabolism, any medical conditions and energy expenditure also need to be considered within dietary practices. This becomes essential especially for athletes who participate in team sports as these prolonged events throw up numerous characteristics, such as time and intensity, which challenges the nutritional aspects of what to eat to aid performance (Burke, 2007). An athlete could put themselves at risk of injury if they don't get their diet right (Griffin, 2001).

Regardless of the level at which a sportsperson competes, diet can play an enormous part in improving performance (Griffin, 2001). Arcelli (1998) states that dietetics has been making considerable progress in the world of football, which is a sport played by millions worldwide (Ekblom, 1994). Numerous studies have explored dietary intake of football players, with varying recommendations for intake being presented (Powers & Howley, 2009). However, with so many guidelines for nutritional intake accessible it can often become confusing of which guidelines to follow.

Therefore the athletes' knowledge is being challenged to see if they can identify the 'right' foods for them to eat to aid their performance and healthy lifestyle. Maughan and Shirreffs (2007) state that sportsmen and women generally are concerned about their diet. However, they go on to propose that although concerns are not always matched by an understanding of the basic nutrition principles aimed towards sports performance.

According to Parmenter and Wardle (1999), a major limitation of current literature relating to this area is that it either concentrates on nutritional intake among athletes or testing their knowledge about nutrition. Rarely are these both examined together. This study will therefore investigate the relationship between nutritional intake of football players and their level of knowledge of nutrition, in order to determine whether these athletes have knowledge of nutrition and the recommended guidelines or not, and also the relationship it has with their dietary intake behaviours.

CHAPTER TWO

REVIEW OF LITERATURE

Review of Literature

2.1 A Background to Football

‘Football’ is a well-renowned term which can include many forms of sport, such as: soccer, American gridiron football and rugby football. The following notions throughout this paper will focus upon soccer, also known as association football, with all themes of soccer being addressed under the term ‘football’. It has been well published that football is watched by millions of spectators worldwide (Ekblom, 1994. p31) and is the most widely played team game in the world (Burke, 2007. p190). Participants range from professional players with contracts worth tens of thousands of pounds a week, skilled enthusiasts who play “pick up” matches on the beaches of South America or fields of Africa, right through to school children (Burke, 2006). However, before further progression, a brief background of football and an insight into the physiological demands of the sport must be made.

As cited, football is a team sport consisting of two opposing teams each containing eleven players at the start of the match. The match is a term widely used to describe football being played competitively, which lasts over two halves lasting forty-five minutes apiece (Burke, 2007. p187). This is based on the regulation rules enforced for adult football contests. Regularly played on a grass field, average dimensions consist of a length of 100-120 meters (m) and a width between 50-100 m. The professional player tends to play in a match every three to seven days during the competition season, which typically lasts from August till May (Burke, 2006). All rules have existed in the present form, with few exceptions, edited by La Federation International de Football Associations (FIFA), since 1938 (Ekblom, 1994. p100).

2.2 Physiological Demands of Football

The game of football is dynamic and multifaceted (Gatz, 2009). Previous analysis of work-rate during play would suggest that footballers should be able to run 9-12 kilometres more or less continuously (Ekblom, 1994). However, during a match, players perform different types of exercise ranging from standing still to maximal running (Bangsbo, 1993. p16). This separates football from sports in which continuous exercise is performed with a high or moderate intensity throughout the entirety of an event, such as a 400 m and 5000 m run respectively (Bangsbo, 1993). Yet this intensity can alter at any time due to the range of movements involved within football (Maughan, 2000). Burke (2007) highlighted that the typical movement pattern of a player would involve running every 30 seconds (s), including a sprint of 15 m every 90 s, with a rest period of about 3 s every 2 minutes. Therefore it is clear to see a modern player would need to utilise the various energy systems throughout the ninety minutes of game play.

The game of football can be played at an intensity that taxes both aerobic and anaerobic parameters. Clark, Lucett and Kirkendall (2009) reported that the National Academy of Sports Medicine [NASM] say 50 percent of a soccer game will require anaerobic energy sources and 50 percent will require aerobic energy sources. Aerobic capacities determine the degree to which a high work rate can be sustained throughout the entire game (Reilly, 1997). Bangsbo (1993) clarifies aerobic capacity as the ability to sustain exercise for a prolonged period and it is synonymous with endurance. Nevertheless, the ability to produce explosive bursts of power, such as jumping or sprinting, is also very important during match-related scenarios (Burke, 2007). These short-term high-energy bursts of movement are incorporated under the anaerobic energy system (Bangsbo, 1993). In this system, movements that increase the heart rate to above 85 percent of maximum and maintain it for short bursts before returning to a recovery heart rate between 60 and 80 percent use the anaerobic energy system (Clark et al., 2010).

For many athletes, and in particular professional players undertaking multiple training sessions in a day or more than one match in a week, the energy cost of training and games is substantial (Burke, Loucks & Broad, 2006). The energy expenditure varies with playing position, being highest among midfield players, and the distance covered by players tends to under-reflect the energy expended (Reilly, 1997). The total energy expenditure and requirements of each individual football player are unique, arising from the contribution of basal metabolic rate, thermic effect of food, thermic effect of activity, and in some cases growth (Manore & Thompson, 2006). The energy to meet these requirements comes from the diet (Griffin, 2001). Conditioning for football should be done according to a progressive, well-thought-out plan that builds from one phase of training to the next within the appropriate context of the game (Gatz, 2009. p133). A player can be successful despite a rather low fitness level, as it can be compensated for by better abilities in other aspects of performance in football, e.g. technical skills (Bangsbo, 1993. p107). Although, Rico-Sanz, (1998) reported that football players tend to fall within a wide range of stature and body weight but are still generally classified as mesomorphs. In addition, more recently it is stated by Burke (2006) that talent and dedication to training are no longer enough to achieve success in football. Thus all aspects of the modern game are starting to be analysed at both the professional and semi-professional level. Therefore when looking to improve performance within football, an individual's performance can be influenced by teammates, opposition, strategy, environmental conditions, differences in skill level, not to mention nutritional impact (Kirkendall, 1993).

2.3 Nutritional Requirements

It should come as no surprise that the effects of nutrition on football performance have been looked at for some time. What players should eat on match day is a frequently asked question in sports nutrition (Willaims & Serratosa, 2006). When determining proper nutritional recommendations in a sport discipline, it is important to assess the requirements of the sport and determine what may aid or limit performance (Maughan, 2000). An overriding reality, even when working with team sport athletes, is that an individual approach is needed to meet each athlete's nutritional and hydration needs (Holway & Spriet, 2011). Not one single diet is effective for all athletes and football players, since one human body has to endure different situations to another; therefore nutritional needs inevitably need to vary (Arcelli, 1998). However, if the general features of a football match are taking into consideration, common practices within the diet are recommended for football players regardless of playing position (Bangsbo, 1993) which are presented in Table 1. Several studies have approved the need to maintain a balance of the basic food nutrients (carbohydrate, fat and protein – also known as macronutrients) for both football professionals and recreational players (Williams & Serratosa, 2006; Kirkendall, 1993; Burke et al., 2006; Holway & Spriet, 2011). Conversely, most information on energy demands, training and conditioning strategies, and dietary habits is extrapolated from the research on male professional footballers (Rosenbloom, Loucks & Ekblom, 2006).

Table 1. Reported macronutrient and total daily intake guidelines for male football players.$^{\pi}$ (Mean Daily Intake ± SD)

Total Energy*	Carbohydrate*		Protein*		Fat*	
(KCal)	g[1]	g/Kg[2]	g	g/Kg	g	g/Kg
2800	437 ± 40	5.5	115 ± 2	1.5	94 ± 1	1.1

$^{\pi}$ Figures in table based on 20 year old male weighing 75 Kilo grams.

[1]Grams (g)

[2]Grams per Kilo gram of body mass (g/Kg)

*Figures adapted from Burke (2007. p430-431).

Stored glucose (glycogen) must be replenished through the intake or carbohydrate before, during (usually through sport drinks) and after practice or competition (Gatz, 2009. p157). It has been emphasized that the rules of football limit the access of players to fluid and carbohydrate replacement during the game; yet, hydration and refuelling are likely to be important to the performance of players during a 90 min game of high intensity football (Burke, 2006). Karinch (2002) states that athletes should eat or drink a carbohydrate snack before exercise to ensure the body has a source of energy. Reviews by Kirkendall (1993) and more recently Burke et al., (2006) on studies testing carbohydrate intake on performance suggest that carbohydrate intake does have a positive influence on performance. A brief synopsis of guidelines for carbohydrate intake was also suggested. This included that carbohydrate intake should meet fuel requirements, that carbohydrate-rich foods with a moderate to high glycaemic index should take priority over other nutrients, and finally, that each individual should adapt their diet to suit their own energy needs in relation to body composition and goals for growth. Subsequently, carbohydrate ingestion has been shown to improve performance of many different types of sporting activities, especially those lasting for longer than 45 min (Jeukendrup, 2004).

There have also been numerous studies on the intakes of proteins in different athletic groups. The body needs protein for growth and development, and it is constantly involved in rebuilding, repairing and maintaining vital tissues (Griffin, 2007). The general finding is that athletes typically ingest sufficient protein to meet their needs, provided that adequate energy and a variety of foods are to be consumed (Maughan & Burke, 2002). Recommended intakes of protein for strength/ speed and endurance athletes – a sub division of sport which football can come under – can be met by a diet which consists of 12 to 15 per cent of energy from protein (Griffin, 2001), or 1.5 grams of protein per kilo of body mass (Burke, 2007).

Advice on healthy eating encourages people to reduce their total fat intakes (Barasi, 2003). Fat is an essential nutrient and an important source of energy, and although people consume excessive amounts it should not be excluded from the diet, only limited in some cases (Griffin, 2007). Therefore, it is important that saturated fats are replaced with unsaturated fats where possible. It has been identified that, in contrast to body carbohydrate reserves, fat stores are abundant in humans and represent a vast source of fuel for exercising muscle (Maughan, 2000). However, Maughan (2000) further states that the total content of fat in the average diet for an athlete is often too high and a general lowering of fat intake is advisable.

In the case of professional football, the administration of sports supplements has become a more or less standard procedure, often promoted by team physicians, coaches, and even the parents of young players. Responses to dietary supplements can vary substantially between individuals, and therefore the ingestion of any supplement must be assessed in training before being used in competition. It is recommended that dietary supplements are only used based on the advice of a qualified sports nutrition professional (Hespel, Maughan and Greenhaff, 2006). In addition, care should be taken not to consume too much of any one vitamin (Barasi, 2003).

Players need to keep their bodies well hydrated for their health and well-being, but also to maintain performance in training and matches (Griffin, 2007). Most athletes and coaches are aware that dehydration – a reduction in the body's water content – will result in a loss in performance however, this knowledge does not always translate into behaviours designed to limit the risk of hydration (Maughan and Burke, 2002). During matches and training sessions some players will lose considerable quantities of electrolytes – particularly sodium – and may need to replace these during the match or training session. If sodium-containing beverages do not suffice, athletes may want to consume small amounts of salted snacks between periods to replace salt losses and stimulate drinking (Shirreffs, Armstrong and Cheuvront, 2004). Once again, it is stated by Shirreffs et al., (2004) that individuals' hydration should be monitored rather than sticking to general fluid intake guidelines.

2.4 Review of Nutritional Intake Studies

As discovered previously, current recommendations of daily intake are set upon a broad range rather than a single goal to suit individuals (Powers & Howley, 2009). Furthermore, below-optimal nutrition status may affect soccer performance and physiological growth and development (Gibson, Stuart-Hill, Martin & Gaul, 2011). Iglesias-Gutiérrez, García, García-Zapico, Pérez-Landaluce, Patterson & García-Rovés (2012), Gibson et al. (2011), Ruiz, Irazusta, Gil, Irazusta, Casis & Gil (2005) and Iglesias-Gutierrez, Garcia-Roves, Rodriguez, Braga, Garcia-Zapico & Patterson (2005) have all analysed the intake of nutrients and dietary practices among football groups of various age and gender. Gibson et al. (2011) evaluated the nutrition status of junior elite female soccer athletes through the use of 4-day food records which analyzed for macro and micronutrient intake. They concluded that a high proportion of players were not in energy balance, failing to meet carbohydrate and micronutrient recommendations. As a result, Gibson et al. (2011) went on to suggest that more research is needed to understand the unique nutrition needs of the football population and inform sport nutrition practice and research. Iglesias-Gutiérrez et al. (2012), study aimed to evaluate the nutritional intake and eating patterns of soccer players according to their playing position in the team. Their research was conducted upon male football players (aged 16-21 years) in Spain. An inadequate nutrient intake was, once more, observed in most individuals of every group. Iglesias-Gutiérrez et al. (2012) yet again suggested that the design and implementation of nutrition intervention programs, taking into consideration positional differences in nutritional intake, would be useful for these players.

However, more recently, Conejos et al. (2011), investigated nutritional intakes of football players (22.0 ± 1.3 years old) in Spain. Seven days intake was measured with the study reporting, once again, that more attention on the part of football club should be focused on the energy and nutrient intake for the football players due to that could help to increase the physical and athletic performance. However this study reported that the players were helped by the dietician of the club and quantities were also estimated using a photographic collection of food portions. Therefore, the accuracy of the results presented by Conejo et al. (2011), should be examined for validity before their suggested intake guidelines can be approved and utilised by other studies.

The general consensus found that inadequate nutrient intake was observed in most individuals of each group. This is a major concern as the groups tested contained adult males, females as well as adolescent males. To present findings that none of these groups were consuming an acceptable amount of nutrients is worrying. This illustrates that over the general population of football players of all levels, nutrition requirements are not being met. With regards to performance, it is proposed by Russell and Pennock (2011) that a mean daily energy deficit, indicated from their findings in soccer nutritional practices, would mean that the athletes become unable to sustain optimal performance during training and the soccer matches.

The positive attributes of the articles mentioned previously by Iglesias-Gutiérrez et al (2012), Gibson et al. (2011) and Iglesias-Gutiérrez et al. (2005) are that their findings are very precise. The calculations that have been made clearly show a depth in the information on the type and amount of nutrients that have been consumed by their tested athletes. On completion of their statistical analysis, the findings are presented thoroughly, highlighting specifically where the athletes are under-consuming. On the contrary, the main flaw of the studies mentioned failed to take into account whether the athletes were eating from a diet plan or consuming food from what they thought most suitable. The studies also fail to state whether the athletes are aware of their undernourishment and understand the consequences of their dietary practices. As a result, it is recommended by Gibson et al. (2011), Ruiz et al. (2005) and Iglesias-Gutiérrez et al. (2012) that nutritional education should be provided to football players, not only with a view to improving performance but also to promoting more healthy dietary practices in the long term.

2.5 Food Diaries

Rico-Sanz (1998) previously suggested that more research is needed on the nutritional habits of male players from different levels (youth, collegiate, semi-professional and professional). It has already been stated that nutritional intake should be different on training days or on match day due to the differences in energy expenditure (Conejos, Giner, Mañes & Soriano, 2011). Therefore Karinch (2002) recommends that if an athlete wants to be serious about developing the best diet for themselves, they should become consistent about their eating practices and keeping a log book about their intakes. This could be developed in the form of a food diary. Food diaries are great in some respects as they allow the athletes to record what they have actually eaten in a given period. Athletes often find it hard to "summarize" their eating habits for a diet history or food frequency questionnaire because their eating habits change with the training program and competition schedule (Lundy & Burke, 2006). Early research from Karvetti and Knuts (1992) concluded that validity of estimated food diaries is very satisfactory on the group level and is probably acceptable on the individual level. However, the downside of food diaries is that they take time and commitment from the athletes to be completed well and can't be quantitatively assessed "on the spot" by the dietician (Lundy & Burke, 2006).

Cook, Pryer and Shetty (2000) state that a major problem in self-reported dietary studies is people who under-report their true habitual food intake, or change their diet, during the period of the survey. An earlier study by Pryer, Vrijheid, Nichols, Kiggins and Elliott (1997) in dietary validation studies, found subjects (participating in the Dietary and Nutritional Survey of British Adults) to under-report their protein intakes also had lower intakes of fat, energy and sugar, but not starch, fiber or alcohol. Two similar Finnish studies 10 years apart also raised the question of low energy reporting being an increasing problem (Hirvonen, Mannisto, Roos and Pietinen, 1997). Little is known about the problem of under reporting food intakes, however the limited evidence available has suggested that low energy reporting does not affect food or nutrient reporting consistently, and is also more likely to occur in certain subjects than others, such as obese participants or those who smoke (Cook et al., 2000). Therefore, due to the bias and imprecision, self-reported energy intakes should be interpreted with caution unless independent methods of assessing their validity are included in the experimental design (Schoeller, 1995). However, Schoeller (1995) also suggests that some of the problems listed above can be countered through the careful design and application of self-report measures.

The results displayed by Gibson et al. (2011), amongst others, show that a high proportion of players who were not in energy balance, failed to meet carbohydrate and micronutrient recommendations. It would appear the athletes who were tested could not have been educated on the effect that nutrition has on sports performance. Nutrition for team sports requires knowledge of the sport-specific physiology of training and competition coupled with social skills to be able to implement dietary recommendations available from multi-professional sport science coaching staff personnel (Holway & Spriet, 2011).

2.6 Athletes' Knowledge of Nutrition

Katch, McArdle and Katch (2011), suggest that many people have made dietary recommendations based on their "feelings" and past experiences rather than sound research evidence. The problem with this is that these individuals may not have the right knowledge or have obtained incorrect information concerning dietary practices which will just intensify the problem of poor nutritional intake. Previous findings have indicated that misconceptions exist in the general population about healthy eating (Dickson-

Spillmann & Siegrist, 2011). As a result, Dickson-Spillmann and Siegrist (2011) proposed that implications such as decreased consumption of foods deemed healthy rise, leading to growing obesity figures amongst the consumer population in Switzerland. Though whether similar results occur in the United Kingdom appear yet to be assessed. For those athletes in which a well-balanced diet becomes essential, previous results from another study by Heaney, O'Connor, Michael, Gifford and Naughton (2011) has shown that athletes' knowledge was equal to or better than that of non-athletes. The athletes' knowledge answering general nutrition questions was judged to be slightly superior to that of those tested from the general population. However, these results do not indicate whether the participants' knowledge of sports nutrition practices is sufficient enough to positively enforce their own dietary practices. Heaney et al., (2011) suggest that research using validated tools to measure nutrition knowledge and its impact on dietary intake should be used to validate suggestions made in previous research that they reviewed.

Nevertheless, sportsmen and women generally are concerned about their diet, although concern is not always matched by an understanding of basic nutrition principles aimed towards sports performance (Maughan & Shirreffs, 2007). This lack of knowledge on dietary practices is worrying since it is argued by many, including Bradford (2011), that football coaches and players at all levels should not underestimate the value proper nutrition and hydration has on performance. For that reason it is essential athletes participating at all levels of football have enough correct nutrition knowledge to put to good use, in order to allow them to consume the appropriate levels of nutrients needed for performance.

Previous studies including Heaney et al (2011) and Douglas and Douglas (1984), have tested athletes' knowledge on nutrition and come to the same conclusion that more education is needed for the athletes. Douglas and Douglas (1984) used a questionnaire to obtain results from the athletes and found that a positive relationship existed between the number of sport seasons and nutrition knowledge and food practice scores. They went on to suggest that sport participation may be a catalyst for learning about nutrition. However, one flaw to their study now is that it has become fairly dated and new research on nutritional intake and knowledge has been presented.

Given the importance of nutrition in sport and physical activity, as well as the increasing competitiveness in football, it is important and necessary to learn the amount and accuracy of the nutritional education that athletes are receiving (Ruiz et al., 2005). Food labels can be used as a tool for nutrition education, but the information available is of little value to consumers who do not understand how to apply it (Papakonstantinou, Hargrove, Huang, Crawley, and Canolty, 2002). This study by Papakonstantinou et al., (2002) incorporated a 'Perception Analyser' which answered questions participants asked on food labels. Although participants reported reading food labels, misconceptions about label content were identified; analysis of mean scores indicated that age and education influenced the nutrition knowledge score. Poor nutrition and an inaccurate perception of nutritional awareness can lead to a disruption in physical development and decrease an athlete's ability to improve physically (Holway and Spriet, 2011). A previous study by Weitzel and Myers (1995) indicated a weak relationship between perceived and actual nutrition knowledge. In addition, the results of this study would suggest that the systematic implementation of a nutritional educational program for athletes can modify athletes' nutritional and dietary awareness. However, this questionnaire needs to be validated using a larger sample of competitive athletes (Weitzel and Myers, 1995).

2.7 Conclusion

Based on this synopsis, it is clear to comprehend that there is a need for high-quality, contemporary research using validated tools to measure nutrition knowledge and its impact on dietary intake (Heaney et al., 2011). The previous research into this topic can be seen to have taken place in two sections. The research has either focused its attention upon examining nutrient intake or analysing the athletes' knowledge on the subject of nutrition. Much of the research from both sections suggests that there is a need for more education from the athletes' point of view to improve their knowledge or intake. Thus, there is a need to conduct research which will combine testing the participants' knowledge of nutrition with the results they provide from completing food intake diaries to record their dietary practices.

Given the problems of measuring nutrition knowledge and the uncertainty of the findings to date, it may be premature to dismiss the link between knowledge and behaviour without first trying to develop a reliable and valid instrument with which to test a broad range of nutrition knowledge of adults (Parmenter and Wardle, 1999). Therefore the principle aims of this study were: (a) to measure nutritional knowledge with regards to caloric, macronutrient and fluid intake amongst football players; (b) to assess which factors, such as perceived knowledge, may impact results of actual nutritional knowledge; (c) to evaluate dietary intake of local semi-professional football players; and (d) to assess the relationship between nutrition knowledge scores with actual dietary intake practices.

These assessments provide data relating to the level of understanding the athlete has on nutritional knowledge. From analysis of such results it may be clear to understand if participants who score well in the questionnaire put their knowledge to good use and consume the appropriate nutrients to benefit their sports performance. Finally, results could indicate that the participants' knowledge is highly sufficient; however their intake of foods may not be helping them to sustain performance.

It will also be beneficial to analyse whether the football players' believe themselves to have clear knowledge on nutrition and whether this perceived high, or low, knowledge actually reflects their true score during testing in relation to similar testing by Weitzel and Myers (1995). By rating their own knowledge and providing reasons why they think this would provide some evidence on where they obtain this knowledge and the importance of nutritional knowledge (Bradford, 2011). Lastly, it has been previously mentioned that age and number of playing years in sport may be beneficial in knowledge testing scores. Therefore, inquiring into the athletes' background of knowledge and playing experience may prove valuable when analysing whether a correlation exists between high knowledge scores and actual nutritional intake.

CHAPTER THREE

METHODOLOGY

Methodology

3.1 Subjects

Eighteen adult male football players volunteered to participate in this study. The mean age of the participants was 22.33 ± 4.61 years old. All eighteen players compete for teams within Welsh League Division One (2012-2013 season) in which they each undertook two training sessions a week lasting one hour alongside one match per week, on average, enduring ninety minutes. All participants were injury free throughout the data collection period. Each gave their written consent after an introductory meeting in which the purpose of the investigation was explained. The study was approved by Cardiff Metropolitan University ethics committee.

3.2 Data Collection and Recording

Each of the participants results were coded to ensure that no names were stored and confidentiality was kept. All players height and weight were measured a minimum of three times under the guidance and supervision of the sole investigator. The average scores of both height and weight were collected and recorded after which Body Mass Index (BMI) was calculated and documented. The mean BMI obtained was 23.85 ± 2.02.

3.3 Dietary Records

For a three day period during the competitive season, players recorded their daily food intakes. Players were encouraged to record their intakes over three continuous days which typically incorporated a match day (Saturday), rest day (Sunday) and a training day (Monday). Alongside this, players were also encouraged to continue their regular eating pattern that they would normally adhere to on such days. Before the study began, instructions on recording daily food intakes were provided in the form of a help sheet, located within the diary pack provided, alongside an example sheet of a completed food diary (See Appendix A). Players were encouraged to be in possession of the food diary sheets at all times over the three day period so that they could more easily recall and record their food intake at relevant intervals throughout the day. With regards to the food consumption sizes, players were instructed to write down the units in grams (g) where possible or write down sizes specified by the manufacturers label if all the food was consumed. Beverages consumed were also recorded as sizes specified by the manufacturers or in millilitres (ml).

The data was stored both as a hard copy in the form of the original dietary sheets provided by the participants and on file in a Microsoft computer system. Results of the food intakes of each individual were examined using the nutritional analysis software program 'CompEat' (Trading since 1992).

3.4 Questionnaires

Participants were handed the questionnaire in conjunction with the food diary packs (See Appendix B). Note: Appendix B contains the correct answers in bold for the purpose of the article. The original questionnaire sent to the participants did not contain any bold. The questionnaire was developed to address four different aims. Questions 1-5 gathered basic educational information about the subjects. Whilst questions 6-10 aimed to investigate influences on food choice and food availability. The next section of questions (11-12), was designed to gather information about the players' perceptions of nutrition and perceptions of their own level of knowledge. The concluding questions (13-78) were designed in a true/false manner to assess their basic sports nutrition knowledge and practices of the subjects. Areas within this section tested the players' knowledge of the macronutrients (carbohydrate, protein, fat), micronutrients (including calcium and iron), hydration, general nutrition knowledge and questions relating nutrition aiding sports performance. The nutritional questionnaire used in the current study was formed from a questionnaire used by Hoogenboom, Morris, Morris and Schaeferd (2009). Their questionnaire was based upon gathering information around nutritional knowledge and eating behaviors amongst female college swimmers. Hoogenboom et al (2009) state that the questionnaire was originally developed by Zawila, Steib and Hoogenboom (2003). Then subsequently revised to its current form by Bailey, Hintz and McCauley (2004) who determined face validity and construct validity for the survey. However some original questions incorporated into the questionnaire were excluded from the questionnaire used in this study as they focused around gathering information solely on the athletes of the female gender.

Once more, individual questionnaires were securely stored as a hard copy, with data also been recorded into file stored within a password-protected computer system. Questionnaire results were also coded, to prevent the use of names being stored, and allowing the data to match up with the stored results of the food diaries.

3.5 Data Analysis

All data were presented as means ± standard deviation (SD). Food diary scores of total intake and macronutrient intake were compared to the Recommended Dietary Allowances (RDAs) highlighted within Table 1 of the literature review. The nutritional questionnaire generated nominal data in the form of true/false responses resulting in the calculation to form a total score.

The data was analysed using the computer software program SPSS (v14.0). To being with, all data was checked for normality (enabling to grasp if data is parametric or non-parametric) before scores from the questionnaires were tested statistically using analysis of variance, t-tests, and Pearson correlation coefficients, where appropriate, comparable to the research by Douglas and Douglas (1984). Each individual questionnaire was compared both to other participants' questionnaire scores and with the food diary that the individual completed.

The participants' results as a whole group were calculated and analyzed using the descriptive statistics and correlation equations above. However, to determine whether knowledge scores had an impact on food dietary intakes and to allow research into relationships between total knowledge score and other factors (mentioned in the four aims of the questionnaire previously), the mean total score of correct responses was calculated. The mean score on nutritional knowledge test was 42.89/66 (64.98% correct). From this point, two groups were created, splitting participants who scored above and below the mean score resulting in two groups of participants (n=10) and (n=8), entitling these groups as 'high knowledge' and 'low knowledge' score groups respectively. All tests above were repeated on these groups and correlations and comparisons were made to explore the resulting data.

Total, macronutrient and fluid intake results were compared with the recommended guidelines and were analysed using an independent t-test. The high knowledge score group and low knowledge score group intake scores were also examined through the use of an independent t-test. P values and tests for significance were also undertaken and displayed. Relationship tests were used to determine connections between descriptive data groups, such as perceived level of knowledge, with correlations used to express the results.

The correlations were described as weak if they ranged between 0 – .299; fairly strong if between .300 – .499; strong between .500 – .699; and very strong if the correlation was between .700 – 1.

Relationship tests were also used to explore the correlation between total knowledge score and actual intake score as well as the correlation between perceived knowledge score and actual intake scores. Total scores of the whole group, high knowledge score and low knowledge score groups were included in the analysis. Perceived knowledge scores were derived from a score (1-4) recorded by the participants in question 12 in the knowledge questionnaire (Appendix B). Actual intake scores resulted from a score given if the participants recorded a score close to the recommended guidelines. If the participant recorded an intake score within ±10% of the recommended guidelines score they would record a score of 1. If they recorded a score outside this percentage they were given a score of 0. Each participants was given a score of either 0 or 1 for total calorie, carbohydrate, protein, fat and fluid (hydration score) intake. Scores were also added to create and overall intake score out of five. These scores were then correlated with total knowledge scores and perceived knowledge scores to explore the relationship between the data.

CHAPTER FOUR

RESULTS

Results

4.1 Descriptive Analysis from Questionnaire Results of Whole Group

The mean total group knowledge score was 42.89 ± 5.48 (out of 66). The "High Questionnaire Score" group comprised from those who scored above the mean score (n=10) achieved a mean total score of 46.50 ± 3.14. The "Low Questionnaire Score" group encompassed the remainder of the participants who scored below the mean total score (n =8), 38.38 ± 4.27.

Out of the eighteen participants (11.1%) were goalkeepers, (38.9%) defenders, (33.3%) midfielders and the remaining (16.7%) identified themselves as attackers or forward players.

All participants regarded themselves as omnivorous (consuming all types of food) when faced with various choices.

Athletes were asked to identify their sources of nutritional information. Choices included athletic trainer, books, coach, community education courses, dietician, doctor, fitness classes, friends, health food store, high school, internet, magazines, newspaper, radio, parents, teammates, university courses, or other. The top five sources selected by the athletes were parents (10.6% of overall vote), followed by the internet (9.7%), doctor (7.3%), dietitian (7.1%) and friends (6.9%).

The majority of participants reported that they have received some form of nutritional education as shown in Table 2.

Table 2. Breakdown of Participants' Educational Background.			
Attitudes towards Sports Nutrition	**Percentage of Participants**		
	Whole Group	High Questionnaire Score	Low Questionnaire Score
Background Education Question:			
"What is your current educational level? (Tick your highest level of education)"			
A-Level (or college equivalent)	44.4%	30%	62.5%
Undergraduate	38.9%	40%	37.5%
Postgraduate/ Masters	16.7%	30%	-
Nutrition Education Received Question:			
"Have you had any formal nutrition education at school/college/university?"			
Yes	66.7%	80%	50%
No	33.3%	20%	50%

Out of those participants who selected 'Undergraduate' or 'Postgraduate/Masters', four (40%) reported to have studied a sports education course in which nutrition was incorporated as one of the modules that was studied.

Overall participants gave a favourable impression of sports nutrition on performance and an above average rating of their own knowledge perception on sports nutrition as presented in Table 3.

Table 3. Overall results of Participants' Attitudes Towards Sports Nutrition.

Attitudes towards Sports Nutrition	Percentage of Participants		
	Whole Group	High Questionnaire Score	Low Questionnaire Score
Importance of Sports Nutrition Question: "Is your diet important to you in aiding your sport performance?"			
Very Important	50%	50%	50%
Fairly Important	44.4%	50%	37.5%
Fairly Unimportant	5.6%	-	12.5%
Totally Unimportant	-	-	-
Rating of Sports Nutrition Knowledge Question: "How would you rate your current level of knowledge on nutrition?"			
Excellent, have detailed knowledge on wide-range of nutritional practices.	16.6%	30%	-
Good, have knowledge on most nutrition practices and information.	55.6%	60%	50%
Below average, some limited knowledge on nutrition and its purposes.	22.2%	10%	37.5%
Poor, have little knowledge on any parts of nutrition information.	5.6%	-	12.5%

4.2 Analysis of Pearson's Correlations

Table 4 displays correlations between total knowledge score of total group, high scoring and low knowledge scoring groups with various descriptive groups.

Table 4. Pearson's Correlations

	Total Group Score (n=18)	**High Questionnaire Score Group[1] (n=10)**	**Low Questionnaire Score Group[2] (n=8)**
Education Level (Q2)	.435	.304	.057
Nutrition Education (Q3)	.162	.336	-.469
Control of Own Dietary Practices (Q5)	-.313	-.412	-.057
Undertake Other Physical Activity (Q10)	.340	.477	.396
Importance of Diet (Q11)	-.016	-.504	.500
Perception of Knowledge (Q12)	-.542[‡]	-.840[‡]	.230

*Relates to Question number in the knowledge questionnaire (Appendix B) E.g. (Q1) refers to Question 1.

[1]Scores taken from participants who scored above the mean knowledge score of whole group.

[2]Scores taken from participants who scored below the mean knowledge score of whole group.

[‡]Correlation is significant at the 0.05 level.

All correlations in Table 4, previously, are calculated by Pearson's Product Moment Correlation. There is no significant difference ($p = .761$) between age and the total group knowledge score. There is a fairly strong positive correlation as the level of education received increases so does the total knowledge score in the total group and high scoring group. However this does not occur within the low scoring group where a very weak to no correlation is observed.

Once again, those who reported they received nutritional education a weak but positive correlation is observed with the total and high scoring groups. Conversely, within the low scoring group the effect changes and those who didn't receive any form of education seemed to score better overall due to the fairly strong negative correlation shown in Table 4.

Also, there is a fairly strong negative correlation between control of own dietary practices and total score. In relation to scoring the questionnaire, those who recorded themselves to generally control what they eat and prepared most of their own food scored superior in the total knowledge score.

Throughout all three groups, those participants who recorded that they undertook other forms of physical activity appeared to score better in the knowledge test as there is a fairly strong correlation across the groups.

No correlation was shown between the participants' rating of importance of dietary practices and their total knowledge scores. However, when the group was split into high and low knowledge scores, there was a fairly strong correlation between the participants' rating of importance of nutrition and knowledge score for those participants in the high knowledge score group.

In contrast, there is a fairly strong correlation in the low scoring group that those who rated dietary practices as least important scored better in the knowledge test.

Finally, Table 4 displays a fairly strong negative correlation between perception of knowledge and total knowledge score for the whole group. This implies that those who rated their perception of knowledge to be high scored fairly high in the knowledge test. A strong correlation between perception of knowledge and actual knowledge is apparent within the high scoring questionnaire group. On the other hand, within the low scoring group a fairly weak positive correlation is displayed which demonstrates that those who scored better in the knowledge test perceived their knowledge to lower than those who scored less in the true/false knowledge test.

4.3 Food Intake

The group as a whole consumed fewer calories than the recommended guidelines suggested (M = 2860.34 ± 267.70 vs. M = 2604.22 ± 366.88), t(17) = -2.39, p < .05 (=.029). Participants' also reported consuming fewer carbohydrate calories than the recommended carbohydrate intake proposed (M = 319.50 ±, 83.97 vs. 413.99 ± 38.75), t(17) = -4.61, p < .05 (<.001).

However, actual protein and fat intake reported by the group as a whole was higher than the recommended guidelines (M = 126.78, SD = 24.05 vs. M = 112.91, SD = 10.57), t(17) = 2.09, p > .05 (=.052) for protein intake and M = 91.22 ± 27.94 vs. M = 82.79 ± 7.75, t(17) = 1.19, p > .05 (=.251) for fat intake.

Finally, levels of fluid intake were found to be slightly lower than the recommended guidelines, however this difference was not significant (M = 2416.67, SD = 228.81) compared to the generic guidelines (M = 2500, SD = 0), t(17) = -1.55, p > .05 (=.141).

Table 5 displays the average total calorie and macronutrient intake of the high and low knowledge questionnaire scoring groups alongside recommended intake guidelines along with the t and p values.

Table 5. Mean (±SD) Caloric Intake Score

	Recommended Guidelines	High Knowledge Score	t	p value	Low Knowledge Score	t	p value
Total Intake	2860.34 ± 267.7	2698.20 ± 339.24	-1.555	.154	2486.75 ± 387.99	-1.779	.118
Carbohydrate (g)	414 ± 38.75	346.10 ± 75.45	-3.340	.009*	286.25 ± 86.78	-3.393	.012*
Protein (g)	112.91 ± 10.57	132 ± 24.23	2.352	.043*	120.25 ± 23.7	.709	.501
Fat (g)	82.8 ± 7.75	89.1 ± 22.13	.696	.504	93.88 ± 35.38	.924	.386
Fluid Intake [Hydration] (ml)	2500 ± 0	2510 ± 241.29	.131	.899	2300 ± 155.84	-3.630	.008*

* p is significant at the 0.05 level (p<0.05).

(g) Equates to grams.

(ml) Equates to millilitres

4.4 Relationship between Intake and Knowledge Scores

Table 6. Relationship between Total Knowledge Score and Actual Intake Score.

	Total Group (n=18)	High Knowledge Score Group	Low Knowledge Score Group
Total Calorie Intake	.605*	.084	.343
Carbohydrate Intake	.177	-.330	.[a]
Protein Intake	.060	.084	.509
Fat Intake	-.047	-.280	.451
Fluid Intake (Hydration)	.243	.624	.271
Overall Intake Score	.543*	.124	.776*

* p is significant at the 0.05 level ($p<0.05$).

.[a] Cannot be calculated because the carbohydrate intake variable is constant.

A strong relationship between total group knowledge score and overall intake score (r=.543) demonstrates as the participants' knowledge score increases so does their score for achieving an intake close to the recommended guidelines. This is a significant value and it also arises in the very strong correlation between the low knowledge group score and overall intake score (r=.776). A weak correlation is displayed (r=.124) between the participants in the high knowledge group and their overall intake scores.

The low knowledge score group reported intake scores that positively correlated with the overall knowledge score. A strong correlation is displayed between protein intake and total knowledge score (r=.509), with a fairly strong intake also being displayed for both fat (r=451) and total calorie (r=.343) intake. A correlation between low knowledge group score and carbohydrate intake could not be obtained as none of the participants recorded an intake within 10% of their recommended intake resulting in each having a score of 0.

The high knowledge score group displayed only a strong correlation between knowledge score and fluid intake (r=.624). A weak correlation was recorded between total calorie, fat and protein intake with total knowledge score. A fairly strong correlation between carbohydrate intake and total knowledge score (r= -.330) was also reported. However, this negative correlation suggests that as the participants' knowledge scores increase, their carbohydrate intake decreases.

4.5 Relationship between Intake Score and Perceived Knowledge

Table 7. Relationship between Perceived Knowledge and Actual Intake Score.

	Total Group* (n=18)	High Knowledge Score Group* (n=10)	Low Knowledge Score Group* (n=8)
Total Calorie Intake	-.218	-.250	.204
Carbohydrate Intake	.098	.582	.[a]
Protein Intake	-.135	-.250	-.325
Fat Intake	.098	.111	-.104
Fluid Intake (Hydration)	-.189	-.582	.104
Overall Intake Score	-.203	.040	-.104

[a] Cannot be calculated because the carbohydrate intake variable is constant.

*No values in were significant at the 0.05 level.

Table 7, above, identifies a weak correlation between participants' overall intake score and their perceived level of knowledge (r= -.203). This also occurs within both the high and low knowledge score groups where no correlation is apparent (.040 and -.104 respectively). A correlation of -.218 indicates a weak correlation that as the total group knowledge score rises so does their total calorie intake. The negative correlation (-.250) between the high knowledge score group and total calorie intake also indicates that those who scored better in the knowledge questionnaire tended to intake more calories overall. Conversely, the low knowledge score group inclined to consume less calories the higher they perceived their knowledge to be (r=.204). A weak correlation was found throughout between the total group knowledge score and each of the macronutrient intake scores.

Those participants in the high knowledge score group who perceived themselves to have higher knowledge reported to intake more fluid (r= -.582) and protein (r= -.250). In comparison as they perceived their knowledge to be higher, these participants reported to intake less carbohydrate (r=.582) and fat (r=.111).

Participants in the low scoring questionnaire group also reported to consume more protein (r= -.325) and fat (r= -.104) the higher they perceived their knowledge to be. However a weak correlation between low group knowledge score and fluid intake (r = .104) proposes the opposite. A correlation between low knowledge group score and carbohydrate intake could not be obtained as none of the participants recorded an intake within 10% of their recommended intake resulting in each having a score of 0.

CHAPTER FIVE

DISCUSSION OF FINDINGS

Discussion of Findings

5.1 Diet and Nutrition Intakes

Caloric intake is a very important aspect of nutrition for football players, among other athletes, as a low intake will not provide enough energy to sustain a high level of training and competition (Powers & Howley, 2009). Previous studies present reason for daily calorie intake levels to reach between 2900-4000 calories per day (Conejos et al., 2011; Burke et al., 2006; Rico-Sanz et al., 1998). Overall the daily mean intake reported in this study was 2604.22 (± 366.88) calories, falling short of intakes examined in previous studies.

Despite the fact that exact energy expenditure cannot be determined for the athletes in this study, the mean daily intake calculated fell short of the guidelines incorporated into this study. According to Daily Reference Intake levels, expressed earlier in Table 1, energy requirements exceed 2,800 calories for very active persons competing in football. However, contrary to these guidelines, 77.8% (n=14) of athletes surveyed intake levels revealed an inadequate intake of under 2,800 calories. Of these 14 athletes, 7 (out of 10) were placed into the 'high' knowledge score group based on their average knowledge score. This left 7 (out of 8) athletes situated in the 'low' knowledge score group who reported an intake of below 2500 calories. While 2,800 calories comes close to meeting sufficient energy requirements for football players, in this instance, with many low scores being presented, negative repercussions may come into effect on the football players within this research group (Gibson et al, 2011). This is also reflected in the mean daily intake comparison of the 'high' and 'low' scoring knowledge groups; 2698.20 (± 339.24) and 2486.75 (± 387.99) respectively. This leads to suggestions that knowledge could have an impact on how many calories are consumed.

Inevitably, with review of the previous study by Gibson et al (2011), the results of this current study revealed a higher total intake level than a study by Gibson et al (2011) presented (2,079 ± 460 kcal/day). It was also stated that those athletes tested did not meet dietary requirements or recommended values. This could still be a case of under reporting by the participants in both studies. Cook et al (2000) stated that a major problem in self-reported dietary studies is people who under-report their true food intake during the period of the survey. An earlier study by Pryer et al. (1997) clarified that low energy reporting causes major problems in the interpretation of dietary data. A reluctance to report foods known to be unhealthy was also a concern highlighted within the study of Cook et al (2000).

5.2 Knowledge Questionnaire Scores

Within the food knowledge questionnaire, participants scored 64.4% (3.22 ± 1.06 out of 5) of questions about the carbohydrate food group correctly. Generally, however, participants from both the high and low scoring questionnaire groups reported carbohydrate intakes of below what the guidelines (414 ± 38.75 grams) recommended. Out of the entire participants tested, only two indicated an intake of above the recommended guidelines of 5.5 grams per kilo of body mass (Burke, 2007: Shown in Table 1). Both of these participants reported to consume a protein and carbohydrate based supplement drink on a daily basis.

When carbohydrate is in short supply, protein can be used as a fuel (Burke et al., 2006). For that reason, carbohydrate intake should be adequate enough to do its job of providing athletes with the energy they need for the occasion (Rosenbloom et al., 2006). However, with the majority of athletes reporting inadequate carbohydrate values, a study by Conejos et al. (2011) is comparable as it also reports an intake low in carbohydrates with too much protein and fat consumption in comparison with daily reference values they obtained from the American Dietetic Association and American College of Sports Medicine. Protein level within this study replicated this with a mean intake of 126.78 ± 24.05 compared to the recommended values of 112.91 ± 10.57. In the previous examination of the carbohydrate macronutrient intake, the high scoring knowledge group reported a mean value closer to the recommended guidelines. However, with regards to the levels of protein intake, the high scoring knowledge group consumed on average 11.75 grams per person more protein, which is even further away from the suggested guidelines.

With reference to the knowledge test scores, participants overall scored 70.1% of questions regarding protein correctly. This is the highest collective score out of all the sub sections (carbohydrate, protein, fat and hydration) within the knowledge questionnaire. Within this sub section, 77.8% (n=14) of participants correctly identified that protein is not stored in the body and needs to be consumed daily. Alongside this, two-thirds of participants scored correctly in recognising protein as not being the primary source of muscular energy. Therefore after recording the highest scores in the protein sub section, the intake of such high protein fails to correlate with the strong apparent knowledge discovered. In comparison, the football players struggled frequently with the sub section of questions concerning fat intake and knowledge, scoring the lowest average of all sub divisions at 59.3%.
Similarly, fat intake levels also exceeded recommendations. Previously stated by Maughan (2000), the total content of fat in the average diet for an athlete is often too high and a general lowering of fat intake is advisable. Despite the fact that both high and low knowledge scoring groups surpassed recommendations (89.1 ± 22.13 and 95.88 ± 35.38 respectively) it was the high scoring participant group that, yet again, recorded fat intake levels closer to the guideline intake values. If an athlete eats an increase in fat and does not consume adequate carbohydrates, the fat cannot be easily used as energy in the body and protein will be used, resulting in muscle breakdown (Wolinsky, 1998). Exactly half of the athletes (n=9) were unable to identify the correct percentage of daily diet from fats on the nutritional questionnaire.

Finally, hydration levels were also examined with recommended intake levels proposing drinking consumption to be around 2500ml per day (Burke, 2007). Athletes from both high and low scoring knowledge groups achieved intake levels closer to the recommended guideline than any of the previous macronutrient intake levels presented (Shown in Table 3.). High scoring knowledge athletes averaged 73.3% of questions regarding hydration correctly, with those participants in the low knowledge scoring category also answering well with a mean of 69.4% correct. Overall, seventeen out of the eighteen football players reported correctly that dehydration can impair their physical performances. This belief may have played a role in helping the participants achieve intake close to the recommended guidelines more so than the other macronutrients demonstrated.

5.3 Relationship between Knowledge Score and Dietary intakes

Nutritional knowledge has been positively correlated with positive eating behaviors within other sports; for instance swimming observed by Hawley and Williams (1991). In comparison, more recent examination of several studies by Heaney et al. (2011) stated a weak ($r < .44$), positive association between knowledge and dietary intake was reported in 5 of 9 studies assessing this. However common flaws in articles appeared once again, which included inadequate statistical reporting and instrument validation (Heaney et al, 2011). Equally, there is a weak correlation between total knowledge score and total intake of calories ($r < .27$) established in this study. The previous results, in this study, do appear to show healthier dietary practices in the high knowledge scoring group (Calorie intake between the two groups presented in Table 5.) after examining the caloric intakes of the high and low scoring groups separately.

However, there is a strong relationship ($r=.543$) between total knowledge score and overall intake score developed from participants recording an intake score within ±10% of the recommended guidelines. This relationship is also significant at the 0.05 level ($p<0.05$). This suggests that as the participants' knowledge score increases they are more likely to intake food closer to the recommended guidelines. This correlation is more apparent in the low scoring questionnaire group, where a very strong and significant correlation ($r=.776$, $p<0.05$) is displayed compared to the high knowledge score group's weak correlation ($r=.124$). It has been discussed previously that the high knowledge score group on average would consume a higher amount of calories closer to the recommendations. Conversely, this correlation suggests that the low knowledge score group are more likely to intake food closer to the recommended guidelines, as their knowledge score increases. Therefore, contributions of other factors may have helped to achieve a higher or lower knowledge score.

It has already been identified that each participant was placed into a high or low knowledge score group based on their overall questionnaire score. On the whole, both groups tended to consume less than the recommended required daily energy intake along with less carbohydrate intake. However both protein and fat intakes that were consumed both exceeded recommendations. The high scoring group had a tendency to, on average, record a score closer to the recommendations, suggesting they eat a better balanced diet overall. However, further investigation of athletes' nutritional knowledge might explain why the majority of athletes consume calories and nutrients without considering their dietary requirements (Dunn, Turner and Denny, 2007).

Several studies (present included) have shown that there is a need for increased knowledge of nutrition in all football programs, regardless of age, sex or calibre (Heaney et al., 2011; Douglas and Douglas, 1984). In this instance, there was seemingly no correlation between age and total knowledge ($r > -.077$) score amongst the athletes. Due to the young average age (22.3 ± 4.61) being tested, seven out of the total eighteen participants reported to be still receiving full time education either in college or university. As previous research has indicated (Jacobson, Sobonyna & Ransone, 2001), college athletes are lacking in nutritional knowledge. However, results in this study have revealed that both the high and low scoring groups have a mean age of 22.6 (±4.1 and ±4.7 respectively), suggesting that the age of the participants had no effect over their level of nutritional knowledge.

On the contrary, out of the twelve participants who had previously received nutritional education, eight scored above the average in the knowledge questionnaire and were placed into the high scoring group. Therefore it should come as no surprise that the three participants who reported to have achieved the highest educational level (postgraduate or masters degree level) all achieved above the average total score. Overall, there is a fairly strong positive correlation ($r = .435$) between educational level and total knowledge score. Nevertheless, this should not be dismissed as education has been proved vital in raising awareness and knowledge of nutrition in which several previous studies (Gibson et al., 2011; Ruiz et al., 2005; and Iglesias-Gutiérrez et al., 2012) have argued for more education to be made available for football players.

5.4 Relationship with Perceived Knowledge

Three participants' who achieved the overall highest knowledge scores were the only athletes to rate and perceive themselves to have an excellent, detailed knowledge of nutritional practices. This reflects within the very strong correlation that exists within the high scoring group between total knowledge score and higher perception of own nutritional knowledge (r= .840) where the correlation is significant at 0.05. An earlier study by Weitzel and Myers (1995) evaluated the competitive athlete's perceived nutrition knowledge and actual nutrition knowledge. Their results indicated a weak relationship between perceived and actual nutrition knowledge which is a contrast to the results from those shown within the higher group of this study. While results from the low scoring group display a weak, yet positive correlation (r = .230), the impact on the group as a whole is minimal as the results still indicate a positive correlation between actual and perceived knowledge (r = .542) contrasting those results from the Weitzel and Myers (1995) study. It has already been mentioned that misconceptions exist for athletes with regards to understanding food labels (Papakonstantinou et al., 2002), leading to problems with the way in which athletes perceive the true caloric values of the food they consume.

Although there is a significant correlation between the athletes perception of knowledge with their total knowledge score, the results in table 7 indicate that there is no significant relationship between the athletes' perceived knowledge and actual intake scores. A weak correlation between both total group (r= -.203) and low knowledge score group (r= -.104) perceived scores with actual intake score suggests that as the athletes perceived knowledge increases so does their actual intake. However, none of the values in table 7 are significant to the $p<0.05$ level. Therefore to develop further research, exploration into the reasons behind why the athletes rated their perceived knowledge as they did may reveal factors such as: previous education and where the athletes obtain the information from, may have an effect on how they portray their own intelligence and reasons behind their rating score.

More recently, it has been revealed that athletes with higher nutritional knowledge may obtain information from various sources to help increase performances and or maintain healthy or competitive weights (Dunn et al., 2007). The football players in this study were asked to identify their sources of nutritional information. While there were many options, with the top three informants being parents (10.6% of overall vote), followed by the internet (9.7%) and doctor (7.3%), which is similar to previous studies by Hoogenboom (2009). Main sources of nutrition information identified from another previous study by Weitzel and Myers (1995) were magazines (14), books (7), friends (6), and classes (5). However, some nutritional information obtained by athletes may be unreliable, contributing to the problem of athletes making poor dietary choices (Dunn et al., 2007). Rosenbloom et al. (2006), found that coaches have an overall lack of nutritional knowledge and they, like their athletes, would benefit from further nutritional educational.

Subsequently, the participants were also asked to describe their eating situation. Exactly half the participants (n=9) stated that they generally controlled what they eat and bought or prepared their own food. 70% of athletes in the high score group claimed to control their own dietary practices which lead to a fairly strong correlation (r = .412) between total knowledge score and having control over ones diet. The correlation lowers considerably (r = .057), expressing that there is seemingly no correlation, in the low scoring knowledge group, between participants having control over their own dietary practices and their total knowledge score.

5.5 Limitations

The main limitation in this study was the use of the 3-day food diaries. Despite use of specific scripted instructions and exemplar sheets, it was difficult for subjects to report everything they consumed within the designated 3-day period, and to accurately estimate serving size. This difficulty was evidenced by a lack of recorded information on some of the 3-day food diaries. In comparison with notions presented by Hoogenboom (2009), incomplete data regarding serving sizes, each of which could contribute to under-reporting. Under- reporting on the 3-day food diary may have led to an underestimation of total caloric intake for the subjects in this study. Therefore, future surveys should be designed to evaluate the degree to which athletes understand when macronutrient intake is ideal for optimizing energy levels (Cook et al., 2000).

5.6 Future Recommendations

A number of findings from this present study suggest recommendations for future research. This study found that knowledge and dietary practices in comparison with nutrition guidelines were lacking, implying that the football players are not meeting the recommended guidelines. This may be due to the fact that they do not have the knowledge. It could be suggested that future research should look deeper into the relationship between knowledge and dietary intake and should investigate reasons for the poor transference of some positive displays of nutrition knowledge into eating behaviours.

Nutrition education is often delivered through schools, colleges and universities. This information would therefore be critical to these educational institutes as they need to understand that although they are providing education, this information is not being translated into dietary practice behaviours. However, there are many organisations that focus on promoting nutrition such as the Nutrition Network Wales, who could also use the results of this study to highlight particular areas of weakness and consider alternative nutrition promotion campaigns. This could help to improve the understanding and ways of implementing nutritional information to aid and develop all athletes knowledge to improve performance, not just that of football players.

CHAPTER SIX

CONCLUSION

Conclusion

The aim of the study was to investigate whether a relationship existed between nutritional knowledge scores and actual dietary practices of football players. Statistical analysis revealed that a significant relationship did exist between total knowledge score and dietary intake application amongst the athletes.

Analysis of the whole group's dietary intake revealed a significant difference between total calorie and carbohydrate intakes compared with recommended guidelines. Intake levels reported a consumption of total calorie intake and carbohydrate intake to be lower than the recommended guidelines. Fat and protein intake levels that were reported, revealed a much higher consumption than what the recommended levels suggested. However, no significant difference was discovered between the reported higher intake levels of protein and fat compared with the intake recommendations suggested. Once again, no significant difference was found between fluid intake and the recommended guidelines.

The high knowledge score group consumed more calories overall compared to the low knowledge score group. However, statistical analysis reveals a strong correlation between total knowledge score and actual intake practices for the group as a whole and the low knowledge score group. This suggests that as the participants' knowledge score increases they are more likely to intake food levels closer to the recommended guidelines.

Finally, the analysis revealed there was no significant relationship level of perceived knowledge and actual intake practices. However, there is a significant correlation between total knowledge score and the athletes perceived knowledge level. This suggests that those participants who believed to have a higher level of knowledge tended to score better in the knowledge questionnaire, however, those with the higher perceived knowledge did not necessarily report better actual intake practices closer to the recommended guidelines.

As a final point, it is clear to see there are areas for improvement for both knowledge and dietary intake practices as the athletes often failed to report intake levels close to the recommended guidelines. Many of the questionnaire answers selected were often incorrect. It is also important that other factors, such as educational background and the sources of information where athletes obtain their knowledge, are considered when assessing nutritional knowledge with food intake practices. This is because as this study highlighted, there are different strengths in the athletes' knowledge throughout different areas of nutrition and food intake practices in relation to the recommended guidelines.

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APPENDICES

APPENDIX A

FOOD DIARY

How to fill in your food diary:

1. Please keep a careful record of:

   All food and drink and the **time** taken

   All supplements (if taken)

2. Remember to **include all snacks** including sweets, crisps, biscuits and drink (especially water)

3. Information about the **amounts of food** eaten is needed. If possible, please state the weight of the food using household scales. If you are unable to do this, give quantities in household measures.

   e.g. 3 heaped tablespoons Branflakes

   2 level teaspoons of sugar

   4 medium slices of white bread

4. State the **brand name** e.g. Heinz baked beans, Sainsbury's own brand margarine

5 State the **cooking method** e.g. grilled, steamed, fried, boiled etc

6 If dishes are **home made** please include the recipe

This may seem tedious but the more accurate the information is, the more accurate the assessment will be.

[The next page gives you an example of the type of details needed]

Name: David Jones Day: Training day Date: 28/11/12

Time eaten	Where eaten	Type of food and drink	Weight (g/oz)
Breakfast – 6am	Home	Kelloggs Cornflakes	50g (small bowl)
		Semi skimmed milk	200ml
		Sugar	5g (1 teaspoon)
		Tea (black, no sugar)	300ml (large mug)
Mid-Morning	Work	Kitkat	4 fingers
10.30am		Coffee	300ml (large mug)
		Whole milk	40ml
		Sugar	10g (2 teaspoons)
Lunch	Desk	Wholemeal sliced bread	4 slices (140g)
1.15pm		Low fat spread (Flora)	15g (thin spread)
		Cheddar cheese- grated	75g
		Asda Sweet pickle	1 tablespoon
		Coke	330ml
Mid-Afternoon			
3.15pm	Desk	Coffee	300ml
		Sugar	10g
Evening Meal	After training, in clubhouse	Cod in butter sauce- frozen	170g
8.30pm		Potatoes – mashed	200g
		With low fat spread	20g
		Frozen peas -boiled	30g (1 tablespoon)
		Tomato ketchup	1 tablespoon
		Red wine (2 glasses)	250ml
During Evening	Home	4 Biscuits –cream filled	40g

Name: **Day:** **<u>Training Day</u>** **Date:**

Time Eaten	**Where Eaten**	**Type of Food and Drink**	**Amount / Weight (g/oz)**
Breakfast -			
Mid-Morning			
Lunch			
Mid-Afternoon			
Evening Meal			
During Evening			

Name: **Day:** **<u>Rest Day</u>** **Date:**

Time Eaten	Where Eaten	Type of Food and Drink	Amount / Weight (g/oz)
Breakfast -			
Mid-Morning			
Lunch			
Mid-Afternoon			
Evening Meal			
During Evening			

Name: **Day:** **<u>Match Day</u>** **Date:**

Time Eaten	**Where Eaten**	**Type of Food and Drink**	**Amount / Weight (g/oz)**
Breakfast -			
Mid-Morning			
Lunch			
Mid-Afternoon			
Evening Meal			
During Evening			

Food Diary - General questions:

Please tick the appropriate answer

1. **What type of milk do you use?**

Whole Milk ☐ Semi Skimmed Milk ☐ Skimmed Milk ☐ Other ☐

Please Specify ____

2. **What type of bread do you usually eat?**

Wholemeal ☐ White ☐ Granary ☐ Wheaten ☐

Other ☐

Please Specify ____

3. **What type of fat do you put on bread?**

Butter ☐ Margarine ☐ Low Fat Spread ☐ None ☐

Other ☐

Please Specify ____

4. **How do you apply this spread?**

Thinly ☐ Medium ☐ Thickly ☐ Don't know – Someone else does it ☐

5. **Do you add butter/margarine to vegetables or potatoes?** Yes ☐ No ☐

6. **Do you put sugar in tea/coffee?** Yes ☐ No ☐ If yes, how many teaspoons? __

7. **Do you add sugar to breakfast cereals?** Yes ☐ No ☐ If yes, how many teaspoons? __

8. **Do you drink "branded" sports drinks?** Yes ☐ No ☐

If yes, please state the amount taken and when

____

9. Do you take vitamin/mineral supplements? Yes ☐ No ☐

If yes, please state type taken and daily dose

____

10. Do you take protein/carbohydrate supplements? Yes ☐ No ☐

If yes, please state type taken and daily dose

____

Please answer the following questions where applicable

11. Do you drink alcohol? Yes ☐ No ☐
If yes, how many units on average per week? (The following are each equivalent to one standard unit of alcohol: ½ pint beer,1 measure of spirit, 1glass wine)

____

12. Do you eat fried foods? Yes ☐ No ☐

13. How many of your meals contain red meat per week?

____

14. How many of your meals contain fish per week?

____

15. Do you eat fruit? Yes ☐ No ☐

If yes, how many pieces per day and which type?

____

16. Do you eat vegetables? Yes ☐ No ☐

If yes, how many portions per day and which type? __________________

____

17. Do you drink fruit juice? Yes ☐ No ☐

18. Do you eat potatoes? Yes ☐ No ☐ if yes, please circle all that apply below.

Chips / Crisps / Baked with skin / Boiled / Roast / Mashed / Other (please specify)

____

19. **Do you eat pasta?** Yes ☐ No ☐ If yes, how many times per week? __________

20. **Do you eat rice?** Yes ☐ No ☐ If yes, how many times per week? __________

Do you have any other comments?

____

____

____

____

____

Thank You ☺

APPENDIX B

NUTRITIONAL KNOWLEDGE QUESTIONNAIRE

NUTRITIONAL KNOWLEDGE SURVEY

1. Age ________________years

Height ________________

Weight ________________

2. What is your current educational level? (Tick your highest level of education)

A-Level (or college equivalent) ☐ Undergraduate ☐

Postgraduate ☐ Masters ☐

3. If you did do a university/college course, what was the name of the qualification (e.g. Sport & Exercise Science, Accountancy)

____

4. Have you had any formal nutrition education at school/college/university? (Please tick) Yes ☐ No ☐

5. Which best describes your eating situation? (Please tick one) I buy and/or prepare most of my own food; thus I generally control what I eat. ☐

My food is normally prepared by a family member, roommate, food service of a dorm, student union, etc., thus I am somewhat limited in my food selection. ☐

6. Many of us learn about nutrition from a variety of sources. From which sources have you obtained your nutritional information? (Rate only those that apply. E.g. 1= most important, 5= least important but still applies as a learning source)

Parents ☐ Books ☐ Magazines ☐ Internet ☐ Doctor ☐ Newspapers ☐ Coach ☐ Fitness Class ☐

High School ☐ Radio ☐ Dietician ☐ Friends ☐ University courses ☐ Community Education Course ☐

Athletic Trainer ☐ Teammates ☐ Health food store ☐ Other (please specify): ________________

7. What category best describes your eating habits: (Please tick one)

Omnivorous (consumes all types of food) ☐ Semi-Vegetarian (avoid all red meat but consume poultry and fish) ☐

Lacto-ovo-vegetarian (avoid all flesh food but consume dairy products & eggs) ☐ Vegan (avoid all animal products) ☐

Other (please specify): ____

8. Does your diet tend to change on a match day compared to a rest day/ non-training day? Yes ☐ No ☐

9. What is your current playing position in football? ____

10. Do you participate in any other sport(s) or physical exercise other than football? Yes ☐ No ☐

If yes, which sports/ physical exercise? ____

11. Is your diet important to you in aiding your sport performance?

Very Important ☐ Fairly Important ☐ Fairly Unimportant ☐ Totally Unimportant ☐ Why? ______________ ______________

12. How would you rate you current level of knowledge on nutrition?

Excellent, have detailed knowledge on wide-range of nutritional practices. ☐ Good, have knowledge on most nutrition practices and information. ☐

Below Average, some limited knowledge on nutrition and its purposes. ☐ Poor, have little knowledge on any parts of nutrition information. ☐

For each of the following questions circle an answer.

13.	An equivalent weight of carbohydrates and protein have approximately the same caloric value.	**True**	**False**
14.	Carbohydrates are not as easily and rapidly digested as protein and fat.	**True**	**False**
15.	A slice of bread is an example of 1 serving from the bread and cereals food group.	**True**	**False**
16.	Foods such as potatoes and honey are best eaten after exercise.	**True**	**False**
17.	Eggs and legumes are examples of protein sources other than meat.	**True**	**False**
18.	Protein is the primary source of muscular energy.	**True**	**False**
19.	Protein is not stored in the body; therefore, it needs to be consumed every day	**True**	**False**
20.	All red meat is high in saturated fat.	**True**	**False**
21.	No more than 15% of calories in the diet should be obtained from fat.	**True**	**False**
22.	Substitution of polyunsaturated fat for some saturated fat is recommended to lower the risk of heart disease.	**True**	**False**
23.	Broccoli is a plant source of calcium.	**True**	**False**
24.	Milk is a good supplier of calcium for all age groups.	**True**	**False**
25.	Two 200 ml glasses of milk is enough to fulfill the recommended amount of calcium per day.	**True**	**False**
26.	Carbonated beverages can negatively affect calcium metabolism.	**True**	**False**

27.	Iron deficiency anemia results in a decrease in the amount of oxygen that can be carried in the blood.	**True**	**False**
28.	Cheese is a good source of iron in the diet.	**True**	**False**
29.	Those with a meatless diet are at a higher risk for iron deficiency.	**True**	**False**
30.	Iron in meat is absorbed at the same rate as iron in a plant food.	**True**	**False**
31.	A lack of iron in the diet can result in fatigue, injury, and illness.	**True**	**False**
32.	Meat and eggs are good sources of zinc.	**True**	**False**
33.	Bananas and avocados are good sources of potassium.	**True**	**False**
34.	Vitamin supplementation is recommended for all physically active people.	**True**	**False**
35.	Excess vitamin supplementation may harm the physically active person.	**True**	**False**
36.	Vitamins in mineral enriched foods are not used by the body as well as naturally occurring vitamins.	**True**	**False**
37.	Vitamins are a good source of energy.	**True**	**False**
38.	Green, leafy, and yellow vegetables are important because they help ensure the Vitamin A requirement for the individual.	**True**	**False**
39.	Carrots are a good source of vitamin A.	**True**	**False**
40.	Whole milk is a better source of vitamin D than skim or 2% milk.	**True**	**False**

41.	The body can synthesize vitamin D with exposure to the sun.	**True**	**False**
42.	Potatoes, strawberries, and cantaloupe are good sources of vitamin C.	**True**	**False**
43.	Salt is an essential part of a healthy diet.	**True**	**False**
44.	Fiber in the diet may help to decrease constipation, decrease blood cholesterol levels, and prevent cancers.	**True**	**False**
45.	Bread and cereals is the only food group that is a good source of fiber.	**True**	**False**
46.	Two servings of vegetables per day fulfills recommended dietary allowances.	**True**	**False**
47.	Fresh, frozen, and canned vegetables all have similar nutrient values.	**True**	**False**
48.	Nutrients can be destroyed if vegetables are overcooked.	**True**	**False**
49.	Eating oatmeal may decrease your risk of heart disease.	**True**	**False**
50.	Dehydration can impair physical performance.	**True**	**False**
51.	During activity, thirst is an adequate guide to the need for fluids.	**True**	**False**
52.	During exercise, mass ingestion of large amounts of fluid is preferred over frequent ingestion of small amounts.	**True**	**False**
53.	An athlete should drink no water during practice, but rather rinse out his mouth or suck on ice cubes.	**True**	**False**
54.	Sports drinks are the best way to replace body fluids lost during exercise.	**True**	**False**

55.	Alcohol consumption can affect absorption and utilization of nutrients.	**True**	**False**
56.	Alcohol has more calories per gram than protein.	**True**	**False**
57.	Caffeine has been shown to improve endurance performance.	**True**	**False**
58.	Caffeine can increase the risk of dehydration.	**True**	**False**
59.	An athlete involved in endurance events (e.g. distance running) should follow a considerably different diet than one participating in events of short duration (e.g. sprinting).	**True**	**False**
60.	A physically fit person eating a nutritionally adequate diet can improve his performance by consuming greater amounts of nutrients.	**True**	**False**
61.	A muscular person expends more energy at rest than a non-muscular person of the same age, sex, and weight.	**True**	**False**
62.	A 90 kg (14 stone) person uses about twice as many calories to run a mile as a 45kg (7 stone) person.	**True**	**False**
63.	A person with a higher percentage of body fat may weigh less than a person of the same size with a greater muscle mass.	**True**	**False**
64.	A sound nutritional practice for athletes is to eat a wide variety of different food types from day to day.	**True**	**False**
65.	Skipping meals is justifiable if you need to lose weight quickly.	**True**	**False**
66.	When trying to lose weight, acidic foods such as grapefruit are of special value because they burn fat.	**True**	**False**
67.	If trying to lose weight, carbohydrates should come only from fruits and vegetables rather than from breads and pastas.	**True**	**False**
68.	The relationship of good eating habits to good health should be stressed to the athlete.	**True**	**False**

69.	Coaches need to have good attitudes toward nutrition because of their close contact and influence upon performance.	**True**	**False**
70.	The type of food an athlete eats affects his physical performance.	**True**	**False**
71.	What the athlete eats is only important if the athlete is attempting to gain or lose weight.	**True**	**False**
72.	Nutrition is more important during the competitive season than during the off-season for the athlete.	**True**	**False**
73.	Food advertisements are a very reliable source of nutritional information.	**True**	**False**
74.	It is the coach's responsibility to stress good nutritional practices.	**True**	**False**
75.	The athlete should schedule his activities so he has adequate time to eat.	**True**	**False**
76.	Learning about nutrition is not important for athletes because they eat so much food they always get the nutrients their bodies need.	**True**	**False**
77.	Learning facts about nutrition is the best way to achieve favourable changes in food habits.	**True**	**False**
78.	Nutritional counselling would be important to the athlete who is trying to change his weight.	**True**	**False**