NUTRITIONAL HABITS AND KNOWLEDGE IN YOUTH ACADEMY SOCCER

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Abstract

Introduction

Soccer is a high-intensity, intermittent team sport which typically includes two 45 minutes halves separated by a 15-minute break. There is limited data on the nutritional intake of elite British fulltime youth soccer players. The current literature in this area generally suggests that youth players are not meeting energy requirements (albeit from estimated values), which generally appears to be a result of inadequate carbohydrate intake (Russell and Pennock, 2011; Briggs et al., 2015; Naughton et al., 2016).

Aims of study

One aim of this research was to assess the nutritional knowledge of youth soccer players from an English Championship Academy. Furthermore, another aim was to assess their energy, macronutrient and micronutrient intake and assess if there were changes in this intake on match, training, and rest days. Moreover, another aim was to assess if there is a correlation between nutritional knowledge and nutritional intake in this group of players.

Nutritional Knowledge Questionnaire

Thirty-nine male soccer players (age 17.5 ± 0.7 years; height 1.82 ± 0.06 m; body mass 74.14 ± 9.67 kg) from an English Championship Academy participated in the study after receiving verbal and written information and providing informed consent. In all Nutritional knowledge questionnaire sections, average scores were around 50% (General Nutrition = 55%, Sport Nutrition = 48%, Protein = 55%; ALL = 53.1%). This demonstrates that there is a lack of nutritional knowledge and further education is required.

Food Diaries

Nineteen of the thirty-nine players were recruited to participate in the study after receiving verbal and written information and providing informed consent. On the return of the food diaries only eight were suitable for analysis due to missing data. The overall mean energy intake resulting from the food diaries analysis was 2655.7 ± 804.4 kcal/day. Whilst there was no significant difference between the types of day (P = 0.594), a hierarchical order of match day > training day > rest day was observed. Furthermore, no statistically significant correlation between energy intake and nutritional knowledge was found (r = -0.468, P = 0.243).

CHAPTER ONE

LITERATURE REVIEW

1.1 Introduction

Soccer is a team sport which includes two 45-minute halves separated by a 15-minute break (Reilly, 1994). Players require high levels of aerobic and anaerobic fitness as they are required to intermittently cover 10-12km per match (Stolen et al, 2005). Players are required to have an ability to take part in repeated actions at maximal or near-maximal intensity, but also in periods of low-to-moderate intensity. Players perform around 1350 activities per match, including -changes of direction every 4-6 s, and a high number of accelerations and decelerations.

Soccer is played by approximately 250 million players and has about 4 million fans around the world, which makes soccer the world's most popular sport (García-Rovés et al, 2014). It is said that despite the huge popularity and progress in soccer-related research, there has still not been enough attention given to the nutritional intake and eating habits of soccer players (García-Rovés et al, 2014). Previous research has shown insufficient energy intake and/or macronutrients may impact an athlete's training adaptations (Kerksick et al., 2018). Athletes who have adequate energy and macronutrient intake can increase physiological training adaptations. Moreover, an energy deficiency during a training period may lead to decreased muscle mass and strength, as well as potentially illness and injuries, dysfunction of the immune and endocrine systems, and an increased tendency for overtraining (Kerksick et al., 2018).

1.2 Nutrition Knowledge

There have been a number of studies conducted using Nutrition Knowledge Questionnaires. It is one of the most popular tools to measure the nutrition knowledge of athletes (Devlin & Belski, 2015; Torres et al., 2012; Manore et al., 2017; De Souza Silveira et al., 2016.; Alaunyte, Perry & Aubrey, 2015; Spendlove et al., 2012). Nutrition knowledge questionnaires are useful ways to compare athletes' knowledge of expert recommendations (Trakman et al., 2017). The measurement of an athlete's nutritional knowledge is an important consideration for practitioners working in the applied field (Trakman et al., 2017). However, measuring an individual's nutrition knowledge is considered difficult to conduct. For athletes, desire to increase lean mass and reduce fat mass or find and adapt fuels for training or competition are reported to be essential (Spronk et al.,2015). It is helpful in sport related research, because nutrition plays a key role in most sports. With regards to adolescent soccer players, there is very little research on their nutrition knowledge. It is known that adolescents do not adequately meet nutrition recommendations generally (Haw, 2014). The validated General Nutrition Knowledge Questionnaire (GNKQ) has been used within general and athletic populations in UK, USA, and Australia to provide a measure of general nutrition knowledge.

Forty-six elite male Australian Football players (23.5 ± 2.8 years) answered 123 questions concerning five distinct areas of nutrition knowledge: dietary recommendations, sources of nutrients, choosing everyday foods, alcohol and sports nutrition (Devlin & Belski, 2015). These questions were from a combination of the GNKQ and an adapted sports nutrition questionnaire (Shifflett et al., 2002). A mean score of 74.4 ± 10.9 (60.5%) was identified. A similar study was conducted in Iran by Arazi & Hosseini (2012), although participants were collegiate and non-collegiate athletes. The authors identified that the correct response rate for the sport nutrition and general nutrition questions in male collegiate athletes was 57.15% and 58.14% ± 54.85% for female athletes. However, both non-collegiate female and male athletes scored significantly lower on the questionnaire compared to their collegiate counterparts (41.55; 39.86% and 42.11; 40.66%, respectively). This suggests that level of education may impact the nutrition knowledge of participants.

Torres et al., (2012) investigated the sports nutrition knowledge of collegiate athletes, coaches, athletic trainers, and strength and conditioning specialists. The average score for all participants was 68.5 ± 16.1% of correct items. The highest mean score was by strength and conditioning specialists (81.6 ± 10.3%). The second highest scorers were athletic trainers (77.8 ± 10.3%), followed by coaches (65.9 ± 14.3%), and finally, athletes (54.9 ± 13.5%). This study draws attention to an important facet of nutrition knowledge; the knowledge of the support staff and coaches is important for athlete education. Nonetheless, the score for athletes was considerably lower than support staff in this study, suggesting that the transfer of knowledge may need to improve.

Manore et al., (2017) investigated sport nutrition knowledge, behaviours and beliefs of high school soccer players. Participants were adolescent athletes (age: 14-18 years; *n* = 535; 55% female; 51% male). The mean score was only 45.6%, while only 6% of participants obtained a score of 75% or greater when asked about sport nutrition. The authors identified females and Latinos as groups that particularly required nutrition education. In a similar study, Patton-Lopez et al., (2018) investigated sport nutrition knowledge, attitude and behaviours among high school soccer players. The 217 participants for this study were mostly female (64.0%). Almost half of participants were of Latino origin (47.5%) and White (44.2%) andthey had been playing soccer for an average of 6.9 years. The study had an educational intervention in which participants took part in physical activity, sport nutrition, and family consumer science life-skills schooling.Data collection was completed at three sperate time points and it was observed that the intervention significantly improved total sport nutrition knowledge scores. The improvement was especially noticeable amongst the female athlete participants. The intervention also increased the athlete's awareness of their nutritional needs and knowledge about the link between nutrition and performance. In general, about 92% of the participants agreed with the statement that 'diet is important for performance'.

De Souza Silveira et al., (2016) modified and validated the GNKQ for use among German adolescent athletes. Participants were 75 adolescent athletes, 14 ± 1 years old. All of them were attending 'Elite Schools of Sports'. Average nutrition knowledge score was 48 ± 21%. Male respondents score (50 ± 11%) was slightly better than females (45 ± 9%). Correct responses ranged from 39 ± 14% to 52 ± 29% dependent on the specific section. The highest scores participants got was in the Dietary Recommendations section followed by Sources of Nutrients. Alaunyte, Perry & Aubrey (2015) investigated the nutritional knowledge and eating habits of professional rugby players from the English Super League (n = 21, age= 25 ± 5 years). Average score was 52.43 ± 4.40, giving a percentage score of 72.8 ± 6.1%. The dietary recommendations section had the best mean score (86% accurate answers). Other sections fared a bit worse, such as food groups (71%) or food choice (70%). Further analysis suggested that the participant knowledge could have been improved by identifying the current recommendations of increasing the intake of CHO rich foods for improving performance.

1.3 Measurement of dietary intake

There are have been a number of studies using food diaries conducted in the last two decades. Dietary records or food diaries are one of the most popular measures of dietary assessment in research and in practice (Burke, 2015). They are a prospective, open-ended assessment of collecting data about consumed foods and drinks across a set time frame. Food diaries can be useful in estimating current dietary habits of individuals and groups. Key considerations for the use of this method include the duration of the assessment period (i.e. number of days assessed), participation motivation to complete the record/diary accurately, information provided to the participant prior to data collection, record/diary format, and the ability of the researcher/practitioner to interpret the input (Burke, 2015). Other important factors include memory, type and amount (over or underestimation), missing information in the food diaries when collected, and mistakes in tabulation (Ortega et al., 2015).

Investigating the nutritional habits of athletes is a key duty for sports nutritionists and dieticians. However, conducting dietary assessments can be extremely challenging in sport nutrition (Burke et al., 2015; Naughton et al., 2015). Dietary assessments methods can be divided into retrospective (what participant ate in the past) and prospective (what happens in the period of time in the future). Retrospective dietary tracking methods include: dietary history - a guide interview which describe habitual intake, known as typical day; 24-hour recall- investigates intake in a specific day, in sport nutrition it can be training day, match/performance day etc.; and Food Frequency Questionnaire (FFQ)- an assessment of typical dietary intake.

Diet history is a method of assessing general nutrition habits and allows the practitioner to have a more individualised approach, whilst accounting for day-to-day variability (Burke, 2015). Generally, this is conducted as an open-ended interview face-to-face, on the phone, or via other communication technologies (i.e. Zoom meetings). Diet history is an open-ended method that can be used to describe usual nutrition intake during a relatively long period – even to up to one year (Castell et al., 2015). Dietary history concerns food use, food preparation, food like/dislike, portion size (quantity) or typical brand of food used.

The 24-hr recall focuses on the participants intake over the previous 24 hours of a 'usual day' (Burke et al., 2015). This method is advantageous to the participant and researcher/practitioner alike as it is fairly quick method (trained practitioner or researcher would take ~10-15 minutes) to implement, it has a low burden for the subject, and importantly it can be arranged around the participants schedule – which is particularly of use when working with athletes whose schedule can change day to day (Burke et al., 2015). However, due to its retrospective nature it is dependent on the participants memory and honesty. Furthermore, it only provides a snapshot of eating habits and is therefore not indicative of typical habits (Burke et al., 2015). Within soccer settings the 24-hr recall has been used in combination with food diaries to complement the information provided (Briggs et al., 2015; Anderson et al., 2018).

When looking at prospective measurements of dietary intake, the most common method used is the food diary and it has been used in previous studies analysing adolescent soccer player dietary intake (Russell and Pennock, 2011; Briggs et al., 2015; Naughton et al., 2017). Food diaries monitor intake over a specific period, with most studies in the area of soccer nutrition analysing 4-7 days (Magkos and Yannakoulia, 2003). Within a food diary, the participant is required to provide information on the time of food consumption, the type and brand of food, the quantity, and the cooking method (Naughton et al., 2016). There are two variations of the food diary; weighed and household measure. The weighed food diary requires the participant the weigh out each component of their food intake using calibrated weighing scales (typically provided by the researcher/practitioner). This method is generally considered the gold standard and is popular in research as it provides accurate data (Burke, 2015). However, it places a considerable burden on participants. The household measure food diary places a significantly lower burden on the participant as the can describe the portion quantity using actual quantity amounts (i.e., 1 large chicken breast) or using individual-determined household measurements (i.e., a cup of oats). It also has improved compliance with participants when compared with weighted record and is less likely to result in participants altering their intake for the purposes of recording accurate data, which is a risk when using the weighed food diary (Burke, 2015). However, this method requires checking by the trained person and also needs standardised set of household measurements.

Prospective methods, like food diaries, have several limitations. Firstly, the data is collected over several days (typically 4-7) and requires a significant amount of detail placing a large burden on the participant (Magkos and Yannakoulia, 2003). Participants may modify their eating patterns and food choices, which can be different than their usual intake. Additionally, athletes may record their intake inaccurately or/and make errors of description and quantification to appear more favourably to the investigator (Burke, 2015). Previous studies within the general population have found that about 30% of the sample under-report their true food consumption, and across studies energy intake was under-reported by about 15% (Burke, 2015). Some types or foods/meals are more likely to be misreported for example snacks, and food and drinks consumed during exercise (Burke, 2015).

Bonicci et al., (2018) examined dietary habits in an under 21 international male soccer team. Twenty-two male players who competed in the Malta BOV Premier League (n =22; age: 27.1 ± 4.2 years) took part in the study. Mean calorie intake was 2164 ± 498 kcal/day^{-1}. Average CHO intake among the examined group was 3.7 ±1.0 g//kg^{-1} body mass (BM) per day. Mean protein intake was 1.5 ± 0.5 g/kg^{-1} BM per day and mean fat intake during the study was 30 ±

5 % of total daily energy intake. The results of this study reported that the habitual daily energy intake and CHO intake in semi-elite soccer players are significantly lower than the recommended levels. However, one of the reasons the authors reported this is due to a common theme in food diary research: underreporting of food intake.

Naughton et al., (2016) reported total daily macronutrient intake along with their daily distribution in elite English youth soccer academy players across a range of squads; U13/14, U15/16, and U18. Total energy among the squads was 43.1 ± 10.3 in the U18s, 32.6 ± 7.9 in the U15/16s and 28.1 ± 6.8 kcal/kg^{-1} BM a day in U13/14. Carbohydrate intake was 6 ± 1.2 in the U18s, 4.7 ± 1.4 in the U15/16s and 3.2 ± 1.3 g/kg^{-1} BM a day in the U13/14s. Fat intake was 1.3 ± 0.5 in the U18s, 0.9 ± 0.3 in the U15/16s, 0.9 ± 0.3 g/kg^{-1} BM a day in the U13/14s. They observed differences in macronutrient intake and distribution between squads. They reported that the U18s were full-time academy athletes and typically consumed breakfast and lunch at the academy training facility each training/match day attend (5/6 days a week). This potentially means that the club has a larger influence over the food and beverages the U18s can choose from, and subsequently the overall daily intake of the athlete (Naughton et al., 2016).

Bettonviel et al., (2016) examined 15 male players from the Dutch Premier League (n = 15; age = 17.3 ± 1.1 years). Mean calorie intake was 2938 ± 465 kcal/day^{-1}. Average CHO intake among the examined group was 6.0 ± 1.5 g/kg^{-1} BM per day. Mean protein intake was 1.7 ± 0.4 g/kg^{-1} BM and mean fat intake was 26 ± 3 % of total energy intake. Recall days consisted of a match, post-match, rest, and training day. They found that the daily distribution of protein intake for youth players and senior players met the guidelines of an even intake across meals.

Briggs et al., (2015) examined ten male players (15.4 ± 0.3 years) who played for a Premier League soccer academy. Mean energy intake among participants was 2244 ± 321 kcal/day^{-1}. The mean daily CHO intake finding was 5.6 ± 0.4 g/kg^{-1} BM per day. Average daily protein intake was of 1.5 ± 0.2 g/kg^{-1} BM. Mean daily fat intake in this study was 29% ± 2% of whole daily calories intake. They found that the mean daily energy intake of British adolescent academy soccer players did not match the estimated daily expenditure within a competitive week.

Murphy et al., (2006) examined twenty-two male players from the English Premier League (n = 22; age = 16-19 years). Mean energy intake was 2452 ± 430 kcal/day^{-1}. Average CHO intake among the examined group was 4.3 ± 0.3 g/kg^{-1} BM per day. Mean protein intake was 1.3 ± 0.2 g/kg^{-1} BM and mean fat intake was 32 ± 3% of total energy intake. They reported nutritional knowledge had little impact on dietary intake among participants. Also, players who lived within the club's own hostels had significantly greater energy intakes, predominantly through higher CHO consumption, and ate less fat ($p < 0.05$) in comparison to home-based players which is worrying considering parents/guardians lack of nutritional knowledge.

Ruiz et al., (2005) conducted research on twenty adolescent soccer players from the Spanish Tercera Division (n = 20; age = 14.9 ± 0.5 years). They reported a daily energy intake of 3418 ± 182 kcal/day^{-1}. Mean protein intake was 2.1 ± 0.1 g/kg^{-1} BM a day. Mean CHO intake among participants was 5.9 ± 0.4 g/kg^{-1} BM. Average fat intake was 38 ± 2 % of total daily energy intake. They reported relative energy intake when comparing youngest to oldest players when normalising for body mass (kcal/kg^{-1} BM). Also, they suggested that the higher energy intake and more evenly distributed macronutrient intake which was associated with the youngest teams is related to physiological growth adaptations and/or that age group eat more meals at school or at home. In this setting the players diet is heavily influenced by their parents/guardians, whereas older players may have more autonomy over their diet leading to a limited intake of different foods for varying reasons (e.g. poor cooking skills). However, as stated earlier; this may not always be the case if parent/guardian nutrition knowledge is poor.

Iglesias-Gutierrez et al., (2002) examined food habits and nutritional status of thirty-three high level adolescent soccer players from the Spanish First Division (n = 33; age: 14–16 years). They reported an average daily energy intake of 3003 kcal. Mean CHO intake was 45% of energy intake, protein 1.9 g/kg BM, providing 16% of energy intake and fats provided 38% of total energy intake. Results reported that the nutrition habits of Spanish academy-level adolescent soccer players with their families do not follow the nutritional recommendations for age and the amount of physical activity they participate in.

LeBlanc et al., (2002) conducted research on young French athletes (n = 180; age: 13-16 years). For three years, in the nine studied groups, the energy intake ranged from 2352 to 3395 kcal/day^{-1}. Protein intake in groups was between 1.3 and 2.3 g/kg^{-1} BM. The nine groups studied had a CHO intake ranging from 294 ± 55 g/day to 395 ± 61 g/kg^{-1} BM. The fat intake in the nine groups studied ranged from 86 to 131 g/day^{-1}. They reported that the diet of the junior soccer players considered in this study was inadequate for athletes. One of the major reported problems was that the fat consumption was too high and the CHO intake too low among participants.

1.4 Carbohydrates

There is a substantial amount of research regarding carbohydrates (CHO) intake and its influence on performance. A common characteristic of match-play in team sports, such as soccer, is the prevalence of intermittent activity, in which players repeat high-intensity exercises alternately with lower-intensity exercises. Sprints are usually 2-4 s long and regeneration between sprints varies in length. Energy during short sprints comes from the anaerobic metabolic breakdown of intramuscular phosphocreatine and glycogen. Repeated bouts of multiple sprints can deplete muscle glycogen stores, which leads to a lower power output and a reduction in overall work capacity during training and competition (Williams and Rollo, 2015).

The International Olympic Committee (2012) suggest 3-5 g/kg^{-1} BM per day of CHO for athletes training at low intensity. For athletes on a moderate exercise training schedule (1 hr/day^{-1}) the recommend intake is 5-7 g/kg^{-1} BM per day. For those on high volume endurance programmes (1-3 hrs/day of moderate to high intensity activity) it is recommended to consume 6-10 g/kg^{-1}

BM per day. Athletes who train at very high intensities, with high volumes (more than 4-5 hrs/day^{-1} of moderate to high intensity exercise) should consume 8-12 g/kg^{-1} BM of CHO per day. For adolescents in the general population the carbohydrate intake recommendation is given in terms of percentage of overall intake, and set at 50% (SACN, 2015). It is likely that due to high training demands youth soccer players would meet or be excess of this value to support their energy needs (IOC, 2018).

According to Rollo (2014), the correlation between glycogen and soccer performance has resulted in the “pre-match meal” strategy. This strategy is based on the ingestion of an easy digestible and carbohydrate-rich meal before performance. These types of meals eaten before exercise or performance enhance the amount of muscle and liver glycogen. Although, on match day the comparative profits in endogenous glycogen stores achieved through CHO loading depends on initial concentrations. Glycogen concentration level also depends of muscle training condition. It is reported that after fasting through the night, ingesting a meal which contains 2.5 g/kg^{-1} BM of CHO can increase muscle glycogen stores by 11-15% and liver glycogen by 33%, 3 h following ingestion (Taylor et al., 1996; Wu & Williams, 2006).

According to Burke, van Loon and Hawley (2017) dietary CHO intake is considered the main factor for muscle and liver glycogen resynthesis. All the factors of CHO intake such as the quantity, type and timing significantly affect the rate of the resynthesis of muscle and liver glycogen. Special attention has been given to the early phase of recovery due to the increased muscle glycogen resynthesis rates seen during this time (0–4 h). It is recommended for athletes to consume ~1 g/kg^{-1} BM of CHO every hour for the first 4 h period of recovery.

Harper et al., (2017), reported the influence of a 12% CHO-electrolyte beverage on soccer-specific exercise performance. This study recruited 15 amateur soccer players who took part in a 90-minute soccer-specific protocol. During performance (at the end of the warm-up and half-time) participants consumed a CHO-electrolyte solution, placebo-electrolyte solution or water before commencing the protocol and at half time. When compared to placebo, CHO raised blood glucose at pre-exercise and half-time. The authors also reported that CHO intake improved dribbling speed from 60-min compared to water and placebo.

According to a review by Hills and Russell (2017), at least 75% of available papers displayed that intake of 6–8% solutions of glucose, sucrose or maltodextrin can improve at least one aspect of skilled performance within a soccer specific task (i.e. dribbling). It is well established that the brain is one of the few human organs which is fed almost exclusively by blood glucose in normal conditions (i.e. regular feeding). Cognitive function is crucial for skilled actions, adhering to tactics and match strategy which can subsequently aid performance. There is also an evidence in non-exercise studies reporting that brain glucose uptake begins to go down when blood glucose concentrations are < 3.6 mmol/l.

Bandelow et al., (2010), observed faster visual discrimination, fine motor and psycho-motor speed among participants with higher circulating blood glucose concentrations following soccer match-play in hot conditions. Cognitive processes are vital to the performance of skilled actions which are characteristic of team sports such as soccer. It has been proved that supplementing exogenous CHO influences blood glucose concentrations. Also, the role of blood glucose in the maintenance of brain function can be a benefit to soccer skills performed in the last phase of a match.

In soccer, the two halves of the match are separated by a scheduled 15 min pause in competition. Players return to the changing room for a 15-minute break after the first half, discuss tactics, engage with medical and/or nutritional practices - which include the consumption of CHO–electrolyte drinks and snacks (Hills and Russell; 2017). According to Rollo et al. (2015), optimal recovery strategies from training and matches are crucial to support a player's overall ability to repeatedly perform. The advice in these situations should be player specific, with the overall physiological load of the player considered (i.e. numbers of matches). As soccer can often have periods of fixture congestion (i.e. 3 games in 7 days), nutritional recovery strategies play a vital role in helping the players prepare to repeatedly perform (Rollo et al., 2015).

The adoption of nutritional strategies to ensure that muscle glycogen stores are optimised in preparation for training and match play is crucial to help delay fatigue and maximise performance. It is recommended that on the day of training or a match that pre-exercise meals should contain high-glycemic CHO foods opposed to low-glycemic CHO foods because they are easily digested and absorbed, and 'top-up' muscle and liver glycogen stores rapidly. Within a soccer specific activity (training and/or matches) athletes complete multiple high intensity movements, the ingestion of exogenous carbohydrates improves endurance capacity and may prevent a significant decrease in sprint speeds. According to Williams and Rollo (2015), consuming high-glycemic CHO immediately after exercise accelerates the rate of glycogen re-synthesis, which is essential for players training or competing on subsequent days.

1.5 Protein

The intake of dietary protein for youth athletes is key for the development and regeneration of lean tissue (Phillips and van Loon, 2011). Athletes have higher protein requirements in comparison to the general population to help support the remodelling of lean tissue which becomes accelerated during physical activity (Phillips and van Loon, 2011).

Within the general population the recommended protein intakes is 0.8 g/ kg^{-1} BM which is considered as adequate to meet dietary needs. Within adult athletes the recommended intake is significantly higher, with 1.3 – 1.8 g/ kg^{-1} BM recommended (Phillips and van Loon, 2011). The British Nutrition Foundation recommended a protein intake of 1.2-2 g/kg^{-1} BM for strength and endurance athletes (British Nutrition Foundation, 2020). Specifically, work from Boisseau et al., (2002; 2007) has demonstrated that the general population RDA for protein is not suitable for youth soccer players, and a higher protein intake is required similar to that which is recommended in adult athletes. The most recent American College of Sports Medicine position stand on dietary practices for athletes recommends a protein intake of 1.2–1.7 g kg day for both endurance- and resistance-trained athletes. That recommendation is based on data from studies which have assessed nitrogen balance within athlete specific populations (Gerovasili et al., 2009). Previous research within soccer has reported that players across a range of academy age ranges meet the current dietary recommendations for protein (Briggs et al., 2016; Naughton et al., 2016; Russell and Pennock, 2011). Though where there may be room for improvement is in the distribution of protein intake, which school age players having a skewed distribution across main meals (Naughton et al., 2016). Research from Mamerow et al., (2015) has demonstrated that even when protein intake is matched, a skewed distribution of intake will request in reduced muscle protein synthesis rates in comparison to an even distribution across meals.

It has been reported in a number of recent studies about protein intake and performance that players should consume 20–40 g or 0.31 g/kg^{-1} BM of high-quality protein as soon as possible after a match (MacNaughton et al., 2016; Moore, 2019). Research conducted on ten male soccer players (19 ± 1 years) from an elite English academy reported that an intake of 40 g of casein protein taken before sleep helps to improve muscle recovery in the 36-h following a night match (Abbott et al., 2019).

The first aim of this research was to assess the nutrition knowledge of youth soccer players from an English Championship Academy. The second aim was to assess their energy, macronutrient and micronutrient intake, and assess differences in energy and macronutrient intakes on match, training, and rest days. Moreover, another aim was to assess if there is a correlation between nutritional knowledge and nutritional intake in this group of players.

CHAPTER 2

Nutritional Knowledge of Academy Soccer Players

2.1 Introduction

Soccer is currently the world's most popular sport, and according to the 2006 Big Count FIFA survey, is played by over 265 million people worldwide (García-Rovés et al., 2014). Over the last 20 years, the amount of research establishing the physiological demands of sporting performance has increased, allowing for the development of nutrition guidelines for exercise of different duration and intensity. This has permitted not only general guidelines for macro and micronutrient intake, but also to some extent, individualised recommendations. Nonetheless, there remains a need for further research in the area of sport and exercise nutrition.

Adequate nutrition and healthy nutritional patterns are essential in any adolescent's life, especially for those involved in sports. Both of them are among factors that impact sporting performance (Croll et al., 2006). It is crucial that adolescent athletes understand and address their energy intake needs, which will depend on the sport(s) they compete in, as well as other factors such as sex, age and body composition. Therefore, it is essential that athletes are educated on their energy requirements, in order to avoid deficiencies and improve health and performance (Purcell et al., 2013). Nutritional guidelines are designed to improve athletes' performance and training, but also for optimal recovery and to reduce the risk of illness and injury (Devlin, 2016).

General low energy intake and/or inadequate CHO or fat intake may be the result of a number of factors, one of which being poor nutritional knowledge among adolescent athletes. Inadequate nutritional habits may be the result of the athlete's own knowledge, as well as potential misunderstanding/misguidance from coaches, parents or peers (De Souza Silveira et al., 2015). Youth athletes have access to large amounts of nutritional information on the internet; however, a lot of this information may be misinformed and unreliable.

The use of questionnaires to assess nutritional knowledge is a popular method in nutrition-specific research. In a previous study by Iglesias-Gutiérrez et al., (2005) the food habits and nutritional status of elite youth soccer players were explored. Results showed that mean cholesterol, fat, and protein intakes were above the recommendations for most participants, but CHO intake was too low. This may be due to inadequate nutrition knowledge of the participants (Iglesias-Gutiérrez et al., (2005)).

In study conducted on Collegiate Athletes, Coaches, Athletic Trainers, and Strength and Conditioning Specialists, Torres-McGehee et al, (2012) reported that only 9% of athletes have adequate nutrition knowledge. In a study on British collegiate American football athletes, the nutritionally uneducated group had an average score of 25 ± 14%. The average score for the nutritionally educated group had a 76% ± 19% correct response rate (Clemo, 2014). It demonstrated that nutritional education among youth athletes has the potential to greatly improve knowledge. Indeed, previous studies have shown that nutrition education is needed to expand sports nutrition knowledge among adolescent athletes (Thomas et al. 2012, Cupisti et al., 2002, Iglesias-Gutiérrez et al. 2012).

The aim of the work reported in this chapter was to assess the nutritional knowledge of youth soccer players from an English Championship Academy.

2.2 Methods

2.2.1 Participants

Thirty-nine male soccer players (age 17.5 ± 0.7 years; height 1.82 ± 0.06 m; body mass 74.14 ± 9.67 kg) from an English Championship Academy participated in the study after receiving verbal and written information. Participants were recruited through the existing research collaboration between the School of Human and Health Sciences and the academy using a convenience sampling method. The anthropometric characteristics of the participants, including body fat percentage, were measured by an ISAK qualified performance coach from the academy. Informed consent was obtained from the players and from parents/guardians if they were under the age of 18. The study was approved by the University of Huddersfield Research Ethics and Integrity Committee (SREP/2019/007).

2.2.2 Study Design

Nutrition knowledge was measured on one occasion using a combination of previously validated tools: The General Nutrition Knowledge Questionnaire and Sports-Specific Nutrition Knowledge Questionnaire (Trakman et al., 2017), which have both been shown to have excellent test-retest reliability (Trakman et al., 2018). The questionnaires were combined and then shortened and adapted to better suit the age and education status of the participants. The adapted questionnaire was assessed for face validity by two independent nutritionists/dietitians working with elite team sport athletes. Participants completed the questionnaire under supervision of the lead researcher at the University of Huddersfield. Completion time of the questionnaire was approximately 10 minutes.

The final questionnaire comprised 24 items pertaining to four areas: General Nutrition, Sport Nutrition, Protein, and Supplementation. The General Nutrition section contained seven questions. One asked participants to state whether they thought experts recommended consuming more, less, or the same amount of specific foods. They also had a ‘not sure’ option. Three questions required the participants to state whether specific foods were high or low in fat, CHOs and protein, with a ‘not sure’ option also provided. The other five questions in this section were multiple choice questions with a single correct answer and were related to fruit and vegetables, vitamins and minerals, types of fat, dietary fibre, and the calorie content of macronutrients.

In the Sport Nutrition section participants were required to answer eight single answer multiple-choice questions that were related to: hydration, training adaptations, dietary intake around training (pre and post) and the role of fat during exercise. The Protein section contained three single answer multiple choice questions related to amount and timing of protein intake. The Supplementation section also contained three multiple choice questions related to the purity and safety of supplements, labelling, and protein supplements. For the questionnaire as a whole, each correct answer was worth one point, creating a theoretical maximum score of 53.

As the data is of a descriptive nature, only percentages, means and standard deviations are presented. Mean and average results were counted in a Microsoft Excel spreadsheet.

2.3 Results

2.3.1 General Nutrition

The overall mean nutrition knowledge score was 28 ± 5 (out of 53; 53%). For the question concerning experts' recommendation about eating more, less or the same amount of specific foods, the average score was 5 ± 1 (out of 10; 53%). Sixty-seven percent of players knew that experts recommend eating less saturated fat. Asked about what foods are considered to be high or low in fat, the average score was 4 ± 1 (out of 9; 46%). For foods that are either high or low in CHOs, the average score was 5 ± 1 (out of 6; 82%).

Notably, only 3% of players knew they should be consuming more dairy products – this links into the protein section below. Only 11% knew the recommendations regarding CHO rich foods (e.g., eating less); however, as soccer players this is less important and they should be encouraged to eat CHO, particularly around intense training sessions and the day before matches. Only 36% of players knew how many servings of vegetables and fruit they should consume. One third of players knew which nutrient contains the most calories, given the choice between CHO, protein and fat. Players were not good at identifying fat content of foods (in particular nuts, ham and avocado). In the question about CHO, they did much better. Cheese and butter were picked as low in CHO by 85% and 87% of players, respectively. Ninety-five percent of players selected rice as high in CHO and 100% picked plain pasta as high in CHO. Porridge was chosen as a high in CHO by 72% of players. However, just over half of players (54%) classified nuts as a source of CHO.

Only 33% of the players knew of the benefits of dietary fibre. Furthermore, only 51% of the players were able to identify a high fibre meal (which is also low in fat). Only 56% of the players questioned knew that following a *balanced and varied diet and using supplements only when prescribed* is recommended to meet their needs for vitamins and minerals.

2.3.2 Sport Nutrition

Only 38% of questioned players knew all of the negative effects of dehydration. In question about colour of dehydrated person urine, the average score was 1 ± 0.4 out of a possible 2 points. Only 41% knew how to modify their diet when an increase in muscle mass is desired (e.g., increased overall calorie intake, not just protein). Thirty-six percent of players knew that the ideal training (60 minutes pre) snack for a resistance training session should be high in CHO and high in protein. In the question about fats, only 21% knew that they are the main source of energy during low intensity (endurance) exercise. Seventy-seven percent of participants were aware of the recommendation for soccer players about the consumption of CHO around training and matches. Moreover, only 59% of players knew the suggested time-frame for consuming a CHO-based recovery snack. However, 67% of participants knew what the recommended post-exercise recovery snack/meal for athletes is (a combination of proteins & CHO).

2.3.3 Protein

In the question about protein content, in particular products, the average score was 5 ± 1 (out of 7; 69%)**.** Only 13% of players picked cheese as being high in protein. Furthermore, only 51% classified natural yoghurt as a high protein food. Ninety-five percent of players knew chicken is a high protein food, and 85% chose cream as a low protein product. Only 64% of players knew that fruits are low in protein. Baked beans were chosen as a high protein food by 86% of players. Only 38% of players knew the recommendation for the amount of protein that should be consumed in each serving (20-30 grams per serving). For the question regarding how regularly experts recommend soccer players should consume a serving of protein throughout the day (every 3-4 hours) only 23% knew the correct answer. Furthermore, when asked about daily protein recommendation for soccer players only 10% knew the correct answer (1.2-2.0 grams per kg of body mass per day).

2.3.4 Supplementation

In the question asking if protein supplements are essential for muscular growth, only 23% thought they were not. Also, only 26% of questioned players knew that not all supplements are tested before sale. Sixty-four percent of participants agreed that supplement labels may contain false or misleading information.

The summary of scores for each section of the Nutrition Knowledge Questionnaire is provided in Table 1.

Table 1 *Scores of each section of the Academy Nutrition Knowledge Questionnaire*

Section	Min	Max	Average score	SD	% Items Correct
General Nutrition (35)	13	27	19	3	55
Sport Nutrition (7)	0	7	3	2	48
Protein (10)	0	9	5	2	55
ALL (53)	**17**	**39**	**28.15**	**4.54**	**53.1**

SD = standard deviation

2.4 Discussion

The aim of this study was to investigate the nutritional knowledge among youth academy soccer players. Limitations of this research include the age of the participants and also the small number (39). In all Nutritional knowledge questionnaire sections average scores were not much more than 50% of items correct (General Nutrition = 55%, Sport Nutrition = 48%, Protein = 55%; ALL = 53.1%). This demonstrates that there is a lack of nutritional knowledge, and further education is required. Nutrition knowledge has a big influence on an athlete's food choices, which may have a notable impact on their sporting performance and recovery. This is arguably even more important for adolescent athletes, as nutrition plays a large role in their natural development (Croll et al., 2006). With regards to adolescent soccer players, there is very little research on their nutrition knowledge. It is known that adolescents do not adequately meet nutrition recommendations generally (Haw, 2014). In this research the overall mean nutrition knowledge score was 53%. Compared to research on Elite Male Australian Athletes (Devlin & Belski, 2015), mean score for was 60.5%. It gives an almost 7% difference, but the difference in age (23.5 ± 2.8 years) and number of questions (123) should be stressed.

In the question concerning experts' recommendation about eating more, less, or the same amount of specific foods, 53% of the players knew the correct answer. This is concerning, as this may influence their dietary choices. Almost 67% knew that experts recommend eating less saturated fat. This is positive, as saturated fats may increase low-density lipoprotein (LDL) cholesterol which is linked to cardiovascular disease. When asked about what foods are considered to be high or low in saturated fat, 45.5% answered correctly which sends us back to the previous question. It can also have a bad influence on players health. However, due to the high physical activity levels of academy soccer players, any negative impact of consuming large quantities of saturated fat may be mitigated by regular exercise training (Ortega et al., 2013).

Players were better at identifying foods considered to be high or low in CHO, with an average score of 82%. This is crucial, as CHO has a vital role in both performance and recovery. Carbohydrate intake is crucial, because of the role as a main substrate in muscle glycogen synthesis. Aspects such as the quantity, timing, and type of CHO intake have significant influence on the speed of muscle glycogen storage (Burke et al., 2016). Through a proper CHO intake, it is possible to achieve a maximal post-exercise storage rate. It is reported that intakes of 7-10 grams of CHO per kg/body mass is optimal for a maximal glycogen resynthesis speed. (Fairchild et al, 2002). Mostly in the 0-4 hours after exercise ($1 g/kg^{-1}$ BM/h^{-1}) – this phase of recovery because of the likely higher muscle glycogen synthesis rates during this time and also multi-session and multi-day exercise programs taken by athletes. When the players were asked when it is highly recommended to consume a CHO based recovery snack following training (0-1 hrs post training), 59% of respondents knew the right answer.

A high CHO diet can increase performance. It has been shown that a high CHO diet can extend muscle glycogen concentration and in effect, extend covered distance (Saltin, 1973). It is recommended to consume 140-330g 3-5 hours pre-exercise to improve performance (Hargreaves et al., 2004). It can also increase muscle glycogen (Coyle et al., 1985). On the other hand, it is important to distinguish CHO with low and high glycaemic index, with high glycaemic index foods providing faster glycogen resynthesis rates (Burke, Collier & Hargreaves, 1993). Nicholas et al., (1995) observed that taking CHO before and during performance extends time to fatigue.

In team sports, as soccer is, extended periods of multiple sprints lead to draining muscle glycogen stores, which can cause a decrease in power output and a reduction in general work rate during match and training (Hills & Russell, 2017). It was noted that blood glucose concentrations will go down during prolonged match time. If blood glucose will not be replenished, it can even result in hypoglycaemia.(Harper et al., 2015). CHO consumption during a day should depend on energy expenditure caused by training session or performance. On match days the intake of 2.5 g of CHO/kg BM , 3 h before match or exercise will complement glycogen reserves in liver and muscle. Intake of 60 g of CHO per hour, pre and during (and in half-time) match have impact on sprints and other soccer specific skills.(Rollo, 2014).

Latest sport nutrition guidelines show that manipulation of glycogen availability can be crucial for causing greater training adaptation and to optimise performance. The body’s reserves of CHO are smaller than lipids or proteins stores. It is important to achieve optimal intake for an athlete and ensure their bodies the substrates necessary to cover the training sessions. All of these factors should provide optimal adaptation and recovery (Burke et al., 2017).

Just over a third (36%) of players knew how many servings of vegetables and fruit they should consume. This is concerning, as fruit and vegetables are one of the main sources of vitamins coming from food. Less than 10% of most Western populations consume adequate levels of whole fruits and dietary fibre - about half of the recommended levels (Dreher, 2018). A well-balanced diet can cover the need for vitamins, thanks to which supplementation is not necessary. Lower systolic blood pressure levels are reported in adolescents who consumed fruits, vegetables and fruit juices at least twice a day (Collese et al, 2017). Whole fruit can provide a major source of fermentable fibre to support colon prebiotic activity (Dreher, 2018). Fruits and vegetables are important sources of bioactive phytochemicals which have antioxidative influence: phenolic acids, flavonoids, carotenoids, minerals, and vitamins (especially vitamin C) (Liu, 2013). These compounds may be beneficial in recovery from exercise, which is crucial for soccer players undertaking strenuous training and match-play programmes (Bowtell & Kelly, 2019). Instead of recommending supplementation in young athletes, it is worth paying attention to the appropriate supply of fruits and vegetables. Just over a half (56%) of participants knew that balanced and varied diet and using supplements only when prescribed is recommended to meet their needs for vitamins and minerals.

Only a third of players knew of the benefits of dietary fibre so more education is required on what it is and what quantities they should consume. Fibre has a positive effect on intestinal peristalsis. Soluble fibres make a sticky layer in the small intestine. The layer increases stickiness, which reduces the reabsorption of bile acids. After, synthesis of bile acids from cholesterol increases and in consequence, whole circulating blood cholesterol decreases (Othman et al,2011). Eating fibre-rich foods also reduces incidence of coronary heart disease, stroke, type 2 diabetes and colorectal cancer by 16-24% (Reynolds et al, January 2019). Changing adolescents' habits and raising awareness of adequate dietary fibre intake benefits can let them avoid illness in future life.

Recommendation for daily fibre intake is 25 grams per day for children (up to 16 years old) and about 30 grams per day for adults (above 16 years old). A study conducted on British adolescent soccer players reported an intake of 16 grams per day in an U18s team (Russell & Pennock, 2011). In another study also done on British adolescent players (Naughton et al, 2017) fibre intake in an U18s team was 17.1 ± 4.2 grams. In both studies fibre intake values were significantly lower than dietary reference value (Russell & Pennock, 2011; Naughton et al, 2017).

In the questions in the Sport Nutrition section only 38% of questioned players knew the negative effect of dehydration. It is reported that athletes must be fully hydrated before training or competition due to the negative impacts of dehydration. The water in the body is responsible for thermoregulation. In effect, dehydration can lead to hyperthermia and increase time to fatigue. Also, dehydration can cause increased rate of muscle glycogen use and decreased skin blood flow (Jeukendrup & Gleeson, 2010). When players were asked about the colour of urine if dehydrated, the average score was 1.15 out of 2 points. It is one of the simplest ways to detect symptoms of dehydration, so players exposed to a high intensity training and higher loss of water should be made aware of it. Mild dehydration will decrease exercise capacity and so players will be unable to perform optimally. An adequate fluid intake before, during and after exercise can help to avoid the negative effects of dehydration (Shirreffs et al, 2005). It is reported that:"exercise performance is impaired when an individual is dehydrated by as little as 2% of body weight, and that losses in excess of 5% of body weight can decrease the capacity for work by about 30%" (Laitano et al., 2014). In addition, dehydration greater than a 2% body mass deficit has been shown to have a negative impact on soccer-specific performance such as dribbling and high-intensity sprinting. If dehydration occurs after a match (more than 5% of body mass) or rapid rehydration is required (24 h before next match or training) players are recommended to drink about 1.5 litres of fluid for each 1 kg of body mass deficit (Laitano et al, 2014). For example, if a player with 74 kg body mass (which was the average BM among participants) lose 5% of their BM (about 3.7 kg) it is recommended to drink 7.5 litres 24 h before performance. To avoid dehydration, players should be aware of importance of drinking fluids during training and matches. They should also monitor changes in body mass during training/match-play and also pay attention and monitor urine colour (Laitano et al, 2014). There is little recent information about the thermoregulatory impact on soccer players during competitive performance (Edwards et al., 2007).

Less than a half of participants (41%) knew how to modify their diet when an increase in muscle mass is desired. Previous research has shown that a key goal for youth soccer players is to build muscle mass and strength to help them make the physical transition to professional soccer (Milsom et al., 2015). One worrying aspect about the results observed is that players have a lack knowledge about supplementation. Only 23% of respondents thought protein supplements are not essential for muscular growth. Also, only 26% of questioned players knew that not all supplements are tested before sale. Sixty-four percent of participants knew that supplement labels may contain false or misleading information. The power of food needs to be put across to the players. **T**his is worrying, as this may lead to inadvertent doping. Since the 1970's, FIFA's anti-doping strategy has taken care of education and prevention. A worldwide network guarantees doping control procedures. FIFA admits their responsibility to protect players from harmful causes of doping and secure equal chances for all competitors (Dvorak et al, 2006). It is clear that players require thorough education around the issues regarding doping and supplementation.

A study conducted on adolescent tennis players (age 13.8 ± 2.5; n = 25) reported that they rate their dietary quality as excellent/good (Argôlo et al, 2018). The authors also reported inadequacy in fruit and vegetable intake and intake of carbohydrates was higher than recommended. Claimed intake of vitamins was highly inadequate in this group of athletes. Overall, this research observed a low level on nutritional knowledge among adolescent athletes, as observed in the present investigation.

In conclusion, the nutrition knowledge score of the players from this English Championship academy was 53%, like previous studies assessing the nutritional knowledge of adolescent athletes. Whilst their knowledge of CHO feeding was good, issues remain regarding protein intake, supplements/doping, fibre, fruit and vegetables, and fat intake. Whilst these results may only reflect the academy players involved, nutrition education programmes for academy soccer players is vital; this should increase knowledge and ensure players are able to perform at their best, whilst also reducing the risk of injury and illness, and potentially increasing their chances of moving into adult professional soccer.

CHAPTER 3

Dietary Intake of Academy Soccer Players

3.1 Introduction

Soccer is classified as a high-intensity, intermittent team sport consisting of two 45-minutes halves which are parted by a 15-minute interval (Reilly, 1994). The game is characterised by phases of low to moderate activity (i.e., walking, slow jogging) with repeated phases of intense explosive actions (i.e., sprinting, kicking). In the UK, the majority of professional clubs have youth academies, which typically span from <11 to <18 years old. The focus of these academies is to develop players to play for the first team, and/or to sell these players for financial gain (Milsom et al., 2015). Within soccer academies youth players go through a key transition when moving from part-time schoolboys (≤U16s) to fulltime athletes (>U18s) which results in increased training loads (Wrigley et al., 2012).

Whilst the development of soccer-skill specific skills (i.e., technical ability, tactical awareness) is a main focus of the training schedule for full-time academy players (Wrigley et al., 2012; Brownlee et al., 2018), it is also a key phase for physical development (Milsom et al., 2015). It has previously been reported that fulltime youth players (U18s and U21s) have significantly less lean mass than their senior first team counterparts, and as such a vital aim for youth players is to increase muscle mass as opposed to focusing on losing fat mass (Milsom et al., 2015). In order to support the high training loads (Wrigley et al., 2012) and physical developmental targets (Milsom et al., 2015) it is vitally important to optimise the nutritional practises of the players.

Presently, there is limited data on the nutritional intake of elite British fulltime youth soccer players. The current literature in this area generally suggests that youth players are not meeting energy requirements (albeit from estimated values), which generally appears to be a result of inadequate CHO intake (Russell and Pennock, 2011; Briggs et al., 2015; Naughton et al., 2016). This concerning trend has also been reported in academy players from outside the UK (Boisseau et al., 2002; LeBlanc et al., 2002; Ruiz et al., 2005; Bonnicci et al, 2018) and is a cause for worry in practitioners. Balancing energy intake with energy expenditure is crucial to prevent an energy deficit or excess, with the former linked to multiple negative consequences (Loucks, Kiens, and Wright, 2011). Within sport there is a growing area of interest in this area and is commonly referred to as Relative Energy Deficiency in Sport (RED-S). Sustained periods of energy deficiency and/or low energy availability within youth athletes can have lasting consequences such as compromised bone mineral density (Ihle and Loucks, 2004) and growth (Misra, 2008). Furthermore, RED-S can potentially have a negative impact on performance, with issues such as: depression, irritability, decreased concentration, decreased coordination, decreased glycogen stores and muscle strength, impaired judgement, increased injury risk, and decreased aerobic performance (Mountjoy et al., 2018). The basis of the RED-S concept is based around energy availability. Loucks, Kiens and Wright (2011) define energy availability in athletes as dietary intake excluding the energy used during exercise. So, in effect, what energy is available once the exercise energy cost is accounted for, this 'left over' energy is required for normal physiological processes (Loucks, Kiens, and Wright, 2011).

In adolescent athletes, appropriate energy availability is seen as 45 kcal·kg Fat Free Mass (FFM)·day^{-1} (Loucks, Kiens, and Wright, 2011). When athletes fall below this set value we commonly see some of the symptoms of RED-S, particularly when the intake falls to <30 kcal·kg FFM·day^{-1} which is defined as Low Energy Availability (LEA) (Loucks, 2004). LEA is defined as mismatch between athletes' energy intake and energy expenditure, caused by an inadequate energy intake to support optimal body functioning and performance. Energy Availability is defined by the following equation from Mountjoy et al. (2018):

Energy Availability (EA)= Energy Intake (IE) [kcal] – Energy Exercise Expenditure (EEE) [kcal]/ fat-free mass [kg]

As previously mentioned, there are many health disorders linked with LEA in athletes. Of particular concern within adolescent athletes is the risk of low bone mineral density and, in females, disruption to the menstrual cycle (Loucks, Kiens, and Wright, 2011). Within elite professional adult soccer players, CHO periodisation (and consequently energy periodisation as a result) has been reported between match days and training days during a single week in a competitive soccer season; (Anderson et al., 2017). The researchers reported that there was significant difference for energy and CHO intake between days, with higher intakes for both on match day in comparison to a training day. The increase in energy intake was due to the increased CHO intake on match day (6.4 ± 2.2 g/kg^{-1} BM) compared with the training day (4.2 ± 1.4 g/kg^{-1} BM). This finding is unsurprising considering the emphasis placed on the recommended CHO intake pre, during and following competition (Burke, Loucks and Broad, 2006). Within youth soccer, Briggs et al. (2015) reported no difference in energy and CHO intake across different types of days (match and training days), but they only assessed a single U16 youth soccer team. Currently, there has been no research which has aimed to assess this in fulltime British youth soccer players.

Nutritional recommendations for adolescent athletes are typically forwarded from adult guidelines, which are generally derived from studies using adult male participants (Desbrow et al., 2014). Due to ethical reasons and access to elite youth athletes, there is a lack of research assessing the nutritional intake of this population. A recent review from Desbrow and colleagues (2014) recommended that future study of adolescent athletes should focus on energy, macronutrient and micronutrient intakes, with specific consideration given to iron and calcium. Only two studies have assessed the micronutrient intake of elite British youth soccer players, with both reporting that players generally meet the UK RNI targets (Russell and Pennock, 2011; Naughton et al., 2017). However, large individual variability has been reported within this population (Naughton et al., 2017). Anaemia caused by iron deficiency is the most common deficiency in nutrition. Among athletes, iron deficiency anaemia affect about 3 % and it is comparable to the general population (Desbrow et al., 2014). Suboptimal iron status can have a negative influence on athletic performance and training adaptation (Desbrow et al., 2014). Currently, the UK recommended iron intake for adolescents is 11.3 mg/day $^{-1}$ (Department of Health, 1991).

During adolescence, the body goes through significant physical change, with skeletal bone growth being one of the key developments. Approximately 90% of peak bone mass will be achieved by the age of 20 (Misra, 2008). To optimise the accrual of bone mass there are several nutritional factors which need to be considered; adequate energy intake (as previously discussed), calcium intake, and vitamin D status (Chan, 1991; Lehtonen-Veromaa et al., 2002; Loucks, Kiens, and Wright, 2011). Exercise loading also has an oestrogenic effect, but it is vitally important that calcium intakes are met to optimise bone mineral density (Desbrow et al., 2014). During adolescence, males are recommended to have a daily intake of 1000 mg/day $^{-1}$ which is higher than adult recommendations (700 mg/day $^{-1}$) to support skeletal development (Department of Health, 1991). Currently, within the literature there has been no study that has investigated the link between UK youth soccer athlete's nutritional knowledge and dietary intake. Whilst previous studies which have reported sub optimal nutritional habits (Russell and Pennock, 2011, and Naughton et al., 2016) have gone on to suggested that nutritional knowledge may help to correct this, no research has assessed this. By assessing if there is a link between nutritional knowledge and intake, practitioners can develop more targeted approaches and pre-empt potential issues before they occur.

Therefore, the aims of this Chapter are three-fold; 1) To assess the energy, macronutrient and micronutrient intake of fulltime British soccer players; 2) to assess if there are differences in energy and macronutrient intakes on match, training, and rest days; and 3) to investigate if there is a correlation between nutritional knowledge and nutritional intake.

3.2 Methods

3.2.1 Participants

Nineteen male academy level soccer players from an English Championship Club were originally recruited to participate in the study after receiving verbal and written information. On the return of the food diaries only eight were suitable for analysis. All the participants took part in the previous chapter.

Table 2. *Participant Characteristics*

	AVERAGE	SD
Body mass (kg)	74.14	9.67
Body fat (%)	7.54	1.02
Lean body mass (kg)	68.83	8.78
Estimated BMR (kcal)	1856.8	189.8

SD = standard deviation

3.3 Study design

Participants were requested to record everything they consumed (food and drink) in a pen and paper food diary on three separate occasions; a training day, a rest day, and a match day. Participants were requested to provide as detailed information as possible, which included the following;

- Type of day (Training / Rest / Match)
- Time of consumption
- Food/drink type, and if possible the commercial brand
- Cooking method (boiled, grilled, fried etc.)
- Portion size using standardised household measures, or if possible the weight/volume as provided on the food/drink packaging

Within the food diaries there were examples included of standardised portions, with their measures given in standardised household measures and in grams to help the players more accurately report the portion size. If participants did not complete any of the requested days (match day, recovery day and training day) their data was excluded from analysis (n=11). The results of eight completed food diaries in combination with previous study which was academy nutrition knowledge questionnaire gave us the opportunity to investigate correlation between player's nutrition knowledge and how this translates into their daily intake.

In the week before data collection took place the research team presented a PowerPoint presentation to all participants who were taking part in the study which explained in detail how to complete the food diaries. Participants had an opportunity to clarify any questions they had at this point and could contact the research team afterwards if they wished to ask any further questions.

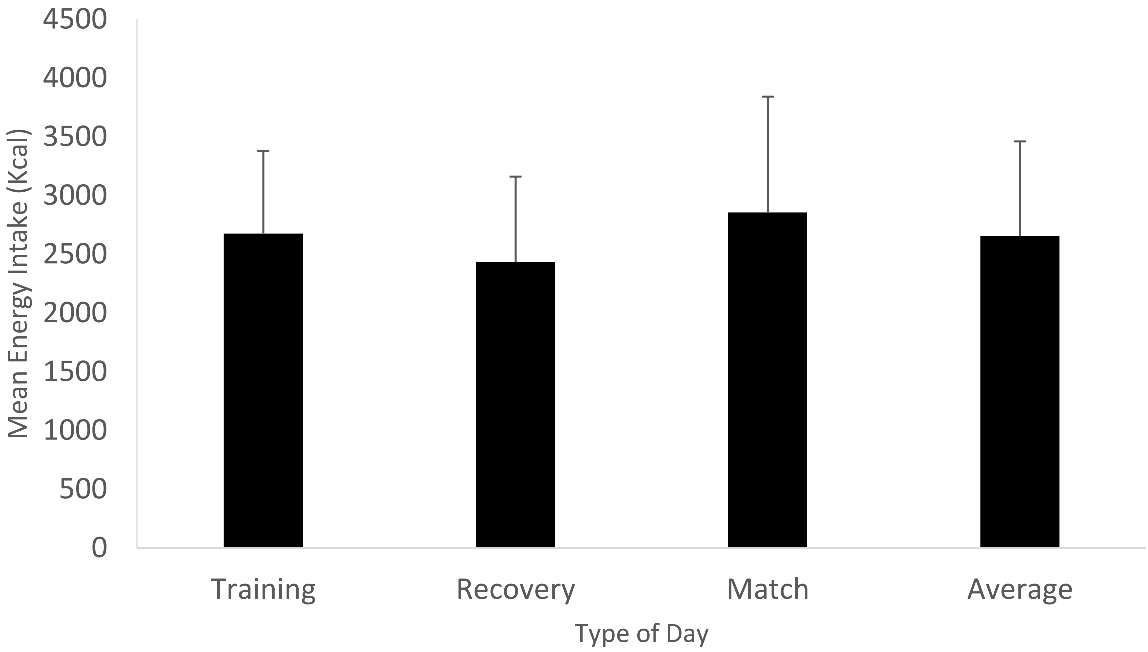
3.4 Data analysis

All of food diaries were analysed through Nutrimen – a web based professional dietary analysis (Dark Green Media Limited, 2016). Total absolute, and relative to BM, intakes of energy (measured in kcals), CHO, protein and fats were calculated. For micronutrients, the intakes of calcium and iron were analysed as these micronutrients have been previously highlighted as key nutrients for adolescent athletes (Desbrow et al., 2014). Statistical differences and correlations were examined through SPSS for Windows (version 26.0.) using one-way ANOVA and Pearson Product-Moment Correlation. All values are presented as mean (±SD) unless stated otherwise.

3.5 Results

3.5.1 Energy Intake

The overall mean energy intake resulting from the food diaries analysis was 2655.7 ± 804.4 kcal/day^{-1}. Whilst there was no significant difference between the types of day (*P* = 0.594), a hierarchical order of match day > training day > rest day was observed. Furthermore, no statistically significant correlation between energy intake and Nutritional Knowledge Questionnaire was found (r = -0.468, *P* = 0.243).



Type of Day

Figure 1 *Energy intake across the different days. Values are mean ± standard deviation*

3.5.2 Carbohydrates

For total absolute CHO intake there was no significant difference reported between days (*P* = 0.416). Daily mean absolute CHO consumption was 316.1 ± 97.3 g, which in relative value was 4.2 g/kg^{-1} BM. The highest intake of CHO was reported on the match day 353.9 ± 110.0

g (relative = 4.8 g/kg^{-1} BM), followed by the training day value of 301.8 ± 91.6 g (relative 4.1 g/kg^{-1} BM), and the rest day reporting the lowest intake with 292.6 ± 90.2 g (relative 3.9 g/kg^{-1} BM). In terms of percentage of total energy intake, CHO made up 49.6% on match day, 48% on a rest day, and only 30% on a training day. There was no statistically significant correlation between the Nutritional Knowledge Questionnaire score and CHO intake (r = -0.300, *P* = 0.470).

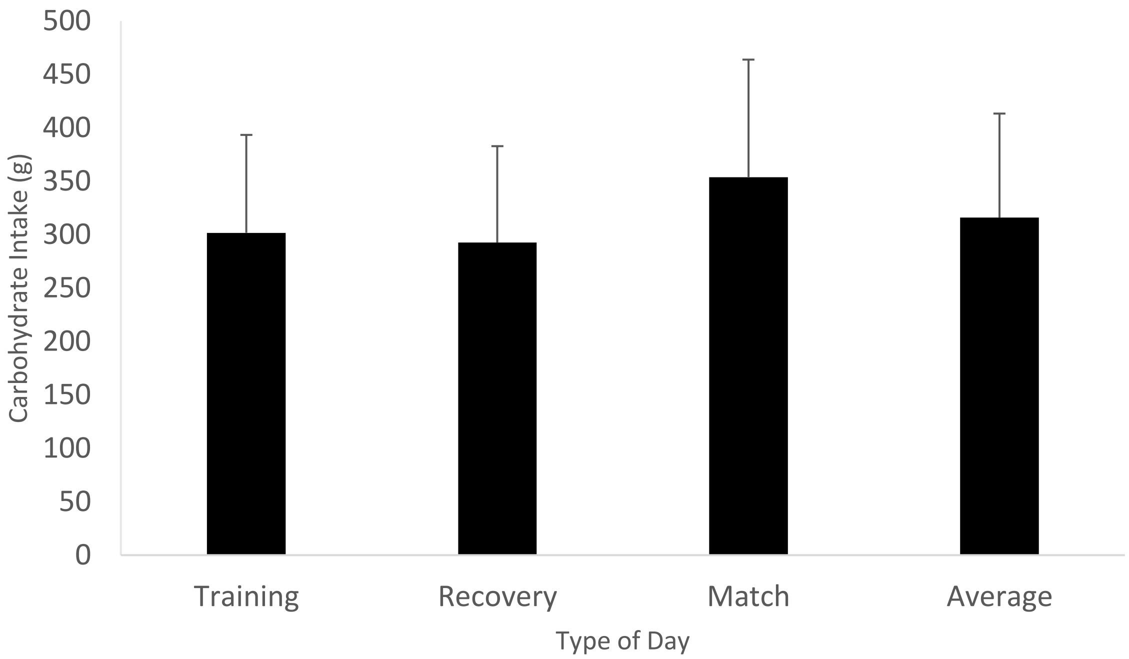


Figure 2 *Carbohydrate intake across the different days. Values are mean ± standard deviation*

3.5.3 Protein

There was no statistically significant difference in protein intake between the different days (*P* = 0.201). The mean protein intake was 151.1 ± 44.4 g, which equated to a relative intake of 2.0 g/kg^{-1} BM. The highest protein intake was on reported on the training day with 173.5 ± 24.0 g (relative = 2.3 g/kg^{-1} BM), followed by the match day with 147.3 ± 43.9 g (relative = 2.0 g/kg^{-1} BM), and the lowest on the rest day with 132.6 ± 47.5 g (relative = 1.8 g/kg^{-1} BM). In terms of percentage of total energy intake, protein made up 24% on a training day, 22% on a match day and recovery day. There was no statistically significant correlation between Nutritional Knowledge Questionnaire score and protein intake (*r* = -0.381, *P* = 0.352).

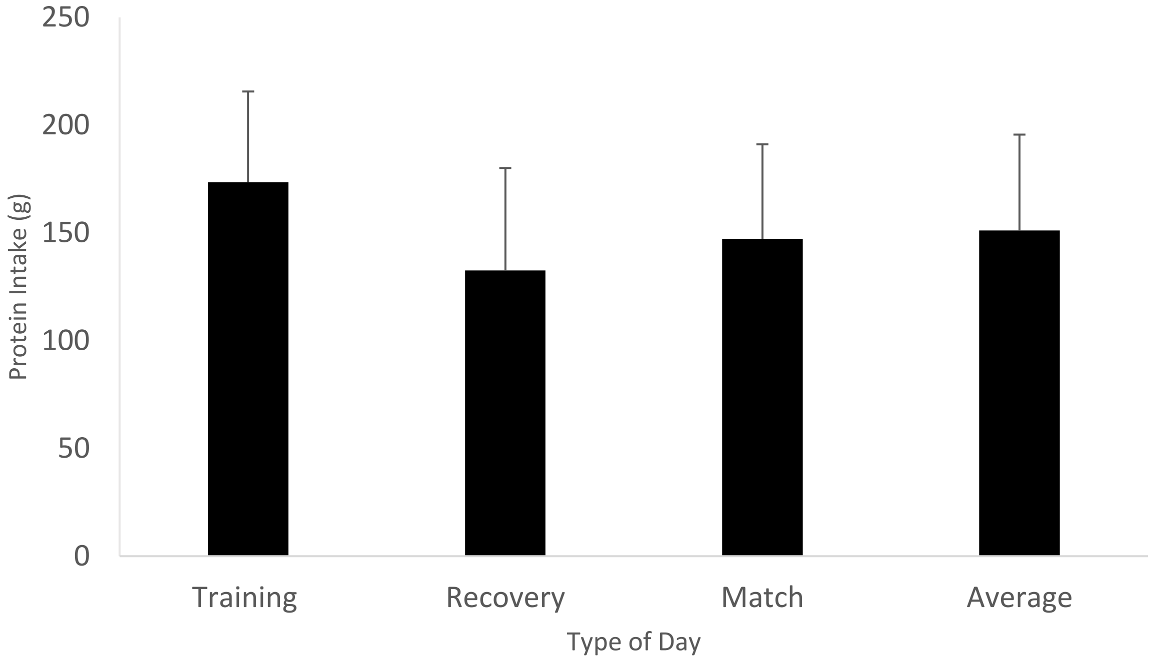


Figure 3 *Protein intake across the different days. Values are mean ± SD*

3.5.4 Fats

There was no significant difference for fat intake across the different days (P = 0.712). The average intake of fat was 94.4 ± 39.7g, which equated to a relative intake of 1.3 g/kg^{-1} BM and 33% of total daily energy intake. The highest intake of fat was reported on match day, 103.5 ± 48.9 g (relative = 1.4g/kg^{-1} BM), followed by training day, 92.8 ± 33.4 g (relative 1.3 g/kg^{-1} BM). The lowest fat intake was reported on the rest day, 87 ± 36.8 g (relative 1.2 g/kg^{-1} BM). There was no statistically significant correlation between Nutritional Knowledge Questionnaire and fat intake (*r* = -0.529, *P* = 0.122).

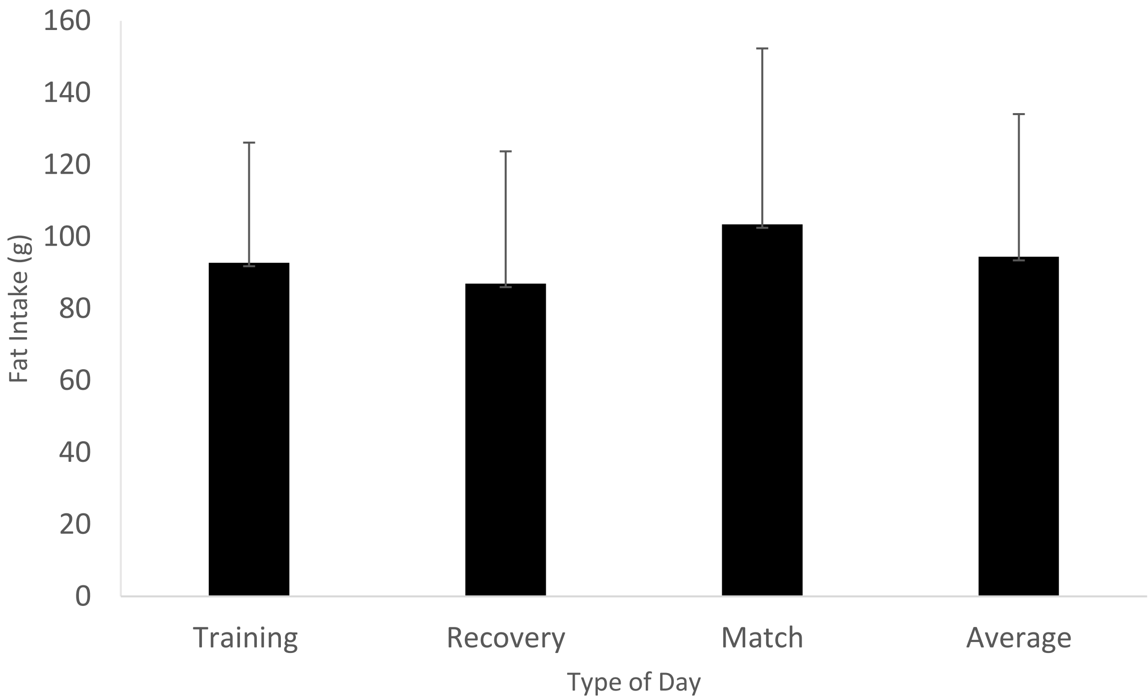


Figure 4 Fat intake across the different days. Values are mean ± SD.

Table 3 Summary of percentage distribution of macronutrient intake during match day, training day and recovery day

	Carbohydrate (%)	Protein (%)	Fat (%)
Match day	49.6	24.3	32.6
Training day	30	22	32
Recovery day	48	21.7	31.2

3.5.5 Micronutrients

Results for micronutrient intake are displayed in Table 4.

Table 4 Combined average intake of calcium and iron for all three types of day (recovery, training and match). Values are mean ± SD (n=8).

	Average intake	RNI
Calcium (mg)	1015.7 ± 494.4	1000
Iron (mg)	14±4	11.3

3.6 *Discussion*

The aims of this Chapter were three-fold; 1) to assess the energy, macronutrient and micronutrient intake of fulltime British soccer players; 2) to assess if there are differences in energy and macronutrient intakes on match, training, and rest days; and 3) to investigate if there is a correlation between nutritional knowledge and nutritional intake. The results shown that the nutritional practices of the sampled group of fulltime British youth soccer players were inadequate to optimise performance throughout training and match play.

Within the present study a mean energy intake of 2655.7 ± 804.4 kcal was reported and perhaps surprisingly no difference between match, training, and rest days were reported. The mean energy intake is higher than that reported by Briggs et al. (2015) and Naughton et al. (2016), but slightly lower than that of Russell and Pennock (2011). Whilst the present study was unable to assess energy expenditure, previous research has estimated that expenditure is approximately 3500 kcal/day^{-1} within a U18s fulltime British soccer team cohort (Russell and Pennock, 2011). This would suggest that the participants in the current study are in a significant energy deficiency (~900 kcal), which supports previous findings in this cohort (Boisseau et al., 2002; LeBlanc et al., 2002; Ruiz et al., 2005; Russell and Pennock, 2011; Briggs et al., 2015; Bonnicci et al, 2018). This could lead to negative health issues (such as increased risk of injury, compromised growth) as well as decreased physical performance (such as early onset of fatigue) (Ackerman et al., 2020). The data from the current study and others would suggest practitioners should initially prioritise ensuring their players are consuming adequate energy.

This low energy intake appears to predominantly be through an inadequate CHO intake, with a reported mean intake of 4.2 g/kg^{-1} BM. CHO recommendations for training and match days 6-10 g/kg^{-1} BM (Burke, Loucks and Broad, 2006), within the current study match (4.8 g/kg^{-1} BM) and training day (4.1 g/kg^{-1} BM) fell well below this target. In comparison to studies in similar cohorts, Naughton et al. (2016) reported even lower values (3.2 g/kg^{-1} BM) than those presented here, although that study did not include a match day which may have skewed the results to a lower value. However, Russell and Pennock (2011) reported a higher CHO intake of 5.9 g/kg^{-1} BM, and within an U16 schoolboy cohort Briggs et al. reported similar 5.6 g/kg^{-1} BM. From the data available it seems that overall British youth soccer players under consume CHOs, though the reason for this is not clear. The consumption of CHO are key to performance within high intensity exercise such as soccer and general guidelines promote a diet that is high in CHO to support training and match demands (Burke, Loucks and Broad, 2006). The data reports not only an under consumption of CHOs, but within that the is a range of values from 3 – 6 g/kg^{-1} BM, which may be a result of the individual nutritional strategies promoted at the clubs investigated.

The finding that the highest CHO consumption was on a match day suggests the participants within the current study have some understanding of the importance of CHO around match-play. The food diaries shown that there was an increase of CHO consumption in and around the match (pre-match, during, and after) in the form of isotonic CHO drinks and sugary sweets. Whereas during training, only the consumption of water was consumed. This finding is similar to that which has been reported in elite adult players (Anderson et al., 2017). That said, there was no significant correlation between players Nutritional Knowledge Questionnaire score and their CHO intake ($r = -0.300$, $P = 0.470$). Taken together, this data suggests British youth soccer players may need further education in regards the importance of adequate CHO intake, and the role that plays in overall energy intake.

Average protein intake over the 3-days was 2.0 g/kg^{-1} BM, which is at the upper end of the recommended intake for athletes (1.2-2.0 g/kg^{-1} BM) (Thomas, Erdman and Burke, 2016). This finding is similar to that previously reported in similar populations within the UK (Russell and Pennock, 2011; Briggs et al., 2015; Naughton et al., 2016) and Europe (Iglesias et al., 2005; Caccialanza et al, 2007; Bettonviel et al. 2016). It appears that youth soccer players easily meet protein intake guidelines, and this will help to support the physical training goals that are a key target for this population such as muscle hypertrophy (Milsom et al., 2015). Similar to CHO recommendations, protein recommendations are based on adult studies, though there is some support for them from adolescent based studies. Research from Boisseau and colleagues (2002) investigated the protein requirements of adolescent male soccer players. In their study, they reported that youth soccer players require a minimal protein intake of 1.6 g/kg^{-1} BM to achieve a positive nutrition balance by recording the participants habitual protein intake and measuring their nitrogen balance through urinary analysis (Boisseau et al., 2002). A follow up to this study in 2007, where set protein intakes were prescribed (1.0, 1.2 and 1.4 g/kg^{-1} BM) the authors reported that an intake of 1.4 g/kg^{-1} BM equated to a nitrogen balance (Boisseau et al., 2002). However, the participations within those studies were recreational soccer players, not affiliated to a club and likely had lower training loads. Further research is required to assess if the values reported in this study and others is appropriate for fulltime youth soccer players.

Fat intake among the study group was 94.4 ± 39.7g grams, which contributed 33% to total energy intake. Unlike CHO and protein, there is no current set g/kg^{-1} BM recommendation for dietary fat intake. Current guidelines suggest an intake range of 20-35% of daily total energy intake (Rodriguez, Di Marco and Langley,2009) for which the data from this study falls comfortably in, however as previously mentioned for the other macronutrients this recommendation is for adult atheltes. This finding is similar to that of previous reported (Russell and Pennock, 2011; Briggs, Cockburn, et al., 2015; Bettonviel et al., 2016; Naughton et al., 2016). Previous research has shown that youth athletes use a higher percentage of fat as a fuel sources during high intensity in comparison to adults, as their glycolytic energy pathway is not fully developed (Armstrong, Barker and McManus, 2015). This, along with the repeatedly reported evidence of youth soccer players being in an energy deficiency may be reason for players to be encouraged to consume dietary sources of fat. Gram for gram, fat is the most energy dense of the macronutrients (~9 $kcal/g^{-1}$) and may be a feasible way to quickly increase energy consumption, whilst also providing a fuel source. That said, players would need to be educated on the sources of dietary fat which would be suitable and provide the body with other useful nutrients, such as full fat milk, oily fish, and eggs.

For micronutrients, mean intake calcium and iron met current UK guidelines. However, it is important to note that there was a large individual variability for micronutrient intake, and whilst the overall means may meet the RNI , there were some individuals who did not. Within this context it is important that practitioners look at individual player values and do not just concentrate on team means. The reported micronutrient intakes here are similar to those previously reported in the only other two studies which have investigated this area (Russell and Pennock, 2011; Naughton et al., 2017). This is perhaps in part due to the high protein intakes that have been reported within this study and similar populations. Phillips et al. (2015) suggests that consuming high-quality sources of protein (such fish, poultry, beef) can help consumers meet the RNIs for calcium and iron. For example, milk and beef are commonly recommended sources of protein, whilst they provide multiple essential amino acids they also excellent sources of calcium and iron respectively.

This study has several limitations that should be addressed. Firstly, the method of collecting the dietary information was pen and paper food diaries, which is one of most popular methods for collecting dietary intake data (Burke, 2015) and has been used in similar previous research Russell and Pennock, 2011; Briggs, Naughton et al., 2016, 2017). However, there is a risk of underreporting estimated at 20% of intake (Burke and Deakin, 2010), which may have had a significant effect on the findings reported in the present study. Furthermore, there are other disadvantages with using food diaries such as being dependent on the participants memory, food knowledge and honesty. Food diaries place a large burden on the participant, and within this study >50% of the recruited participants were removed from the analysis due to the inadequate completion of the food diary. Future research in the area should potentially look to employ more user friendly and valid methods, such as the 'snap-n-send' method which has been validated within youth rugby league cohorts (Costello et al., 2017). Additionally, this study only looked at three individual days (match, training, rest days), to increase the validity of the data more each individual day should be assessed on numerous occasions.

To more accurately assess the extent of energy deficiency the energy expenditure of the participants would have been investigated for the different days. Within the field this is extremely difficult to do, and can be exceptionally costly, such as using the gold standard method of doubly labelled water. Unfortunately, the club involved in the present study could not provide the training and match data for the players involved, which therefore also made it difficult to estimate. With the findings in the present study and others that players appear to be in significant energy deficiencies, future research should look to accurately quantify the energy demands of youth soccer players ideally across a range of ages. Another limitation of the present study is that it only provide descriptive data, and does not assess why the players' nutritional habits were what they were. There is a lack of qualitative research within soccer nutrition, and there is no present literature which has taken this approach to assess the thought process behind certain nutritional practises in youth soccer. The area would greatly benefit from this, and it would help provide a context to the descriptive literature already published.

In conclusion, the data presented in this chapter provides further evidence that youth soccer players appear to be under consuming energy, which is predominantly through lower than recommended CHO intakes (< 6 g/kg^{-1} BM). In agreement we previous research, this study reports that youth soccer players have a high protein intake, meet current dietary fat guidelines and meet micronutrient RNIs. Future research should look to accurately quantify energy expenditure within this population, from which specific dietary guidelines can be formed. Practitioners working in youth soccer should look to ensure their players are consuming enough energy and familiarise themselves with symptoms of RED-S.

4.0 Conclusions

This thesis aimed to assess the nutritional knowledge (Chapter 1) and dietary habits (Chapter 2) of academy soccer players. The overall mean nutrition knowledge score was 53%. Whilst low, this is comparable to previous investigations on both adolescent and adult athletes (Devlin & Belski, 2015). Generally, the players were aware of the importance of CHO-rich foods, and which foods are high in CHO. Nevertheless, the CHO intake of the players on training (4.1 g/kg^{-1} BM), rest (3.9 g/kg^{-1} BM) and match days (4.8 g/kg^{-1} BM) was lower than recommendations (Burke, Loucks and Broad, 2006). Whilst food diaries are typically exposed to underreporting, when taking into account the typical error of food diaries, it still appears that players are likely not consuming sufficient CHO, particularly on a match day.

Knowledge of protein was low, with a lack of awareness of suggested serving sizes, daily distribution, and overall daily recommendations. However, the food diary analysis suggests that the players were consuming sufficient protein to meet their needs (2.0 g/kg^{-1} BM). Notably, players were not knowledgeable when it came to protein supplementation, as well as the testing of supplements for illegal substances. This is worrying, and players should be educated on the importance of a *food first* approach, and the potential dangers of taking supplements that have not been batch tested by companies such as Informed Sport. Nutritionists working within this setting should make this a point of focus for their athletes.

Future research is required on multiple soccer academies to assess if differences exist between players and clubs. Importantly, energy expenditure should be measured in future investigations, to accurately assess if the energy intake of academy soccer players is meeting their needs; this may have important implications for their development and maturation, as well as their soccer-specific performance and health.

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HUDDERSFIELD TOWN ASSOCIATION FOOTBALL CLUB

ACADEMY NUTRITION KNOWLEDGE QUESTIONNAIRE

1) Do you think health experts recommend that people should be eating **more**, the **same** amount, or **less** of the following foods? ***Tick only one box per row.***

	More	Same	Less	Not Sure
Meat				
Fish				
High Fibre Foods				
Sugary Foods				
Vegetables				
Salty Foods				
Carbohydrate Rich Foods				
Dairy Foods				
Fruit				
Takeaway/Fast Foods				

2) It is recommended that for general health people should consume:

- ☐ Two pieces of fruit and vegetables per day
- ☐ Seven pieces of fruit and vegetables per day
- ☐ Two servings of fruit and five servings of vegetables per day
- ☐ Not sure

3) Which type of fats do experts recommend as the most important to limit within our diets?

- ☐ Monounsaturated fat
- ☐ Polyunsaturated fat
- ☐ Saturated fat
- ☐ Not sure

4) Do you think the following foods are considered to be high or low in **fat**?
Tick only one box per row.

	High	Low	Not Sure
Cottage Cheese			
Almonds			
Bread			
Baked Beans			
Margarine (e.g., Flora)			
Sliced (Sandwich) Ham			
Avocado			
Plain Pasta			
Honey			

5) Do you think experts would class the following foods as **carbohydrates**?
Tick only one box per row.

	Yes	No	Not Sure
Cheese			
Rice			
Butter			
Nuts			
Porridge			
Plain Pasta			

6) Do you think the following foods are considered to be high or low in **protein**?
Tick only one box per row.

	High	Low	Not Sure
Natural Yoghurt			
Chicken			
Cream			
Butter			
Fruit			
Baked Beans			
Cheese			

7) If you had 1 gram of each of the nutrients listed below which would contain the most calories (energy)?

- ☐ Carbohydrate
- ☐ Protein
- ☐ Fat
- ☐ All contain the same amount
- ☐ Not sure

8) Fibre is important to a football player's health because…

- ☐ It reduces the risk of intestinal diseases
- ☐ It is filling, but contains no calories
- ☐ It is flavourful and so a good substitute for sugary products
- ☐ It converts fat into muscle
- ☐ Not sure

9) Which of the following is the best choice for a low fat, high fibre meal?

- ☐ One medium grilled Chicken Breast (140g)
- ☐ Cheese (40g) on Wholemeal Toast (Two slices)
- ☐ Beans (half tin) on Wholemeal Toast (Two slices)
- ☐ One personal sized Quiche (200g)

10) Football players are recommended to do which of the following to meet their requirements for vitamins and minerals:

- ☐ Use high strength multi-vitamin and mineral supplements
- ☐ Follow a balanced and varied diet, using supplements only when prescribed
- ☐ Eating plenty of high fibre foods
- ☐ Follow a diet primarily consisting of dairy, vegetables and fruits
- ☐ Not sure

11) For football players, approximately how much protein (grams) is recommended to be consumed in each serving?

- ☐ 5-15 grams
- ☐ 20-30 grams
- ☐ 50-60 grams
- ☐ 80-90 grams
- ☐ Not sure

12) How regularly do experts recommend that football players should consume a serving of protein throughout the day?

- ☐ Once a day
- ☐ Three times a day
- ☐ Every 3-4 hours
- ☐ Every 1 hour
- ☐ Not sure

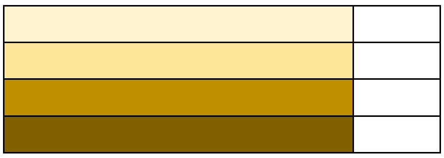
13) It is recommended that football players daily protein should be approximately…

- ☐ 0.8 grams per kg of body mass per day
- ☐ 1.2-2.0 grams per kg of body mass per day
- ☐ 2.1-4.0 grams per kg of body mass per day
- ☐ Over 5.0 grams per kg of body mass per day
- ☐ Not sure

14) Protein supplements are essential for muscular growth.

- ☐ Agree
- ☐ Disagree
- ☐ Not sure

15) Which of the following colours of urine would indicate that the person was dehydrated?
Tick the box next to the colour(s) that apply.



16) When a football player begins to get dehydrated, which of the following may negatively impact on their performance?

- ☐ Unbalanced electrolytes
- ☐ Muscle cramps
- ☐ An elevated core temperature
- ☐ All of the above
- ☐ Not sure

17) When an increase in muscle mass is desired, along with resistance training, football players should…

- ☐ Increase their energy intake from all food groups
- ☐ Increase their protein intake only
- ☐ Increase their carbohydrate intake only
- ☐ Their diet should remain the same
- ☐ Not sure

18) Which of the following statements are recommended for football players use of **carbohydrates** around training/matches?

- ☐ Should be consumed both pre- and post-training/matches
- ☐ Should be consumed both pre- and post-matches, but only post-training
- ☐ Should never be consumed around training, but both pre- and post-matches
- ☐ Not sure

19) The ideal nutritional composition of a pre training (60 minutes pre) snack for a resistance training session would consist of…

- ☐ High carbohydrate, low fibre, low fat
- ☐ High carbohydrate, high protein
- ☐ High protein, low carbohydrate
- ☐ Not sure

20) Football players are highly recommended to consume a carbohydrate based recovery snack following training. What is the suggested time frame?

- ☐ 0-1 hour post-training
- ☐ 1-2 hours post-training
- ☐ > 2 hours post-training
- ☐ With the following meal (meal time)
- ☐ Not sure

21) What is the recommended nutritional composition of an optimal post-exercise recovery snack/meal for athletes?

- ☐ A combination of protein & carbohydrates
- ☐ Protein only
- ☐ Carbohydrates only
- ☐ A combination of fats, carbohydrates and protein
- ☐ Not sure

22) Select the true statement regarding fats.

- ☐ They are the only source of energy during exercise
- ☐ They are the main source of energy during high-intensity (maximal/interval) exercise
- ☐ They are the main source of energy during low intensity (endurance) exercise
- ☐ They provide no energy during exercise
- ☐ Not sure

THANK YOU FOR COMPLETING THE QUESTIONNAIRE

THE TERRIERS

Name

Squad Number

Age

The aim of this booklet is to attain a greater understanding of your INDIVIDUAL NEEDS in order for you to maximize PERFORMANCE, TRAINING ADAPTATIONS & RECOVERY as well as keeping you HEALTHY at all times.

For 3 days, you will need to record EVERYTHING you EAT and DRINK and ALL forms of training undertaken. Examples are provided to show you how to fill in this food diary.

PLEASE REMEMBER TO:

1. EAT NORMALLY AND NOT TO CHANGE YOUR USUAL DIET – YOU WILL GET THE MOST OUT OF THIS IF YOU ARE HONEST!

2. TICK WHETHER IT IS A TRAINING, RECOVERY OR MATCH DAY.

3. BE AS DETAILED AS POSSIBLE – I.E. TRY AND PROVIDE WEIGHTS OF FOODS AND VOLUMES OF FLUIDS CONSUMED (IF NOT APPROPRIATE, DESCRIBE THE AMOUNT ACCORDING TO PLATE, BOWL, PORTION, GLASS AND CUP SIZE ETC). GUIDANCE IS PROVIDED TOWARDS THE END OF THE BOOKLET.

Date: *Monday 3rd April*

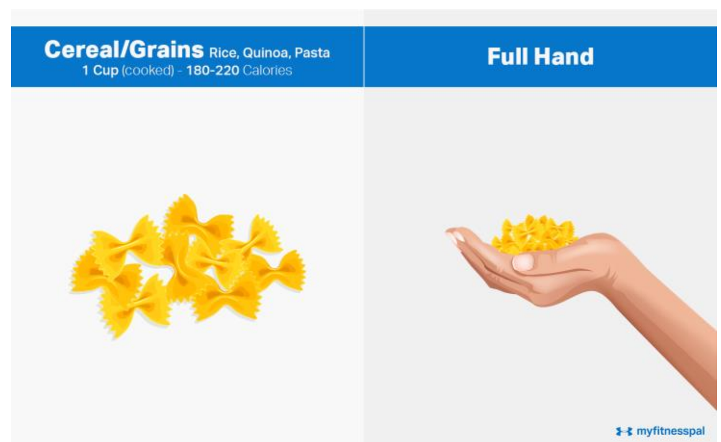
☒ Training Day ☐ Rest & Recovery Day ☐ Match Day (please tick)

TIME	TRAINING ACTIVITY	INTENSITY	DURATION
10:30	Tennis training	High	1 hour
14:15	Weight training	High	45 mins

Example Only

In general, how you were feeling today e.g. tired, energetic, hungry, alert, moody, weak, strong etc.?

Animal Protein	Amount in grams (g)	What does this look like?
Cooked meat (beef/pork/ lamb/mince/chicken/turkey)	60g-90g	A deck of cards
Cooked white fish (cod or plaice) or canned fish	140g	Palm of hand
Cooked oily fish (salmon, mackerel, sardines)	140g	Palm of hand
2 eggs	120g	
Plant Protein	**Amount in grams (g)**	
4 tablespoons of baked beans	150g	
4 tablespoons of beans (kidney beans/butterbeans/ black eyed beans	150g	
4 tablespoons of pulses (lentils/chickpeas)	150g	
4 tablespoons of soya/ tofu, vegetable based meat alternative	100g	
1 tablespoon/handful of nuts or peanut butter	30g	



TIME	FOOD/BRAND	COOKING METHOD (boiled, grilled, fried etc.)	PORTION SIZE (weight, volume or household estimation)
7:30	Wholemeal Bread – Tesco		1 slice
	Flora light		Thin spread
	Cornflakes		Large bowl
	Semi-skimmed milk		250ml
	Apple Juice		1 large glass
10:00	Water		½ large glass
13:00	Chicken Fillet	Grilled	1 medium
	Potatoes	Baked	1 large
	Beans – Heinz		½ can
	Orange Juice		2 small glasses
16:30	CNP protein shake in		2 scoops
	500ml water after weights		

Example Only

What is a portion	Amount in grams (g)
1 apple/pear/orange/banana	80g
A handful (10-12) grapes/ berries	80g
2 plums/apricots/kiwis/ satsumas	80g
1 small handful/ 1 tablespoon of dried fruit (eg. raisins or sultanas)	30g
3 heaped tablespoons of peas/carrots/sweetcorn/mixed vegetables	80g
1/2 pepper/1 medium tomato/ 1 medium parsnip	80g

Type of dairy food	Portion size in grams or millilitres (ml)	What does this look like?
Milk	200ml (1/3 pint)	1 glass
Calcium fortified soya alternatives	200ml (1/3 pint)	1 glass
Yoghurt	125g	1 standard pot/ 3 tbsp
Cheese (hard)	30g	A matchbox size piece

Type of oil/spread	Amount in grams (g)
1 teaspoon of butter or spread	5g
1 teaspoon of oil	3g

Day 1

Date:

☐ Training Day ☐ Rest & Recovery Day ☐ Match Day (please tick)

TIME	TRAINING ACTIVITY	INTENSITY	DURATION

In general, how you were feeling today e.g. tired, energetic, hungry, alert, moody, weak, strong etc.

TIME	FOOD/BRAND	COOKING METHOD (boiled, grilled, fried etc.)	PORTION SIZE (weight, volume or household estimation)

Day 3

Date:

☐ Training Day ☐ Rest & Recovery Day ☐ Match Day (please tick)

TIME	TRAINING ACTIVITY	INTENSITY	DURATION

In general, how you were feeling today e.g. tired, energetic, hungry, alert, moody, weak, strong etc.?

TIME	FOOD/BRAND	COOKING METHOD (boiled, grilled, fried etc.)	PORTION SIZE (weight, volume or household estimation)

Day 2

Date:

☐ Training Day ☐ Rest & Recovery Day ☐ Match Day (please tick)

TIME	TRAINING ACTIVITY	INTENSITY	DURATION

In general, how you were feeling today e.g. tired, energetic, hungry, alert, moody, weak, strong etc.?

TIME	FOOD/BRAND	COOKING METHOD (boiled, grilled, fried etc.)	PORTION SIZE (weight, volume or household estimation)

Participant Information Sheet

You are being invited to take part in a study investigating the nutritional knowledge and dietary intake of academy soccer players. Before you decide whether you want to take part, it is important that you understand why the research is being done and what it will involve. Please take time to read the following information carefully and discuss it with the investigator if you wish. Please do not hesitate to ask if there is anything that is not clear or if you would like more information.

What is the study about?

Despite soccer being a high-profile professional sport, there is a scarceness of research on academy players' nutritional knowledge and dietary intakes. Therefore, data is required to allow for specific recommendations to be made in relation to nutritional requirements during training and competition.

Why I have been approached?

You have been asked to participate because your son/ward is an academy soccer player.

Do they have to take part?

It is your decision whether or not you take part. If you decide to take part, you will be asked to sign a consent form. You will be free to withdraw at any time without giving a reason.

What will they need to do?

If you agree take part in the research you will be asked to complete a questionnaire on your nutritional knowledge and complete a food diary where you will be asked to report everything they eat and drink on three separate days.

Will their identity be disclosed?

All information disclosed from the study will be kept confidential and protected by the use of a pseudonym and storing data in password protected files on a secure computer.

What will happen to the information?

All information collected during this research will be kept secure and any identifying material, such as names will be removed in order to ensure anonymity. It is anticipated that the research may, at some point, be published in a journal or report. However, should this happen, your anonymity will be ensured.

Who can I contact for further information?

If you require any further information about the research, please contact Marcelina Majba on: Marcelina.majba@hud.ac.uk or Dr Liam Harper (Principal Supervisor; L.harper@hud.ac.uk).

Participant Information Sheet for U18's

Your son/ward is being invited to take part in a study investigating the nutritional knowledge and dietary intake of academy soccer players. Before you decide whether they should take part, it is important that you understand why the research is being done and what it will involve. Please take time to read the following information carefully and discuss it with the investigator if you wish. Please do not hesitate to ask if there is anything that is not clear or if you would like more information.

What is the study about?

Despite soccer being a high-profile professional sport, there is a scarceness of research on academy players' nutritional knowledge and dietary intakes. Therefore, data is required to allow for specific recommendations to be made in relation to nutritional requirements during training and competition.

Why I have been approached?

You have been asked to participate because your son/ward is an academy soccer player.

Do they have to take part?

It is your decision whether or not they take part. If you decide they can take part, you (as parent/guardian) will be asked to sign a consent form. They will be free to withdraw at any time without giving a reason.

What will they need to do?

If you agree for your son/ward to take part in the research they will be asked to complete a questionnaire on their nutritional knowledge and complete a food diary where they will be asked to report everything they eat and drink on three separate days.

Will their identity be disclosed?

All information disclosed from the study will be kept confidential and protected by the use of a pseudonym and storing data in password protected files on a secure computer.

What will happen to the information?

All information collected during this research will be kept secure and any identifying material, such as names will be removed in order to ensure anonymity. It is anticipated that the research may, at some point, be published in a journal or report. However, should this happen, your son/ward's anonymity will be ensured.

Who can I contact for further information?

If you require any further information about the research, please contact Marcelina Majba on: Marcelina.majba@hud.ac.uk or Dr Liam Harper (Principal Supervisor; L.harper@hud.ac.uk).

CONSENT FORM

Title of Research Project: Nutritional knowledge and dietary intake of academy soccer players

It is important that you read, understand and sign the consent form. Your contribution to this research is entirely voluntary and you are not obliged in any way to participate, if you require any further details, please contact Marcelina Majba (marcelina.majba@hud.ac.uk) or Dr Liam Harper (L.Harper@hud.ac.uk).

I have been fully informed of the nature and aims of this research as outlined in the participant information sheet.	☐
I consent to taking part in the research project.	☐
I understand that I have the right to withdraw from the research at any time without giving any reason.	☐
I understand that the information collected will be kept in secure conditions for a period of 10 years at the University of Huddersfield.	☐
I understand that no person other than the researcher/s and facilitator/s will have access to the information provided.	☐
I understand that my identity will be protected by the use of pseudonym in the report and that no written information that could lead to my being identified will be included in any report.	☐
I consent for the findings of this study to be published in academic journals or conference proceedings	☐

If you are satisfied that you understand the information and are happy to take part in this project please put a tick in the box aligned to each sentence and print and sign overleaf.

Signature of Participant:	Signature of Researcher:
______________________	______________________
Print: ______________________	Print: ______________________
Date: ______________________	Date: ______________________

(one copy to be retained by Participant / one copy to be retained by Researcher)

CONSENT FORM

Title of Research Project: Nutritional knowledge and dietary intake of academy soccer players

On behalf of your son/ward it is important that you read, understand and sign the consent form prior to partaking in this research. Contribution to this research is entirely voluntary and your son/ward are not obliged in any way to participate. If you require any further details please contact, please contact Marcelina Majba (marcelina.majba@hud.ac.uk) or Dr Liam Harper (L.Harper@hud.ac.uk).

I have been fully informed of the nature and aims of this research as outlined in the participant information sheet.	☐
I consent to my son/ward taking part in the research project.	☐
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I understand that my identity will be protected by the use of pseudonym in the report and that no written information that could lead to my son/ward being identified will be included in any report.	☐
I consent for the findings of this study to be published in academic journals or conference proceedings	☐

If you are satisfied that you understand the information and are happy for your son/ward to take part in this project please put a tick in the box aligned to each sentence and print and sign overleaf.

Signature of Participant: ______________________	Signature of Researcher: ______________________
Print: ______________________	Print: ______________________
Date: ______________________	Date: ______________________

(one copy to be retained by Participant / one copy to be retained by Researcher)