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**‘Fuelling and recovery habits of professional academy
rugby players around a match day’**

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1. This work has not previously been accepted in substance for any degree and is not being concurrently submitted in candidature for any degree.

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The Abstract

Aim

The aim of the study was to assess Welsh professional rugby senior academy players matchday fuelling and recovery practices. As Rugby Union requires a physique that includes an appropriate amount of lean muscle mass, nutritional requirements cannot be ignored by players in order to safely participate in the sport.

Methods

The study used a paper based estimated food diary and nutritional/recovery habits questionnaire over a three-day period that included a matchday. The quantitative data was analysed and run through the software 'IBM SPSS statistics' alongside the qualitative data being assessed through the software 'NVivo'.

Results

The day before the game (Matchday-1) neither backs nor forwards met rugby recommendations for protein (2.0g/kg BW) with intakes averaging 1.85g/kg/BW, or Carbohydrate intakes (4-6g/kg/BW) with intakes averaging 3.6g/kg/BW. Nutritional knowledge and focus for matchday was deemed appropriate with all players understanding the importance of carbohydrate loading, this was shown with pre match CHO intakes averaging 1.1-3g/kg/BW in the hours leading up to kick off. Post-match CHO intakes for the rest of the day ranged from 0.9-2.6g/kg/BW which was deemed inappropriate and insufficient to replenish glycogen stores and maintain future performance standards. Appropriate recovery strategies were implemented by the majority of the participants however some participants opted not to use any recovery strategy post-match.

Conclusion

Several positive nutritional habits were identified in this study, with academy players showing knowledge on appropriate fuelling requirements and recovery practices for high level rugby competition. Despite the positive findings, several suboptimal practices were highlighted, especially around matchday-1 macronutrient and post-match CHO intakes.

Key words: Sports nutrition, academy rugby, matchday fuelling

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List of Abbreviations/phrases

CHO- Carbohydrates

DRV- Dietary reference value

g/kg/BW- grams per kilogram of body weight

M-1- The day before a match (Matchday-1)

M+1- The day after a match (Matchday+1)

MPS- Muscle protein synthesis

P- Participant

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Chapter One - Introduction

1.1 Introduction to sports nutrition

Sports nutrition has become an essential component of athletic preparation and recovery for performance for all levels of sports. Traditionally, athletic success and capability has been linked to technical, physical and psychological traits of individuals, however the influence of optimal diet is now being recognised as an equally important factor in sports performance. Diet relates to an athlete's ability to recover quicker between exercise bouts and their ability to train longer and at higher intensity (Thomas *et al.*, 2016). Research and knowledge into sports nutrition has developed a considerable amount over recent years. Early research focused on meeting individuals' basic needs for nutrition, which included avoiding different nutrient deficiencies. However, research over recent decades has drawn attention to the positive impacts of specific macronutrient intake, hydration strategies and nutrient timings on sports performance (Jeukendrup., 2017). Nutritional interventions have now developed to support sports specific recommendations, rather than focusing on generic dietary guidelines (Close *et al*, 2019). Having a sports specific approach provides athletes with guidelines tailored towards their individual sport backed up by previous research and data, allowing them to be optimally prepared for performance.

Performance during exercise is dependent on many factors. A key factor being the body's ability to produce adenosine triphosphate (ATP), the body's source of immediate energy ATP is a limited supply of energy stored in the body's skeletal muscle, being limited it requires constant replenishment through three different energy systems: oxidative metabolism, anaerobic glycolysis and the phosphagen system (McArdle *et al.*, 2022). The specific contribution of each energy system depends on the exercise intensity and duration. Therefore, sports nutrition focuses on optimal energy availability prior to exercise and adequate nutrient intake following training and competition for efficient recovery.

1.2 Sports specific context- Rugby Union

Rugby union (RU) is a globally played collision sport consisting of high impacts bursts of play played over two forty-minute halves. Its distinctiveness lies in the

physical elements such as tackling, rapid burst of acceleration and deceleration and other unique physical components not seen in any other sport such as scrummaging and lineout mauls. Depending on their physical characteristics and individual ability, players are divided into two playing categories such as forwards and backs. Forwards typically experience a higher amount of collisions, participate in scrums and lineouts which results in increased muscle damage (Posthumus *et al.*, 2021). Back positions generally perform higher running speeds over further distances. Subsequently, players can also be placed in subcategories which include front row forwards or half backs which highlights players individual roles on the pitch (Posthumus *et al.*, 2021). These varied physical demands put stress on the players bodies, highlighting the importance of contributions from both aerobic and anaerobic energy systems.

Given the relentless training and competition schedules in season for rugby players, inadequate nutritional habits can have a negative impact on ability to recover, the amount of fuel a player has for competition and the increased risk of injury and illness (Close *et al.*, 2019). Current research therefore suggests that team sports athletes such as rugby players follow individualised nutrition strategies that focus on adequate carbohydrate intake for sustaining performance levels, appropriate protein intake to help aid recovery in between training loads and competition, and hydration strategies that consider sweat loss to maintain physiological function during performance (Thomas *et al.*, 2016). However, although the evidence is available to guide players in fuelling optimally, studies have shown that rugby players fail to meet nutritional guidelines particularly around carbohydrate intakes (Bradley *et al.*, 2015). Therefore research into academy players nutritional intake is important for identifying potential barriers stopping players from following these guidelines to the best of their abilities.

1.3 The importance and influence of academy set ups in sports

Professional sports academies are in place to bridge the gap between youth and elite level of competition. Academy programmes play an integral part in developing young athletes by providing structured environment that facilitates the development of technical, physical and psychological attributes (Rees *et al.*, 2016). As well as

sports specific skill development, academy settings are now emphasising the importance of other multidisciplinary sports services like strength and conditioning, sports medicine and nutrition (Rees *et al.*, 2016).

Teenage and young adulthood is a crucial period for individuals to grow and develop, with several hormonal and physiological changes occurring. These changes happen alongside increasing training loads, new competition standards, leading for the highlighted need for nutritional requirements to support growth and optimise recovery (Desbrow *et al.*, 2014). Sports nutrition knowledge, dietary habits and confidence have been shown to improve through the delivery of nutritional education within sports academy settings (Trakman *et al.*, 2017). Despite these benefits, studies have shown that a high amount of academy players do not meet the current recommendations for carbohydrate intakes and nutrition related to recovery, this highlighting the poor practical application and calls for understanding of why these recommendations aren't met (Jenner *et al.*, 2019).

1.4 Gaps in Research

From reviewing the literature, it is clear there is an abundance of studies assessing rugby players, from elite to academy players. However, only 18 studies have investigated dietary intakes of rugby players, making the pool for nutritional data for rugby very minimal (Roberts and Gough, 2024). Nutritional knowledge of players has been assessed but it is unclear how this knowledge translates into dietary habits and choices for players (Roberts and Gough, 2024). Extremely limited studies exist assessing young academy and female rugby players nutritional intake. This may be argued due to the financial backing the academies and women's game receives, although growing in popularity each year. Overall, although recent literature on dietary intakes of rugby players has begun to explore new themes, the studies remain largely independent of one another. As a result of this, the ability to apply these findings broadly is limited due to differences in participant gender, playing level, and geographical location (Roberts and Gough, 2024). Therefore, by increasing research into rugby academies dietary habits, knowledge on the

foundation level of professional rugby can be explored and areas for further development can be identified.

1.5 Aims/ Objectives

The primary objective of the study will be to assess and understand the fuelling and recovery habits adopted by a professional rugby senior academy over a three-day period covering a match day. Performance nutrition is essential for all athletes to optimise in order to support the demands of their respected sport. Especially for rugby players that endure intermittent bouts of high intense exercise, factors like carbohydrate, protein, fluid and micronutrient intake play a vital role in contributing to performance, recovery and maintaining training quality (Bradley *et al.*, 2015).

Although there is an abundance of scientific research on recommendations for nutritional performance, there remains limited research that shows whether academy players implement these recommendations (Roberts and Gough, 2024). Therefore, the study aims to provide a further insight into the nutritional habits of academy players and try and identify specific barrier that stop players implementing these recommendations.

The study will achieve this by focusing on dietary intakes over three days, one day prior to a match, matchday and the day after the match. Recovery strategies will also be assessed for the day after the match to determine if such strategies are appropriate. The specific objectives of the study are to identify if carbohydrate intakes are appropriate for pre-match fuelling and post-match glycogen replenishment. Protein intakes will be analysed to depict if intakes are adequate to support muscle recovery and growth. Hydration strategies that are deployed during the match will also be looked into. Fat intakes and their sources will be discovered to conclude if these intakes are suitable for rugby players. These findings will be compared to sports specific guidelines and recommendations and also to previous research on professional rugby players to assess if the academy players practices are similar and optimal.

Chapter Two –Literature review

2.1 Introduction to the chapter

This chapter reviews the existing literature surrounding sports nutrition, more specifically around rugby players dietary intakes. Initially, the importance of nutrition for athletic performance is discussed to provide context. The chapter then examines current guidelines and recommendations for rugby players relating to macro and micronutrients to support their rugby performance. This followed by barriers rugby players may face that contribute to optimal fuelling, that highlight the rationale for the present study.

2.2 Review of the Literature

2.2.1 Search strategy

A systematic search of the literature was conducted to identify appropriate research assessing sports nutrition relating to rugby union players around dietary habits and match day fuelling. Electronic databases such as the online UWTSD library, PubMed and Google Scholar were utilised to identify peer-reviewed articles. Searches were performed by using key words and phrases such as '*rugby union, sports nutrition, fuelling, carbohydrates, rugby academies, protein, fats, hydration strategies, match day fuelling, nutrition for recovery, muscle protein synthesis, muscle glycogen resynthesis*'. The filters used during the searches required the articles to be peer-reviewed and published after 2016 to ensure the inclusion of current evidence. However, there are a few studies published prior to 2016 used within the current study due to the niche information provided and lack of research done in more recent years. Reference lists of relevant articles were also screened to identify studies that were not discovered in the initial database search.

2.2.2 Study selection/ inclusion exclusion criteria

Studies identified through the above search strategy were screened based on their titles and abstracts to determine their relevance to the topic. Full texts of potentially relevant studies were then reviewed to confirm eligibility. The inclusion criteria included studies that assessed the topic of nutritional habits of athletes, competition fuelling strategies or if the studies involved human participants involved in any

sports. The inclusion criteria also required studies to be published in English and that were peer-reviewed.

Studies were excluded if they focused solely on non-human or animal models, were not directly related to sports or sports nutrition or were abstracts, editorials or other non-peer reviewed sources. Additionally, studies that lacked sufficient methodological detail or did not report relevant outcome measures were excluded. After applying these criteria, the most relevant studies were selected for inclusion in the literature review.

2.3 Introducing the importance of nutrition for athletic performance

The importance of nutrition for athletic performance cannot be overstated, with adequate energy intake being essential for athletes. Proper nutrition allows the body to function at its best while enabling sufficient consumption of macro and micronutrients (Thomas, Erdman and Burke, 2016). Knowledge and practise of nutrition evolve over time and must be constantly updated and integrated into the player's preparation for them to have the best possible chance to succeed (Burke *et al*, 2019). Well executed nutrition plans for performance are not only needed in rugby but needed in all sports. UEFA's expert group statement on nutrition in elite football state that nutrition is crucial for enhancing both the physical and mental performance of elite players during training and matches as well as supporting their overall health over the course of a long season (Colin *et al.*, 2021). What players eat and drink along with how much and when they consume it can significantly affect their performance and recovery before during and after games.

Research shows that various nutritional approaches can help improve athletic performance and using a combination of strategies is usually more effective than relying on just one. These approaches involve optimising the intake of macro nutrients, micronutrients and fluids as well as considering the components and timing across the day (Beck *et al.*, 2015). Studies have shown that following a structured science-based nutrition plan, that includes fluid carbohydrates, sodium and caffeine enabled non elite runners to finish a marathon more quickly and helped trained cyclists improve their time trial performance compared with using their own self-selected nutrition approaches (Bean, 2022). The value of personalised nutrition advice is also increasingly acknowledged since the best dietary strategies depend on

the athlete's sport goal and individual factors such as food preferences (Beck *et al.*, 2015).

2.3.1 Rationale for studying dietary behaviours in rugby players

Due to the physical demands of rugby causing high amounts of stress to the body, players must meet their nutritional requirements to support their energy availability, muscle repair, recovery and overall health (Bradley *et al.*, 2015). Studying dietary habits of rugby players is therefore essential to assess whether current dietary eating practices are adequate for optimal performance. Despite there being recognition of the importance of nutrition several studies have shown that athletes do not meet their recommended dietary guidelines. A study by Bradely *et al* (2015) on elite rugby players nutritional intake during a season discovered that the players were consuming towards the lower end of carbohydrate intakes (4-6g/kg/BW) compared to The American College of Sports Medicine (2016) high recommendations for team sport being (6-10g/kg/BW). As academy players have access to nutritional professionals, who provide the best current practice, the expectation is that their dietary intakes should be adequate to support performance.

2.4 Physiological Demands of Rugby Union

2.4.1 Energy systems used in RU

Rugby Union is a multi-paced game that includes bouts of explosive movements alongside periods of lower intensity or rest. Therefore, due to the nature of the game, all energy systems are utilised during a match. An immediate source of energy for the contractions of muscles comes from the hydrolysis of adenosine triphosphate phosphocreatine (ATP-PC), although it exists in very low concentration in the muscle (Hackney, 2017). The ATP-PC system provides instant energy for explosive short bursts such as tackling or sprinting in rugby with no fatigue inducing byproducts but depletes quickly. The second process involves the anaerobic breakdown of carbohydrates to produce glycogen, stored in the muscles and liver (Hackney, 2017). The final energy system involves the combustion of carbohydrates and fats through aerobic or oxidative metabolism, and under some conditions, proteins in the presence of oxygen. Together these three energy processes are well suited to deal with diverse energy demands placed on the body during exercise (Hackney, 2017).

2.4.2 Physical demands of playing positions

The physical demands of rugby vary by playing positions. All players require strength, power and endurance, however certain specific positions require more specialised attributes. Forwards are generally larger and possess greater body mass than backs who are typically leaner and quicker, which makes diet planning essential to ensure each individual player receives their macro and micronutrient requirements to correctly fuel. (Bradley *et al.*, 2015). Furthermore, the faster players break the gain line, evade defenders and score tries more frequently (Zabalov *et al.*, 2021). All players can be further subcategorised from forwards and backs into their specialised playing positions.

The forwards pack are numbered 1-8, with the front row (1-3) typically being the heaviest players on the pitch who specialise in scrummaging which requires a high amount of strength and power. However, due to their body mass, their total running distance is typically lower than all other players (Ruck, 2018). Second row players numbered 4 and 5 also carry great mass however they specialise in lineouts which require a taller body physique and a great amount of power to enable adequate ariel work. Back row forwards (6,7,8) are more athletic forwards that require speed and strength due to their carries and high ruck involvement (Zabalov *et al.*, 2021).

Backs are numbered 9-15 with their primary role being territorial gain with speed and skill execution (World Rugby, 2026). Scrum-Half (9) acts as the link between forwards and backs, controlling what ball will be feed out to the backs, the position is typically played by the smallest player on the pitch due to the excessive running, and numerous changes in direction during a match (Ruck, 2018). The Fly-half (10) is considered the 'heartbeat' of the team, due to their responsibility of orchestrating the teams attacking and defensive positioning. Similarity to the no 9, fly-halves are usually smaller builds to meet their physical demands on the pitch (Ruck, 2018; Zabalov *et al.*, 2021). The two centres (12,13) stand outside the fly half and are typically strong dynamic runners who are well built to break the gain line. The final three backfield players being the wingers (11,14) and the fullback (15). These three players are considered the last line of defence and typically the teams go to try

scorers in attack due to their speed and agility to beat apposing defenders (Ruck, 2018).

2.5 Macronutrient Requirements for Rugby Players

2.5.1 Carbohydrates: Role in energy supply, glycogen replenishment and intake recommendations for team-sport athletes.

Carbohydrates are the primary source of fuel for high intensity, intermittent exercise such as team sports like rugby. Carbohydrates play a crucial part in energy supply during exercise and glycogen replenishment between training and matches (Thomas *et al.*, 2016). Carbohydrates rightfully have received a great deal of focus and attention in sports nutrition and there is plentiful amount of research on the benefits of exercising with a high carbohydrate availability. Due to the body's relatively small carbohydrate stores, daily dietary intake is vital for athletes to support their performance energy needs (Thomas *et al.*, 2016). Restoration of muscle and liver glycogen stores must be a fundamental goal especially for athletes that undertake multiple workouts in a short amount of time. Inadequate carbohydrates fuelling and refuelling will hinder performance and recovery (Bean, 2022).

Carbohydrate Intake recommendations vary according to sport and training demands. The American College of Sports Medicine (2016) suggest daily intake ranges from 3-12g/kg body weight, while research from over a decade ago, Burke (2011) proposes a narrower range of 6-10g/kg body weight. Bradley *et al* (2015) study reported that elite rugby players consumed approximately 4-6g/kg body weight of carbohydrates. Although these intakes appear lower than general guidelines, the study concluded that these intakes were not considered insufficient and were appropriate for rugby athletes if carbohydrate intake was increased in the days immediately before and after competition. Furthermore, Bradley *et al* (2019) investigated muscle glycogen utilisation, recommended an absolute intake of approximately 600g of carbohydrates over the 36 hours preceding match as a strategy for a players match preparation, highlighting the relatively low carbohydrate consumption observed among participants in their study.

2.5.2 Protein: Requirements for muscle growth, repair and maintenance.

Protein is a vital macronutrient that makes up part of every cell and tissue within the body, including organs, muscle tissue, hair, skin, tendon and nails (Bean, 2022).

Protein is needed for regulating metabolic pathways, growth of new tissue and the repair of current tissue within the body. After resistance training both protein breakdown and synthesis increase, but if minimal or no protein is consumed during this post exercise period, minimal strength gains will be experienced or even muscle loss (Bean, 2022). Recent meta-analysis of 18 studies has found that consuming more protein than the DRV (Dietary Reference Value) increases lean muscle mass in people completing resistance training (Hudson, 2020). However, consuming high amounts of protein alone will not provide the same results, protein intake combined with adequate resistance training is needed for growth (Hudson, 2020).

Owing to the high physical demands of rugby, including frequent collisions as well as repeating acceleration and deceleration, substantial muscle damage is commonly observed, this highlighting the importance of adequate protein intake for muscle repair and adaptation for rugby players (Black *et al.*, 2018). Current recommendations for resistance training athletes suggest a daily protein intake of 1.2- 1.7g/kg body weight (Bean, 2022). Whereas The American College of Sports Medicine (2016) proposes a slightly higher range of 1.2-2.0g/kg body weight for athletic populations.

Bradley *et al* (2015) reported that professional rugby players macronutrient intakes, recordings of up to 2.8g/kg BW were seen for protein intake. Showing the focus and importance that professional players put towards high protein intakes. However these intakes ask the question if elite players are consuming too much protein as it has been proposed that too much protein might cause kidney damage through increased pressure and hyperfiltration in the blood capillaries of the kidneys (Bean, 2022). However, a review of 26 studies by Van Elswyk *et al* (2018) found that no adverse effect was witnessed of high protein intakes in healthy individuals. These results were also mirrored by Devries *et al* (2018) in their meta-analysis of 40 studies and found no difference in kidney functions between people on a high or normal amount of protein.

2.5.3 Fat: Recommendations and its role in long duration energy.

Fat is a necessary part of a healthy diet, by providing energy, making up essential parts of cell membrane, creating hormones, and facilitating the absorption of fat-soluble vitamins (Thomas et al., 2016). Fat is also the highest calorie dense macronutrient, supplying 9 calories per gram, this along with the human body's seemingly unlimited storage capability makes it the largest reserve of energy (Bean, 2022). It is suggested that athletes follow public health guidelines for fat intakes which differ from around 20-35% of total calories. Aswell as following these guidelines, it is also stated that athletes should focus their intakes on their individualized training levels and their body compositions goals (Thomas et al., 2016).

During endurance training, fat in the form of adipose tissue, fatty acids (plasma free and intramuscular triglycerides provide a plentiful fuel substrate. The relative proportions of each fuel that is oxidised (Carbohydrates or fats) depends on the intensity and the duration of the exercise, the pre-exercise diet and the athlete's fitness levels (Bean, 2022; Thomas *et al.*, 2016). During lower intensity exercise the body's main source of fuel is fat, compared to higher intensity exercise being carbohydrates. Even though the percentage of fat contribution decreases as exercise intensity increases, the total amount of fat oxidised does increase due to energy expenditure being higher (Bean, 2022).

2.6 Micronutrients and Hydration to Support Rugby Performance

2.6.1 Key vitamins and minerals

Due to the high amount of stress placed on the metabolic, neuromuscular and immune system during rugby training and games, vitamins and minerals (micronutrients) place a crucial role in maintaining health and helping with recovery. Three key micronutrients were analysed in this study, Vitamin D, Iron and Calcium are all seen as particularly crucial micronutrients for rugby. Vitamin D is known as a crucial vitamin for maintaining bone health and its role in muscle structure and function. However, several studies have recorded low levels of vitamin D intake for athletes that train indoors or get little to no exposure to sunlight (Owens *et al*, 2015). The same study also showed that muscle recovery following exercise induced muscle damage was improved by supplementation. Foods shown to be high in vitamin D include, oily fish, egg yolks, red meat and fortified foods such as some

breakfast cereals and fat spreads. Intakes for vitamin D in Bradley *et al* (2015) study of elite rugby players showed that the average (8ug) amount exceeded the UK dietary reference value (DRV) of 7ug. Although, the study concluded that future studies should consider investigating blood vitamin D concentration in elite rugby players to further investigate the hypothesis shown by Owen *et al* (2015) that deficiencies are commonplace for many athletes.

Calcium is an essential mineral involved in energy metabolism skeletal integrity muscle contraction and numerous other physiological functions within the human body (Ghimire *et al.*, 2024). Dietary sources of calcium include dairy products cereals nuts and vegetables with fortified foods such as certain cereals and fruit juices also contributed to overall calcium intake. Rugby's high exposure to contact increases players chances of obtaining bone fractures, therefore players are advised to pay attention to their calcium intake as this is the main mineral that conditions the maintenance of the skeletal system (Róžańska *et al.*, 2015). In a study assessing 44 rugby players nutrient intake, only 13% of players were under the estimated average requirement (EAR) of 800mg of calcium (Róžańska *et al.*, 2015).

Iron is an important mineral for athletes, due to its function of formatting haemoglobin which transports oxygen in the blood and myoglobin which transports oxygen into the muscle cells (Bean, 2022). Adequate iron status support aerobic capacity delays the onset of fatigue and contributes to the optimal training and match performance (Bean, 2022). It is estimated that 15-35% of female athletes and 3-11% of male athletes have iron deficiency (Sim *et al.*, 2019). There are three stages of iron deficiency, stage 1 occurs when ferritin levels (a protein in the blood that stores iron) fall below 35mcg/litre. Stage 2 is caused when red blood cell formation starts to become impaired but not yet at the point of anaemia, ferritin below 20mcg/litre. Stage 3 is called iron deficiency anaemia and involves a fall in haemoglobin production with ferritin levels below 12mcg/litre (Sim *et al.*, 2019). Rugby players may be at increased risk of iron deficiency due to a combination of factors including high training loads, exercise induced iron losses through sweat and haemolysis caused by repeated impacts. However, Bradley *et al* (2015) study focusing on elite players intake showed that players recorded a significant amount over the iron DRV (6mg) with intakes averaging 24mg.

Table 2.6.2: Government micronutrient recommendations (Public Health England, 2016)

Age (Years)	19-64
Iron (mg/d)	8.7
Calcium (mg/d)	700
Vitamin D (μ g/d)	10

Above is a table of the relevant DRV's for the micronutrients that will be assessed in this study. Several of the recommendations from previous studies discussed follow similar, but not identical values to the DRV's provided by Public Health England.

2.6.3 Hydration strategies

Being hydrated is key to optimal health and to positive sports performances for athletes. Water is used daily within the body for respiration, gastrointestinal, renal and sweat sources (Sawka *et al.*, 2015). Due to the high intensity sequence of plays in rugby and players body composition, players will lose a high amount of water not only through sweat but also as water vapour in the air that is breathed out.

Therefore, adequate hydration strategies leading up to and during matches is essential to avoid hypohydration. Previous advice from the ACSM recommended athletes to 'drink as much as possible' to replace the water weight lost during exercise, however, this advice is no longer valid with recent statements providing no specific recommendations due to the variability of sweat rates and sweat composition of each athlete in different sports. (Thomas *et al.*, 2016). The current advice by the ACSM for athletes is to limit hypohydration to less than 2% of BW during exercise.

Although, many studies have suggested a drink to thirst strategy is more optimal than a planned drinking strategy for certain sports. Hoffman *et al.* (2016) highlighted that drinking to thirst may be an appropriate strategy when it is expected that the athletes would lose less than 2% of total BW, such as lower intensity exercise lasting more than 90 minutes. Compared to a planned drinking strategy which replaces fluid according to sweat losses calculated from body weight and pre-determined exercise

intensity/ duration. An intake of around 400/800ml on hour prevents hypohydration with the higher end more relative to heavier or faster athletes in a warmer environment, compared to the lower amounts more appropriate for a lighter, slower athlete in a cooler environment (Thomas *et al.*, 2016).

2.7 Recovery and Adaptation

2.7.1 Protein distribution

Adequate protein intake is widely recognised as essential for supporting recovery from physiological stress imposed by prolonged exercise (Gillen *et al.*, 2017). However, while much attention in sports nutrition has been directed towards total daily protein intake, the pattern of protein distribution across the day is often neglected. MacKenzie *et al.*, (2015) examined protein intake and distribution in developing elite rugby players during a preseason and reported similarly high protein intakes to those observed by Bradley *et al.* (2015), with players consuming approximately 2.2g/kg BW per day. Mackensie *et al.*, (2015) also found that these developing elite rugby players would typically consume moderate to large quantities of protein at each eating occasion, amounts that have been shown to be sufficient in stimulating muscle protein synthesis (MPS). However, the overall distribution was seen to be suboptimal.

Protein distribution patterns have also been investigated in other sports aside from rugby. Gillen *et al.* (2017) analysed the dietary intake of well-trained Dutch athletes and discovered that approximately 80% of total daily protein intake was consumed across three main meals with the largest ingestion seen in the evening. Gillen *et al.* (2017) concluded that athletes may have adopted suboptimal protein distribution strategies as maximal stimulation of MPS is achieved with the ingestion of approximately 20-25g of protein per meal, evenly distributed across several eating occasions throughout the day.

2.7.2 Carbohydrates for recovery

It is essential to replace depleted glycogen stores after exercise to maximise performance at future workouts or events (Bean, 2022). Glycogen resynthesis is initiated immediately following the ending of the exercise. Studies have shown that glucose uptake by previously active muscle fibres is enhanced through translocation

of glucose transporter type 4 (GLUT-4) proteins to the muscle membrane (Bean, 2022). A study by Alghannam *et al* (2016) discovered the importance of carbohydrate for short term recovery performing two workouts in one day) demonstrated that when runners consumed a high carbohydrate drink of around 1.2k/kg BW after their first workout reached the point of exhaustion significantly later in their second workout compared to runners consuming a low carbohydrate drink (0.3g/kg BW). Both studies highlighting the importance of adequate carbohydrate intake prior to training to perform at a high standard in near future workouts/ events.

2.7.3 Fats for recovery

Not only is fat an important fuel for exercise, but recent research suggests that Omega-3 fatty acids derived from oily fish may benefit athletes recovering from exercise as well rehabbing an injury (Papadopoulou, 2020). Omega-3 fatty acids have been shown to reduce exercise induced inflammation, support muscle repair and decrease muscle soreness which helps athletes reduce DOMS (delayed onset muscle soreness) (Papadopoulou, 2020). More specifically, it is the eicosapentaenoic acid EPA and docosahexaenoic acid (DHA) that are reported to contain anti-inflammatory properties, providing additional rationale for the recommended use in aiding exercise recovery in a dose and duration dependent manner (Naderi *et al*, 2025). Dietary fat is also required to produce hormones such as testosterone which in turn plays a vital role in muscle growth and repair (Naderi *et al*, 2025).

2.7.4 Sleep for recovery

Understanding players' energy needs alongside their daily training schedules is essential for preventing fatigue and ensuring suitable recovery strategies that support peak performance (Bradley *et al.*, 2015). Inadequate sleep duration can negatively affect metabolic processes and endocrine function, impaired both physical performance and cognitive capacity, and increased perceived exertion during exercise (Charest and Grandner, 2020). One study by Hamlin *et al.*, (2021) sought out to investigate whether sleep duration and quality were inked to signs of maladaptation in university athletes. Subjective assessments of sleep quantity and quality were evaluated alongside measures of mood state, perceived energy, academic stress, training load and quality and the incidence of illness and injury in

82 elite athletes aged 18-23 years across a 1-year period in 2020. The study concluded that athletes who maintain good sleep routines (>8hr/ of high-quality sleep a night) were less likely to be negatively affected by problems associated with elevated stress levels (Hamlin et al., 2021).

2.8 Matchday Nutrition

2.8.1 Pre-match fuelling

Given the compatible physiological demands and match durations of football and rugby games carbohydrate (CHO) guidelines developed for elite football players are considered applicable to rugby players. A statement issued by UEFA expert group on elite football fuelling pre match states that CHO Intake is particularly important as liver glycogen storages may be reduced by up to 50% following an overnight fast (Collins et al., 2021). To support energy availability a CHO rich meal providing approximately 1-3g/kg BW is recommended 1-3 hours before kick-off. While the primary focus should be on CHO intake, moderate protein intake should not be excluded, as muscle protein synthesis (MPS) is optimised with doses of 20-25g distributed evenly across the day (Gillens et al., 2017). However, foods high in fat fibre or excessive protein should be avoided close to kick-off to minimize gastrointestinal discomfort. Carbohydrate source is also relevant with low glycaemic index foods more appropriate earlier in the pre match period to provide sustainable energy (Thomas et al., 2016). Adequate pre match hydration is essential with players advised to consume 5-10ml/kg BW in the 2-4 hours prior to kick off to reduce dehydration risk (Thomas et al., 2016).

2.8.2 During a match

Opportunities to consume fluids and energy during rugby match play are limited and inconsistent making structured fuelling strategies difficult to implement. As such a drink to thirst approach is considered appropriate particularly for matches lasting less than 90 minutes provided body mass losses remain below 2% (Hoffman et al., 2016). Half time represents the primary opportunity for refuelling in rugby with a carbohydrate intake of approximately 30-60g/Hr recommended (Thomas et al., 2016). Due to limited digestion time rapidly absorbed glucose-based carbohydrate sources such as sports drinks or gels are preferred to provide a quick energy source and reduce gastrointestinal discomfort.

2.8.3 Post-match fuelling

Recovery nutrition is critical in rugby due to the high mechanical and collision demands of the sport. Muscle damage has been shown to delay glycogen resynthesis meaning post-match glycogen restoration may be prolonged in rugby players (Alghannam et al., 2016). To support glycogen replenishment CHO intake of approximately 1g/kg BW per hour for up to 4 hours post-match is recommended (Collins et al., 2021). Protein intake becomes particularly important during this phase as it supports muscle repair and mitral chondral protein synthesis. Post exercise protein ingestion has been shown to enhanced MPS with intake prioritised within one to two hours following exercise (Bean, 2022). Dietary fat intake particularly omega-3 fatty acids consumed following exercise has been shown to reduce inflammatory responses within the body (Shahidi & Ambigaipalan, 2018). Given the substantial muscle damage incurred during rugby match play, post exercise inflammation is common and the inclusion of omega-3 rich foods such as oily fish is recommended to help ensure adequate omega-3 intake in rugby players.

2.9 Nutrition knowledge and support in rugby

Practitioners within sports nutrition play a vital role not only in helping athletes optimise their performance, but to also safeguard athlete health by delivering high-quality nutrition services (Close, Kasper and Morton, 2023). A meta-analysis study by Wilson *et al* (2025) assessed the sports nutrition services within male and female international rugby union. The study stated that there is significant work done on researching dietary needs for athletes, even rugby players. Despite this, the specific nutritional services available to international level players remains under researched (Wilson *et al.*, 2025). The study found that practitioners primarily prioritised individuals fuelling, recovery and hydration strategies, however there appeared to be a disproportionate emphasis on body composition manipulation, particularly with male teams.

Although the nutritional support is there for rugby players, studies have found that some players don't utilise this support, especially around supplementation information. Sanches-Oliver et al., (2020) examined supplementation habits of 144

rugby players, consisting of 69 professionals and 75 amateurs. The findings indicated that amateur players mostly sourced supplementation advice from friends (26.8%), whereas professional players were more likely to consult trainers (34.1%). Some may argue this may be since amateur players have limited access to resources in comparison to professional players. Furthermore, these results highlight the potential concerns regarding the credibility of information accessed by amateur players and underscore the need for further investigation (Sanches-Oliver et al., 2020). As this current study will focus on professional academy players, the expectation would be that these academy players would follow similar routes to gaining information on supplementation as that of the professional players in Sanches-Oliver et al., (2020)'s study.

2.10 Barriers to Optimal Nutrition

As this study will be focusing on professional academy players, which in terms of daily schedule, is typically part time hours. These players may encounter a blend of challenges that overlap what amateur players face and what barriers are seen at professional level. The barriers that influence amateur athletes like rugby players nutritional choices are numerous. The financial cost associated with consuming a nutritionally balanced diet, as many high-quality protein rich foods may be financially inaccessible, limiting players ability to meet nutritional requirement. While professional athletes generally perceived to be less affected by these barriers it remains important to examine available evidence to identify whether similar challenges exist at higher levels of the sport.

Sharples et al., (2021) Investigated barriers attitudes and influences on dietary intake among elite rugby union players highlighting the limited existing research examining factors affecting athlete's nutritional behaviours. This qualitative study employed in person interviews with thirty rugby union players including nineteen professional Super Rugby players eight semi-professional players and three Super Rugby development players. The findings demonstrated that dietary intake was influenced by a range of sociological, physiological cultural factors with participants identifying multiple barriers and attitudes perceived to affect their ability to maintain an appropriate diet. Consistent with the findings of Alaunyte *et al.*, (2015), Nutritional knowledge was not considered a major barrier at professional level however players

competing at semi-professional and development levels displayed comparatively lower levels of nutritional understanding.

Furthermore childhood upbringing was identified as both a barrier and facilitator of dietary behaviours among semi-professional and development players reinforcing the need for increased nutritional education and support at lower levels of rugby participation notably access to healthy foods and the rising cost of food were also recognised as significant barriers amongst professional players challenges that were similarly evident at lower competitive levels (Sharples et al., 2021).

2.11 Comparison with other sports

2.11.1 How rugby players' needs differ from other sports

Different sports have different nutritional challenges, depending on the intensity of the exercise, the duration and the environment. Therefore, different nutritional strategies are required for many different types of sports that range from endurance events, team sports and sports that require athletes to make weight (Bean, 2022). As rugby is a high intensity collision-based sports, its nutritional strategies compared to a marathon runner will have noticeable differences. For events lasting longer than 90 minutes, a glycogen loading protocol is advised, typically commencing 36-48hours prior to competition with a carbohydrate intake of approximately 10-12g/kg BW a day (Cao et al., 2025; Thomas et al., 2016). Furthermore, elite endurance athletes can often begin preparing their glycogen loading 10 days prior to major events. During the initial 7-10 days, carbohydrate intake is primarily derived from whole foods with limited use of carbohydrate supplementation (Cao et al., 2025). In the final week, carbohydrate intake is progressively increased, with carbohydrate rich foods included at each meal alongside the reintroduction of carbohydrate supplementation during training such as sports beverages and carbohydrate gels (Cao et al., 2025).

This compared to the smaller amount of carbohydrates recommended by UEFA expert consensus for team sports such as football and rugby, where players are advised to consume between 6-8g of carbohydrates/kg BW the day before a match. This is since muscle glycogen depletion would not be a limiting factor in events lasting less than 90 minutes (Collins et al., 2021). For weight class sports such as

boxing, judo, weightlifting, mixed martial arts (MMA) and bodybuilding, making weight safely requires a meticulously thought through nutritional plan in the lead up to any event.

Chapter Three- Methodology

3.1 Introduction/ Research Design

The study will adopt a mixed methods research approach, integrating both qualitative and quantitative data collection techniques to provide a comprehensive understanding of players' nutritional habits. Questionnaires containing open ended questions will be used to collect qualitative data, allowing participants to express their personal perceptions, experiences, and knowledge related to sports nutrition. In addition, food diaries will be employed to gather quantitative data, offering measurable insights into players' actual fuelling and recovery strategies. This dual approach enables the study to identify not only what players consume, but also how and why they make these choices in relation to their performance and recovery routines.

3.2 Epistemology

The research is situated primarily within a positivist paradigm, based on the hypothesis that professional academy rugby players will demonstrate a strong understanding and implementation of sports nutrition principles due to the resources, education, and support typically available within elite sporting environments. From an epistemological standpoint, the investigation embraces both objective and subjective interpretations. The objective viewpoint is reflected in the analysis of measurable dietary intake data derived from food diaries, whereas the subjective view arises from the interpretation of players' self-reported knowledge, attitudes, and experiences captured through the open-ended questionnaires (Buğdayci, 2019).

3.3 Ontology

In relation to ontology, this study recognises that multiple realities may coexist within the sporting environment. While nutritional knowledge and behaviours can be quantified objectively, each player's understanding and implementation of nutrition is also shaped by individual experiences and contextual factors such as coaching influence and access to support staff (Atkinson, 2012). Therefore, the research assumes a pragmatic ontological position, acknowledging both the external reality in

measurable food diaries and the subjective realities created by players' perceptions and experiences.

3.4 Sampling

The research was carried out with professional academy rugby players who were members of a club competing in the United Rugby Championship (URC).

Participants were drawn specifically from the club's senior academy, which functions as a transitional stage between junior development programmes and the professional first team. As such, the sample represents players who are already exposed to high performance training and match demands, while still in the process of developing their long-term professional careers.

3.4.1 Inclusion/ Exclusion criteria

To ensure the relevance and appropriateness of the data, specific inclusion and exclusion criteria were applied. Eligible participants were required to be formally registered with the club at the time of data collection, to be aged 18 years or older, and to be available for fixture selection during the study period.

The exclusion criteria excluded long term injury players, any players with dietary restrictions that preclude typical fuelling and refusal of consent. This was put in place to maintain consistency through data collection. If long term injury players took part, they would not be exposed to the same training and playing routine as the other active participants and their nutritional strategies would likely differ significantly.

3.4.2 Participants

The study will aim to gather data from around 20-30 players within the senior academy. Having a sample size of around 20+ players increases the statistical power which provides stable descriptive estimates and allows moderate size effect detection. Therefore, the study has capability to identify not only large or obvious differences but also subtle, variations in nutritional intake across all players. These findings will be compared to current data available on adequate fuelling and recovery intakes.

3.5 Procedures

During the preseason period, all participating players attended an introductory briefing session in which the purpose and procedures of the study were clearly explained. This session outlined the rationale for the research, detailing why the investigation was being conducted and how it aimed to contribute to a better understanding of fuelling and recovery habits among academy rugby players. Players were also informed of the inclusion and exclusion criteria, as well as the specific expectations placed upon them throughout the data collection process. The session served not only to inform but also to ensure that all participants provided informed consent and fully understood their roles within the study.

Each player was subsequently provided with both a paper based and online copy of the questionnaire and food diary to ensure accessibility and convenience, accommodating varying preferences and schedules. Beyond the group lecture, the main researcher took additional steps to promote clarity and accuracy by speaking to each player individually or in smaller groups when possible. These conversations allowed participants to ask questions and confirm their understanding of how to correctly complete both the questionnaire and the food diary, thereby enhancing data reliability. Furthermore, participants were given contact information of the main researcher should they require further assistance, wish to clarify any part of the process, or decide to withdraw from the study at any time in accordance with ethical guidelines.

Given the variability of players' schedules, with some individuals competing for the first team and others representing affiliated semi-professional feeder clubs, it was deemed impractical to require all participants to complete the questionnaire and food diary on the same matchday. To maintain consistency and fairness in data collection, it was decided that only players included in the starting fifteen for their respective matches would be asked to complete the documentation. This decision ensured that data reflected the experiences of players who actively participated in a match, rather than those who remained on the bench and may not have engaged in comparable physical exertion.

3.5.1 Energy calculations

The nutritional analysis software Nutritics has an inbuilt energy calculator that was utilised. Although the Cunningham (1980) equation is best suited to calculate energy for high lean body mass's the study decided to use the 'Mifflin-St Jeor' as it is highly accurate for general athletic populations as the body compositions of the academy players ranged. (Add reference)

3.6 Data Collection/ Questionnaire Validity

The study's questionnaire validity is highlighted through its use in multiple other studies in sports (Chlíbková *et al*, 2014; Dascombe *et al*, 2010; Fleming, Naughton & Harper, 2018). The questionnaire 'nutrients habits questionnaire' was initially designed by two registered Sports and Exercise Nutritionists (SENR). In a 2018 study by Fleming, Naughton and Harper investigating nutritional and recovery habits of tennis players, the questionnaire at hand was independently checked by researchers not involved in this study to identify the face validity prior to data collection. This confirming the validity of the questionnaire for use in this study (questions specifically relating to tennis have been altered to fit the terminology and structure of a rugby match).

The questionnaire is broken up into four sections. The first section of questions is included to gather anthropometric data such as age, height, weight and playing position. These measurements can determine body composition of players and can determine any other underlying nutritional status such as identifying obesity (Casadei and Kiel, 2022). The second part of the questionnaire is based around 'matchday -1' intakes. This includes a question asking participants to record a typical day of eating the day before a game. Alongside this food diary, a question is asked what their focus is on nutritionally the day before a game.

The third segment is specifically around matchday habits and intakes, like 'matchday-1 questions', there is a question outlining a full day of eating during a matchday. Participants are asked if these meals change if the game has a late kick off. To understand a bit about what players consume close to kick off or even during half time, there is a multiple-choice question aiming to gather information on these habits. Specific questions on carbohydrate intakes are put in to get an indication on

whether players are either under or over fuelling. The study aims to gather information on players hydration strategies, therefore there are three questions on fluid amount and habits. A subsection has been included to cover questions around post-match intakes to depict if players are re fuelling properly.

The final section of the questionnaire focuses on recovery strategies and food intake during 'matchday +1'. Participants were asked on their preferred recovery strategy and to state their reason for this choice. The questionnaire and food diaries aim to gather a wholistic picture of the players typical eating around three full days including a match day and recovery strategies and their reasons for these choices. To ensure that the structure of the questionnaire and the specific questions asked are user friendly, the questionnaire was piloted by the rugby teams lead nutritionist. Changes that occurred to produce the final draft of the questionnaires included a table for participants to tick off which recovery strategy they implement in line with the reason for the use of this strategy.

3.7 Data analysis

Due to the amount of numerical and categorical data collected, the study can take on a mixed methods approach. Both quantitative and qualitative data gathered can also be subcategories into two types of quantitative data (correlation and comparative). Players will be coded and divided into two groups depending on their playing positions (forwards and backs) with each groups macronutrients intakes compared to discover any significant differences. After this correlation between players is assessed, a comparison to previous findings on professional rugby players and other academies will be conducted. The study will utilise several data analysis software's to discover findings. Nutritics will be used to analyse nutritional data and provide an insight into the specific amounts of each macro and micronutrients that the players consumed. To analyse quantitative data the software 'SPSS statistics v31' (Statistical Package for Social Sciences) will be used to run a paired sample T test. SPSS is powerful tool used across many different fields to analyse sets of data, for this study, SPSS will be used to identify any significant differences provided by the quantitative data. The software NVivo will also be used. This software performs a deep level analysis on unstructured data to generate word frequencies allowing the researcher to produce findings. NVivo will be used in this study during data analysis to identify patterns between participants from questions with larger volumes of text.

3.8 Ethical Approval/ Summary

A completed PG2 ethical approval application is included in the appendix. The study will be conducted in line with the UWTSD Research Ethics and Integrity Code of Practice, the professional standards set by the Sport and Exercise Nutrition Register (SENr, 2021), and the British Association of Sport and Exercise Sciences (BASES) Code of Conduct (2017). Adhering to these guidelines will ensure that all aspects of the research are carried out ethically and with professionalism. The data collection methods used in the study were analysed and thought through carefully before data collection. The combination of both questionnaires and food diaries allows the collection of data that answers and addresses the research objectives.

Chapter Four- Results

4.1 Introduction

This chapter will state the findings from analysing both food diaries and questionnaires over three days (Matchday-1, Matchday and Matchday+1). Both qualitative and quantitative data were found, and data analysis software's such as Nutritics, SPSS and NVivo were used.

4.2 Completed questionnaires and food dairies

Of the thirty players within the senior academy only seventeen returned their questionnaires and food dairies $n=17$ (56.6%). One of the seventeen participant returned an incomplete questionnaire and food diary which was omitted before data analysis $n=1$ (3.3). The study had hoped to collect above twenty food diaries and questionnaires, however from the sixteen returned, there was enough data to proceed with data analysis. Initially the study intended on gathering three days' worth of food diaries. However, only a few of the sixteen participants completed all three days covering the food diary (Matchday-1, Matchday, Matchday+1). All sixteen participants that returned their food dairies had completed the first and second day in their diaries, the study decided to alter the data analysis to two days which covered Matchday-1 and Matchday and omitted any data covering food analysis for Matchday+1.

4.3 Analysing participant anthropometric data

The sixteen total participants were coded P1-P16 to keeping participant confidentiality. Player coding was divided into two groups Forwards (P1-P10) and backs (P11-16). See Table 1 below for anthropometric data. The mean age of all participants was 19.1 with a standard deviation (SD) of 0.7. The ages of the forwards ranged from 18-20 (mean= 18.9; standard deviation (SD) ± 0.6). The ages of all backs ranged from 18-21 (mean= 19.1 (SD) ± 1.03). The height of the forward participants ranged from 177-197cm (mean=183.7 (SD) ± 7.8). The height of the backs ranged from 172-190cm (mean=178.8 (SD) ± 6.37). The weight of the forward

participants ranged from 93.5-130kg (mean=111.7 (SD) $\pm$ 11.1). The weight of the back participants ranged from 76.1-98 (mean=89.2 (SD) $\pm$ 7.3).

Table 4.3.1 Participant Characteristics:

	Forwards Mean (SD)	Backs Mean (SD)	Combined Mean
n	10	6	16
Age (Years)	18.9 (0.6)	19.1 (1.03)	19.1 (0.7)
Range	18-20	18-21	18-21
Height (cm)	183.7 (7.8)	178.8 (6.37)	181.9 (7.4)
Range	177-197	172-190	172-197
Weight (kg)	111.7 (11.1)	89.2 (7.3)	103.3 (14.1)
Range	93.5-130	76.1-98	76.1-130

Although the sample size was small n=16 results were produced for every playing position on the rugby pitch. For the forwards there were four front row participants n=4 (25%). Three back row participants n=3 (18.75%). And three second row participants n=3 (18.75%) covering all forward positions.

For the backs three participants could play in the back three n=3 (18.75%). One participant played scrum/fly half n=1 (6.25%). And two back participants had a playing position of centre n=2 (12.5%).

4.4 Analysis of Data from food diaries and questionnaires Matchday-1

4.4.1 Analysing Matchday-1 Macronutrients

Calories (Kcals)

From imputing the food diary reports into Nutritics and with the use of Excel the study produced a set of quantitative data. The average amount of calories (Kcals) consumed the day before the players match (M-1) was 3168kcal ($\pm$ 491). Only one participant (n=1) (6.25%) went over the recommended calorie intake set by the energy calculation (Mifflin-St Jeor) for M-1. Every other participant (n=15) (93.75%) was under their recommended calorie intake by an average of 393kcal ($\pm$ 350).

Forwards average Kcal intake for M-1 was 3405 ($\pm$ 435) compared to the Back participants of 2774 ($\pm$ 293).

Carbohydrates/ Sugar

Carbohydrate (CHO) intake for all participants averaged at 375g ($\pm$ 81) with an average of 3.7g/kg/BW ($\pm$ 0.8). Forwards average CHO intake for M-1 was 415g ($\pm$ 72), 3.7g/kg/BW ($\pm$ 0.6). Compared to the Backs participants of 310g ($\pm$ 81), 3.5g/kg/BW ($\pm$ 1.1). Total sugar intake was also calculated on average across all players intakes for M-1 were 65g ($\pm$ 55).

Protein

For participants protein intakes the average for all players for M-1 was 191g ($\pm$ 34) with 1.8g/kg/BW ($\pm$ 0.2). Forward participants recovered a higher average amount of 205g ($\pm$ 35) with 1.8g/kg/BW ($\pm$ 0.2). Compared to the back's participants lower recording of an average of 167g ($\pm$ 16) with 1.9g/kg/BW ($\pm$ 0.2).

Fat/ Sat fat

Average total fat intake for all participants for M-1 was 100g ($\pm$ 20). Forward participants recorded an average of 102g ($\pm$ 21) compared to backs recording an average of 95.5g ($\pm$ 20). Saturated fat intake was also reported and analysed. Average total saturated fat intake for all participants for M-1 was 36.5g ($\pm$ 14). Forward participants recorded an average of 34g ($\pm$ 12.1) compared to backs recording an average of 39.8g ($\pm$ 17.6).

Table 4.4.2: Mean Macronutrient intake during M-1

Macronutrient	Forwards (P1-10)	Backs (P11-16)	Sport intake recommendations	Rugby recommendations
Protein (g/kg BW)	1.8	1.9	1.2-2.0g/kg BW (ACSM, 2016)	2.0+g/kg BW (Black et al, 2018)
Carbohydrates (g/kg BW)	3.7	3.5	Recommendations range from 3-12 g/kg BW (ACSM, 2016)	4-6g/kg BW a day (Bradley et al, 2015)
Fat (% of total calories)	26.9	30.9	20-30% (ACSM, 2016)	20-35% (Black et al, 2018)

Table 4.4.2 shows the participants macronutrient intake for matchday-1 expressed via g/kg/BW or % of total daily calories. These intakes are then compared to generic sports intake recommendations and to rugby specific recommendations for players. From the table above we can see that all participants (forwards and backs) reached their protein targets and were in their fat % of total calories. Although all participants met CHO recommendations for generic sports intakes, neither backs nor forward groups met the recommendations for total CHO g/kg/BW for rugby performance.

Table 4.4.3: Mean Micronutrient intake M-1

Micronutrient	Forwards Mean ($\pm$ SD)	Backs Mean ($\pm$ SD)	<i>Recommendation (PHE, 2016)</i>
Iron (mg/d)	17.9 ($\pm$ 4.6)	20.5 ($\pm$ 8)	<i>8.7</i>
Calcium (mg/d)	750 ($\pm$ 273)	945 ($\pm$ 373)	<i>700</i>
Vitamin D (μ g/d)	10.5 ($\pm$ 7.9)	10.1 ($\pm$ 4.7)	<i>10</i>

Three micronutrients were highlighted and analysed during this study, Iron, Calcium and Vitamin D (Public Health England recommendations in italics).

Table 4.4.3 shows that both participant groups (forwards and backs) average Iron, Calcium and Vitamin D intakes were above the recommendations set by Public Health England in 2016.

4.4.4 Analysing Players Nutritional focus Matchday-1

Compared to the quantitative numerical data produced from the food diaries, questions that produced a substantial amount of text in the questionnaires were analysed through the qualitative data analysis programme Nvivo. Nvivo was used in this study to organise, analyse and code unstructured non-numerical data to develop themes, similarities and differences between the participants answers. Only one question for M-1 in the questionnaire produced qualitative, the question being: What are your nutritional focuses the day before a game?

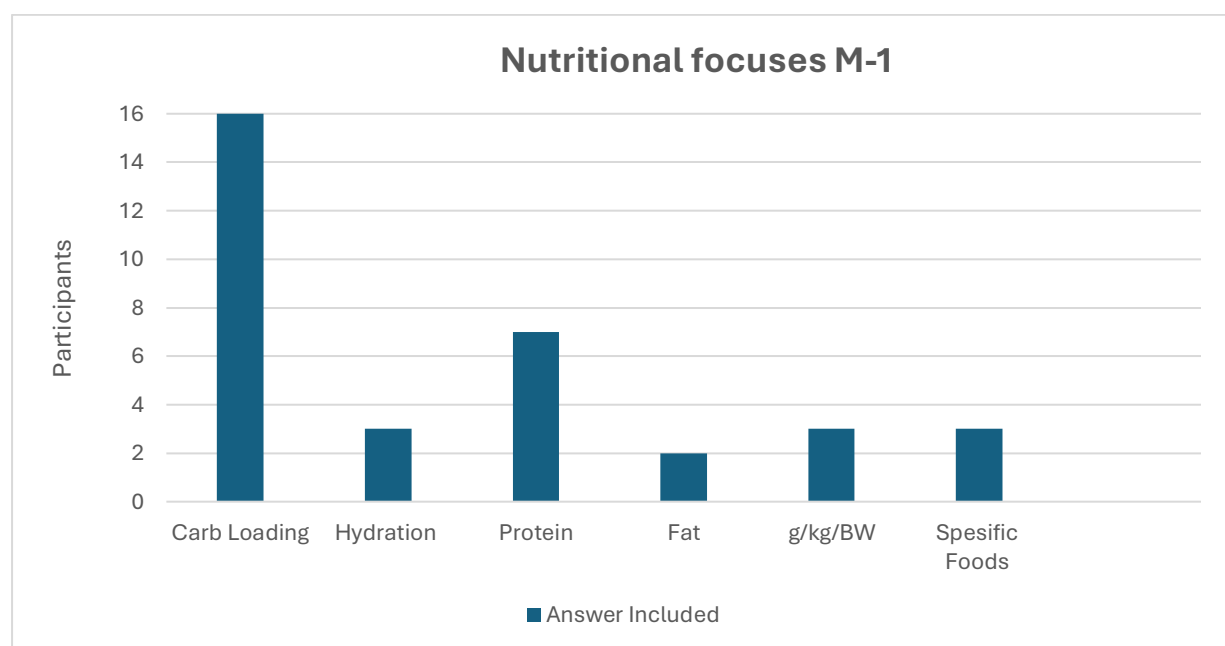


Figure 4.4.5: Nutritional focuses M-1

Figure 4.4.5 above shows what the participants included in their answers (X axis) and how many participants mentioned that topic (Y axis). The figure shows that all participants $n=16$ (100%) discussed a form of carbohydrate loading as one of their nutritional focuses for M-1. Hydration or monitoring urine colour was mentioned by three participants $n=3$ (18.75%). Consuming enough protein to aid in recovery was the second most frequent answer $n=7$ (43.75%). Three participants mentioned they

track g/kg/BW for macronutrients n=3 (18.75%), the same amount that included specific foods/meals in their answer n=3 (18.75%).

4.5 Analysis of Data from food dairies and questionnaires Matchday

4.5.1 Analysing Matchday Macronutrients

Calories/Kilocalories

The average amount of calories (Kcals) consumed on matchday (M) for all participants was 3144kcal (± 544). Only three participant (n=3) (18.75%) went over the recommended calorie intake set by the energy calculation (Mifflin-St Jeor) for M. Every other participant (n=13) (81.25%) was under their recommended calorie intake by an average of 404kcal (± 412). Forwards average Kcal intake for M was 3221 (± 636) compared to the Back participants averaging 3016 (± 361).

Carbohydrate

Total carbohydrate intake for M was measured alongside pre- and post-match CHO intakes for all participants. Total M CHO averaged at 403g (± 74) for all participants. Forwards recorded an average of 424g (± 75) compared to backs average intake of 366g (± 60). In grams per kg of body weight the average amount for all participants was 3.9g/kg/BW (± 0.6) with forwards averaging 3.8g/kg/BW (± 0.7) and backs 4.1g/kg/BW (± 0.7).

Pre match CHO intake for all participants ranged from 1.1-3g/kg/BW (154-328g averaging 246g (± 56)). With forward participants averaging 258g (± 54) compared to back participants recording an average of 225g (± 60).

Post match CHO intake for all participants ranged from 0.9-2.6g/kg/BW (90-276g averaging 152 (± 45)). With forward participants averaging 161g (± 48) with back participants averaging 136g (± 39).

Table 4.5.2: Paired sample T test comparing Pre and Post match Carbohydrate intake

	Mean	± SD	±SD. Error Mean	95% Confidence Interval of the Difference		t	df	One sided p	Two- sided p
				Lower	Upper				
Pre match carbs vs Post match carbs	93.7	64.48	16.12	59.38	128.11	5.81	15	<.001	<.001

Data from the participants pre match carbohydrate intake (in grams) and their carbohydrate intake after the match was compared and put into SPSS for a paired sample T test. The tests were run to examine whether the observed difference could simply be due to chance. Figure 2 shows the average decrease between carbohydrate intake before the match compared to after the match being 93.7g. The degrees of freedom (df) can be seen as 15 with the t value for the comparison being 5.81.

Protein

For participants protein intakes the average for all players for M was 189g (± 54) with 1.9g/kg/BW (± 0.5). Forward participants recovered a lower average amount of 183g (± 60) with 1.6g/kg/BW (± 0.5). Compared to the back's participants higher recording of an average of 198g (± 44) with 2.2g/kg/BW (± 0.4).

Fat/Sat fat

Average total fat intake for all participants for M was 85.6g (± 28.9). Forward participants recorded an average of 86.6g (± 34.4) compared to backs recording an

average of 83.8g ($\pm$ 19.2). Saturated fat intake was also reported and analysed. Average total saturated fat intake for all participants for M-1 was 29.2g ($\pm$ 8.8). Forward participants recorded an average of 29.7g ($\pm$ 8.9) compared to backs recording an average of 28.2g ($\pm$ 9.5).

4.5.3 Analysing Matchday focuses, habits and targets

What was consumed during the match?

Players were asked what they consumed during a match, this question covered their energy intake just before kick-off, during breaks during the match and at half time.

The options given were as followed:

- Water
- Energy Gels
- Bananas
- Sugary sweets
- Sports drinks
- Jaffa Cakes
- Other

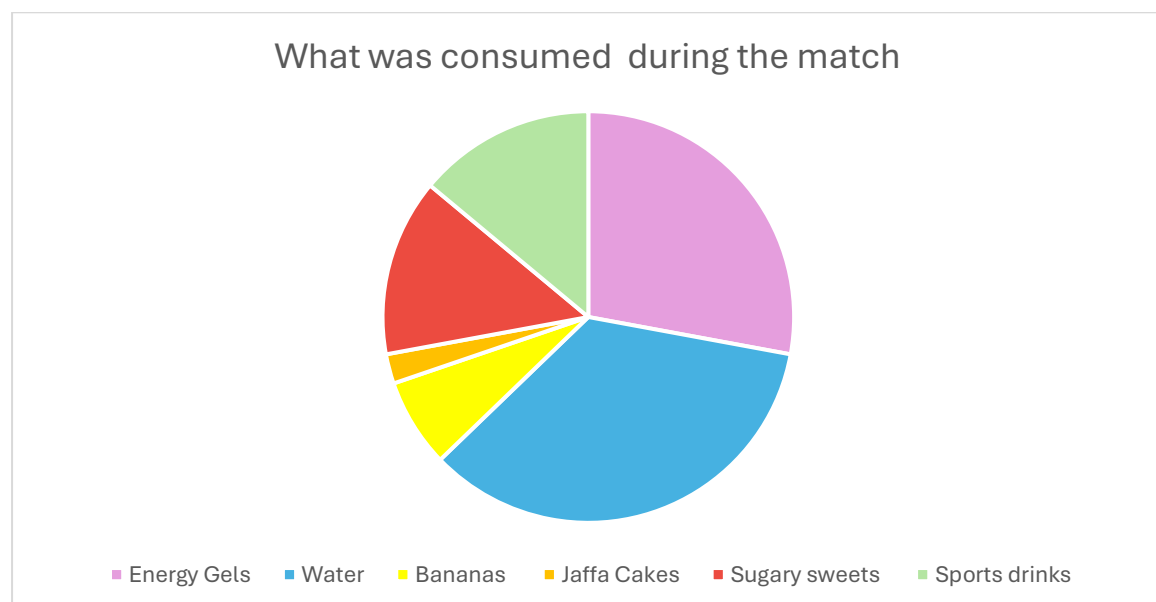


Figure 4.5.4: What was consumed during the match

Figure 4.5.4 demonstrates the participants answer for what food or drink item is favoured on matchday. The most popular answer was water with n=15 selecting (93.75%). The second highest answer was energy gels with n=12 (75%). Both

sugary sweets and sports drinks had n=6 answers each (37.5%). Three participants stated that they consumed bananas during matchday n=3 (18.75%). Only one participant said they consumed Jaffa cakes n=1 (6.25%). No participant selected the option 'other' in their questionnaires.

When fluid was consumed

Participants were asked how much fluid they consume and when during a game.

The three options given were:

- A specific amount
- Drink to Thirst
- Whenever there is a stop in play
- Other

No participant chose the option for a specific amount of water they consume during a game. All participants either chose a drink to thirst strategy n=9 (56.25%) or whenever there was as stoppage in play n=8 (50%) or both n=2 (12.5%).

Amount of Carbohydrates aimed to consume

Participants were also asked if there was a specific amount of carbohydrates that they aimed to consume before kick-off. The study used NVivo to depict any similarities or differences between the participants answers. NVivo found that 68.75% (n=11) of the participants recorded either 'no' or 'no target' in their answer for this question. Three participants (18.75%) stated they aim for around 500g of carbohydrates before a game. Only two participants (n=2 12.5%) stated that they calculate grams per kg of body weight for their total amount of carbohydrates.

Table 4.5.5: Matchday Micronutrient intake compared to M-1 intakes and PHE recommendations

Micronutrient	Forwards Mean <i>M+</i> <i>M-1</i> ($\pm$ SD)		Backs Mean <i>M+</i> <i>M-1</i> ($\pm$ SD)		<i>Recommendation</i> (<i>PHE, 2016</i>)
Iron (mg/d)	<i>16.4 ($\pm$ 5.4)</i>	<i>17.9 ($\pm$ 4.6)</i>	<i>21.6 ($\pm$ 9)</i>	<i>20.5 ($\pm$ 8)</i>	<i>8.7</i>
Calcium (mg/d)	<i>1259 ($\pm$ 530)</i>	<i>750 ($\pm$ 273)</i>	<i>785 ($\pm$ 194.4)</i>	<i>945 ($\pm$ 373)</i>	<i>700</i>
Vitamin D (μ g/d)	<i>7.7 ($\pm$ 8.8)</i>	<i>10.5 ($\pm$ 7.9)</i>	<i>9.3 ($\pm$ 3.9)</i>	<i>10.1 ($\pm$ 4.7)</i>	<i>10</i>

The same micronutrients analysed for M-1 were also looked at for M (Iron, Calcium and Vitamin D). Above is Table 4.5.5 with a side-by-side comparison of both days' intake compared to the recommendations set by Public Health England in 2016. Matchday results are in *Italics*.

4.6 Analysing Matchday+1 questionnaires

4.6.1 Analysing Recovery strategies Matchday+1

The study gathered data on different recovery strategies used on M+1 and the reason the participants opted to use this recovery strategy over others available.

Table 4.6.2: Recovery strategies with reasoning for M+1

Reason Provided								
Recovery strategy		No reason given	Scientific Literature	Peers, Coaches, Teammates	Saves Money	Easily Available	Saves Time	Personal Preference
	Ice baths	1	2					2
	Hot baths				1	1		2
	Compression clothing	1	1			2		
	Foam Rolling		1	1	1	1		2
	Protein shakes	1	1			5		3
	Other		1 (walking)		1 (walking)			
	None	3						

Table 6.6.2 shows the participants preferred recovery strategies on M+1 and the reason they pick that specific strategy. The most popular recovery strategy was the use of protein shakes with n=10 votes (62.5%) with 5 of these votes choosing 'easily available' as their reasoning. Foam rolling had 6 votes in total (37.5%) with personal preference being the highest reasoning (n=2). Ice baths had 5 total votes (31.25) with n=2 choosing scientific literature as their reasoning, n=2 chose personal preference for ice baths as their reasoning. Hot baths and compression clothing both had four votes (n=4). Two participants n=2 chose the option 'other' and stated that they walked for recovery, one of these two participants stated they opted for walking as it saves money while the other said scientific literature was their reasoning. Three participants did not answer the question n=3 (18.75%).

4.6.3 Analysing Macronutrient targets/focuses Matchday +1

The final question on the questionnaire asked participants if there were any macronutrient targets on Matchday+1 or any specific foods they looked to consume. NVivo identified a theme of 'protein', with seven participants included some mention of 'protein' in their answer n=7 (43.75%), however only two of these participants gave a specific amount of protein. Five participants included some mention of 'carbohydrates' in their answer n=5 (31.25%). Three participants included individual food items that they tend to consume on recovery days n=3 (18.75%). Five participants stated they did not have any targets n=5 (31.25%). Only one participant included some mention of hydration n=1 (6.25%).

Chapter Five- Discussion

5.1 Introduction to the chapter

This chapter will assess all the results provided in the study and highlight any key pieces of data that stand out. As the study was conducted on senior professional academy players, the results will be compared to studies that have assessed dietary intakes other professional academy players and of professional rugby players in recent years to depict any differences and similarities. By comparing the data in this study to past studies on professional player, this may offer the academy at hand vital insights in further helping their players transition into full professional players in years to come.

5.2 Research Question 1- Do professional senior academy rugby players fuel sufficiently the day before a match?

5.2.1 Result 1- Do players meet their sports specific nutrient intake guidelines

Macronutrients

Table 3 shows participants macronutrient intake the day before a match. These results are compared to general sports intake recommendation set by the American College of Sports and Medicine (ACSM). And rugby specific recommendations shown by two different studies assessing professional players food intakes.

Protein consumption being an essential macronutrient for rugby players due to the repetitive, intermittent contact frequencies throughout the game. These characteristics of the game cause muscle damage, making protein vital for players growth and repair (Black *et al*, 2018). Sports protein recommendations depicted by the ACSM are between 1.2-2.0g/kg BW, this being a wide range that covers all athletes for non-contact and contact sports (Thomas *et al*, 2016). Both forward and back participants met these general sports protein intakes with respective average protein intakes of 1.8 (F) and 1.9g/kg/BW (B) for M-1. However, rugby specific protein recommendations stated by Black *et al* (2018) should be 2.0+ per kilo of body weight. Concluding that although both forward and back participants met the general sports recommendations for general athlete protein intake, they were not consuming enough protein the day before their match to meet rugby specific nutritional targets.

Carbohydrate intakes for the participants M-1 mirror that of their insufficient protein intake. CHO recommendations for athletes in general have a wide range, from 3-12 g/kg BW due to the variety of different physical intensities that different sports require (Thomas *et al*, 2016). Rugby specific ranges shown by Bradley *et al* (2015)'s study on professional players macronutrient intake are between 4-6g/kg BW on the day of a game. Although this may seem quite low on the 3-12g/kg BW range set by ACSM, Bradley *et al* (2015) concluded that these intakes were not considered 'low' if players increased their intakes the day before a game. Although, a recent study by Meyer *et al* (2025) assessing the macronutrient intakes of professional rugby players from Italian club Zebre showed that 90% of players fell below the recommended CHO intakes before a match. Intakes from this study showed players were consuming as little as a 2.7g/kg BW on average (Meyer *et al*, 2025). Another study by Bradley *et al* (2016) looking into the utilisation of muscle glycogen reported that an absolute amount of 600g CHO 36-h prior to a match is an optimal strategy for players consumption. The same study showed that players performed better following a diet of 6g/kg BW CHO compared to 3g/kg BW leading up to a game.

Therefore, although both forwards (3.7) and backs (3.5) in this study met the ACSM range starting at 3g/kg BW CHO intakes for athletes. Neither set of participants consumed as much as the professional players seen in Bradley *et al* (2016) or reached their 4-6g/kg BW recommendation. However, on average a higher amount of CHO was recorded in the study at hand compared to the recent study by Meyer *et al* (2025). There are no known advantages of training with low carbohydrate intakes for sports performance, as muscle damage delays glycogen replenishment (Bean, 2022). Due to the contact nature of rugby, damage muscle fibres are common, and stores may take longer to fill. Emphasising the low amount of CHO players in this study consumed for M-1.

Fat intake is essential for hormone production and vascular health; however, the type and amount are likely to determine its effects on the body (Black *et al*, 2018). Recommended fat intakes by the ACSM for athletes are between 20-30% of total calories consumed. This compared to rugby specific intakes shown by Black *et al* (2018) to be between 20-35% of total calories. Fat intakes can also be seen in Table 3 and although back participants fat intake (30.9%) was slightly above the

recommendations for athletes set by ASCM, both forwards (26.9%) and backs were well within the ranges specifically for rugby players according to Black *et al* (2018). However high saturated fat intakes were recorded in both forward and back groups. With one forward consuming 59.6g of saturated fat (13.9% of total calories) for M-1. A report by SACN in 2019 stated that saturated fat intakes for all individuals should not exceed 10% of total calories. Similarly Black *et al* (2018) recorded high amounts of saturated fat intake with their professional players.

5.2.2 Micronutrients

Three micronutrients' intakes were evaluated and recorded in the study (Iron, Calcium and Vitamin D). These micronutrients were highlighted as they are essential nutrients that play multiple roles within the body that can benefit athletes and their performance. Calcium supports bone health, Iron helps in the transportation of oxygen and Vitamin D supports immune function as well as working alongside calcium for absorption (Bean, 2022). As seen in Table 4, on average, all players exceed the recommendations for all three micronutrients set by Public Health England (2016). These high nutrient intakes mirror that of what players recorded in Bradley *et al* (2015) with Iron intakes surpassing 24mg on average for the professional players with recommendations set at 8.7mg/d. Professional academy players from this study recorded 17.9mg (forwards) and 20.5mg (backs) for average iron intake, a positive comparison to the professional players intakes.

5.3 Result 2 – Do players have the correct nutritional focus the day before a match

5.3.1 Players nutritional habits and focuses M-1

Player's nutritional focusses the day before a game is an indication on their knowledge of fuelling, therefore it was important to assess whether the players in this study were implementing correct habits for M-1. Players were asked in their questionnaire, what their nutritional focuses were the day before a game. Positively, NVivo discovered that all 100% of the participants discussed or mentioned CHO intake or loading in their answer. Carbohydrate loading has been shown in previous studies to maximise muscle glycogen stores prior to an event or match. One study by Kazemi *et al* (2023) on professional football players showed that the group that increased CHO consumption four days prior to a match scored significantly higher

for running distance and maximum speed compared to the group that did not CHO load.

The second highest focus was seen to be protein intakes with 43.75% of participants mentioning in their answer. Players stated that protein was a focus to optimise recovery in aid of the damage caused by the match. In Alaunte, Perry and Aubrev (2015) study of professional rugby players knowledge on nutrition it was concluded that overall, nutritional knowledge was adequate with questionnaires averaging 72% in correct scores. However, the study also showed that most athletes were unaware of certain macronutrient recommendations. This showing that although general nutritional knowledge of players may be adequate, the ability to transfer this knowledge into person specific intakes for optimal performance may be lacking. This similar to the study at hand where all players understood the importance of CHO fuelling for M-1, however on average, putting this knowledge into practice was not achieved.

5.4 Research Question 2- How sufficient is matchday fuelling from professional senior academy player

5.4.1 Result 1- Are players pre- and post-match nutritional routines fuelling them properly (CHO)

Sufficient CHO and fluid levels are two key nutritional factors to consider before a match. As insufficient CHO levels (glycogen stores) can hinder performance, and low fluid levels can cause risks of dehydration (Bean, 2022). The results showed that Pre match CHO intake for all participants in this study ranged from 154g-328g, averaging 246g (range of 1.1-3g/kg/BW). A study by UEFA (2021) on nutrition for elite professional football players stated that a CHO-rich meal of 1-3g/kg/BW, 3-4 hours before kick-off is recommended to ensure players begin the match with adequate glycogen stores. Although rugby and football are two different sports, there are a lot of similarities, especially when it comes to certain physical elements. Therefore, the nutritional recommendations seen in Colin *et al* (2021) are deemed appropriate for rugby. During the match it is seen that a consumption of around 30-60g CHO is consumed after a warmup and again at half time (Colin *et al*, 2021). Participants in the study at hand were asked what they consumed just before kick-off and during the

match, their options were water, energy gels, bananas, sugary sweets, sports drinks, Jaffa cakes or other. Figure 3 shows that water scored the highest with 93.75% of participants selecting, however in terms of carbohydrate consumption, energy gels (75%), sugary sweets (37.5%) and sports drinks (37.5%) were favoured items. As all players averaged 1.1-3g/kg/BW CHO before kick-off, it is evident that on average players pre-match CHO intake was sufficient in aiding fuelling alongside Colin *et al* (2021)'s recommendations.

Post match carbohydrates are essential to replenish glycogen stores. Research has shown that during the first 2 hours post exercise replenishment is at its highest at 150%, replenishment speed then slows down during the 4 hours after but is higher than normal, with normal replenishment speed Continuing after (Bean, 2022). Therefore, it is recommended to consume 1-1.2k/kg/BW/hour for the first 4 hours post exercise (Thomas *et al*, 2016) for rapid recovery. Although the study at hand did not take into account the exact timings that the players consumed their CHO, players made it clear what was consumed after their games. Post match CHO intake for all participants ranged from 0.9-2.6g/kg/BW (90-276g averaging 152 ($\pm$ 45)). With forward participants averaging 161g ($\pm$ 48) with back participants averaging 136g ($\pm$ 39). Comparing this to a study by Hengist *et al* (2020) also looking into a professional rugby academy rugby fuelling. The study found that players consumed 0.8g/kg/BW/hr during a 3-hour recovery period following an intense training session. This resulted in a 2.4g/kg/BW over the recovery period. The study authors found that this amount of CHO was deemed appropriate as it maintained subsequent training performance. In comparison to the study at hand where players consumed a total of 0.9-2.6g/kg/BW after their match. However, this amount of CHO was recorded as their intake for the rest of the day prior to their match, not during the 3 hours prior to intense exercise like Hengist *et al* (2020). Concluding that the total amount of CHO consumed prior to the game was deemed suboptimal to maintain future performance standards and for appropriate glycogen refuelling.

5.4.2 Hydration strategies

No participant in the study opted for a specific amount of water they aimed to consume during a game. The answers in the questionnaire were split with a drink to

thirst strategy n=9 (56.25%), whenever there was a stop in play n=8 (50%) or both n=2 (12.5%). As all sports have different rates of fluid loss, recommendations are not set, however the current advice by the ACSM for athletes is to limit hypohydration to less than 2% of BW during exercise. One study by Love *et al* (2018) investigated hydration strategies in 33 professional rugby union players during a 120-minute training session. The study measured a range of factors such as players perception of hydration, sweat losses, change in body mass and fluid intake. The study discovered that players underestimated both their sweat loss and fluid intakes but believed that their hydration strategies and levels were appropriate. With the authors concluding that professional rugby players struggled to accurately perceive their hydration levels, suggesting objective monitoring methods may be required for optimal fluid replacement.

In comparison, the findings of the study at hand indicate that players primarily utilised a drink to thirst strategy, consuming fluids whenever there was a chance to do so rather than following a structured drinking plan. This suggests that fluid intake was largely guided by subjective feelings of thirst instead of objective assessments of hydration status. These findings correlate with that of Love *et al*. (2018), who reported that rugby players often relied on perceived hydration despite underestimating their sweat losses. As a result, relying solely on the perception of thirst may not adequately meet the fluid needs of the individual or fully replace fluid lost during the activity. However, choosing a drink to thirst strategy for a team sport like rugby is a practical approach in rugby, where the opportunities to take on fluid during the game are unpredictable apart from the natural break of half time. Therefore, although the hydration practice observed in the study at hand reflects those commonly used in team sports like rugby, they may not be sufficient practice in optimising hydration levels for players, particularly those with greater sweat losses or when competing in warmer conditions.

5.5 Research Question 3- Are players taking the right steps to maximise recovery

5.5.1 Result 1- Player's recovery strategies

Recovery in all sports is an essential factor that cannot be overlooked, enabling athletes to restore physiological function and allow the body to prepare for future training and competition performance (Bean, 2022). In high intensity team sports such as rugby where repeated collisions, shorts sprints and short recovery periods are common, implementing a sufficient recovery strategy is essential to maintain performance and minimise injury risk (Tavares *et al*, 2017). The players in the study at hand were asked about the recovery strategy they adopt after a match and to provide a reason why they opted for such strategy. Table 6 in the results show the most popular recovery strategy implemented by n=10 participants (62.5%) was the use of protein shakes. A systematic review by Pearson *et al*. (2023) looking into the impact of dietary protein supplementation on recovery from resistance exercise induced muscle damage analysed 29 studies. The study found that protein shakes may improve recovery of muscle function, especially in the first 24-48 hours prior to training. Although the study found no evidence that protein shakes reduce muscle soreness, the study did find that the use of protein shakes reduced markers of muscle damage, suggesting less muscle damage and a more rapid speed of recovery (Pearsons *et al*, 2023). Therefore, scientific literature recommends the use of protein shakes as a recovery strategy, however only n=1 participant that chose protein shakes stated it was down to scientific literature as their reasoning, most players put their reasoning down to easily available n=5.

The second most popular recovery option chosen by the players was the use of foam rolling n=6 (37.5%). This method is supported by Hendricks *et al*. (2020) looking into the effects of foam rolling on performance and recovery. Hendricks *et al* (2020) concluded that foam rolling is a suitable and effective tool for reducing delayed onset of muscle soreness (DOMS). Although, there was no evidence in the study that the use of foam rolling had a direct effect on enhancing athletic performance, improvements in recovery may help athletes prepare for future competition. Therefore, the recovery strategies that most of the participants utilised have peer reviewed, scientific literature, providing evidence for their effectiveness.

However, there were $n=3$ participants that stated they did not use any form of recovery strategy, showing the need for education to ensure all players understand what strategies are available and the effectiveness of them.

5.6 Limitations of the study

One notable limitation of this study is the relatively small sample size, which restricts the extent to which the findings can be generalised across wider academy populations. A potential way to strengthen the research design would have been to include players from multiple professional academies, thereby increasing the overall sample and providing a more diverse dataset.

The addition of including CHO timings in the questionnaires would have allowed for a more accurate analysis of pre and post-match CHO intakes. However, this may have been challenging due to the poor detail provided in the questionnaires to begin with. Another important consideration is the reliance on self-reported data. Because food diaries and questionnaires depend on the accuracy of participants' own accounts, there is an inherent risk of recall bias or misreporting. Players may forget to log certain items, estimate portion sizes inaccurately, or respond in ways that they feel are socially desirable rather than fully accurate. This could influence the validity of the data collected.

Lastly, as the study participants were all academy athletes, issues relating to compliance may also have been present. Academy players often have busy schedules and may not yet have developed the same level of professional responsibility and consistency as senior players. This can sometimes lead to incomplete data entries, rushed responses, or reduced engagement with the study protocols.

Chapter Six- Conclusions and future focus

6.1 Conclusions

In conclusion, the findings of the study at hand suggest that the academy players demonstrated several positive recommended nutritional strategies surrounding a match day. The players consumed sufficient micronutrients, intakes of pre-match CHO were appropriate, and they demonstrated knowledge on correct nutritional focuses during the lead up to the game. Also, players adopted appropriate recovery strategies for M+1. These findings show that players understand the importance of good nutritional and recovery strategies to maximise performance.

Despite these positive findings, several findings during the study highlighted suboptimal practices. In particular, macronutrient intake for M-1 was seen to be insufficient with players consuming less than the recommended intake for CHO and protein, and on average, over consuming fat (Bradley *et al*, 2015; Black *et al*, 2018). Post match CHO intakes were also a concern with several players either under consuming or under reporting intakes. This highlighting the possibility that glycogen replenishment may have been limited and not given the focus it needed to optimise glycogen resynthesis in preparation for future training/competitions. Given the high physical demands and contact nature of rugby union, these nutritional practices are important for maximising performance, optimising recovery and preparing the players for future training. Although players showed an appropriate amount of knowledge towards nutritional priorities surrounding a matchday, this knowledge did not accurately reflect their food diary inputs. This seen gap between knowledge and practical implementation highlights the challenges for future focus.

6.2 Future focus

Future research should explore the challenges and barriers preventing academy athletes from translating knowledge into practice. This may include looking further into individual nutritional needs rather than having set recommendations for rugby players on average. Practical education sessions that focus on behavioural strategies may improve adherence to evidence based scientific literature around matchday fuelling practices and methods. Bringing light to this gap is essential for future academies to potentially enhance matchday fuelling practices, optimise

recovery and support the development of future Welsh professional academy rugby players.

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APPLICATION FOR ETHICAL APPROVAL

RESEARCH STUDENTS

This form is to be completed by the student within **SIX** months for full-time students and **TWELVE** months for part time students, after the commencement of the research degree or following progression to Part Two of your course.

Once complete, submit this form via the **MyTSD Doctoral College Portal** at (<https://mytsd.uwtsd.ac.uk>).

This document is also available in Welsh.

RESEARCH STAFF ONLY

All communications relating to this application during its processing must be in writing and emailed to pgresearch@uwtsd.ac.uk , with the title 'Ethical Approval' followed by your name.

STUDENTS ON UNDERGRADUATE OR TAUGHT MASTERS PROGRAMMES should submit this form (and receive the outcome) via systems explained to you by the supervisor/module leader.

In order for research to result in benefit and minimise risk of harm, it must be conducted ethically. A researcher may not be covered by the University's insurance if ethical approval has not been obtained prior to commencement.

The University follows the OECD Frascati manual definition of **research activity**: "creative work undertaken on a systematic basis in order to increase the stock of knowledge, including knowledge of man, culture and society, and the use of this stock of knowledge to devise new applications". As such this covers activities undertaken by members of staff, postgraduate research students, and both taught postgraduate and undergraduate students working on dissertations/projects.

The individual undertaking the research activity is known as the "principal researcher".

Ethical approval is not required for routine audits, performance reviews, quality assurance studies, testing within normal educational requirements, and literary or artistic criticism.

Please read the notes for guidance before completing ALL sections of the form.

This form must be completed and approved prior to undertaking any research activity.
Please see Checklist for details of process for different categories of application.

SECTION A: About You (Principal Researcher)

1	Full Name:	William David Icke			
2	Tick all boxes that apply:	Member of staff:	☐	Honorary research fellow:	☐
	Undergraduate Student	☐	Taught Postgraduate Student	☒	Postgraduate Research Student

3	Institute/Academic Discipline/Centre:	University of Wales Trinity Saint David
4	Campus:	Carmarthen
5	E-mail address:	2308497@student.uwtsd.ac.uk
6	Contact Telephone Number:	07949361996
For students:		
7	Student Number:	2308497
8	Programme of Study:	MSc Sports and Exercise Nutrition
9	Director of Studies/Supervisor:	Dr Chris Cashin

SECTION B: Approval for Research Activity

1	Has the research activity received approval in principle? (please check the Guidance Notes as to the appropriate approval process for different levels of research by different categories of individual)	YES	☐	NO	☒
					Date
2	If Yes, please indicate source of approval (and date where known): Approval in principle must be obtained from the relevant source prior to seeking ethical approval	Research Degrees Committee	☐		
		Institute Research Committee	☐		
		Other (write in)	☐		

SECTION C: Internal and External Ethical Guidance Materials

Please list the core ethical guidance documents that have been referred to during the completion of this form (including any discipline-specific codes of research ethics, location-specific codes of research ethics, and also any specific ethical guidance relating to the proposed methodology). Please tick to confirm that your research proposal adheres to these codes and guidelines. You may add rows to this table if needed.		
1	<u>UWTSD Research Ethics & Integrity Code of Practice</u>	☒
2	<u>UWTSD Research Data Management Policy</u>	☒
3	<i>[List any other relevant documents here]</i>	☐

SECTION D: External Collaborative Research Activity

If there are external collaborators then you should gain consent from the contact persons to share their personal data with the university. If there are no external collaborators then leave this section blank and continue to section E.

1	Institution					
2	Contact person name					
3	Contact person e-mail address					
4	Is your research externally funded?	YES	☐	NO	☐	
5	Are you in receipt of a KESS scholarship?	YES	☐	NO	☐	
6	Are you specifically employed to undertake this research in either a paid or voluntary capacity?	Voluntary	YES	☐	NO	☐
7		Employed	YES	☐	NO	☐
8	Is the research being undertaken within an existing UWTSD Athrofa Professional Learning Partnership (APLP)?	If YES then the permission question below does not need to be answered.	YES	☐	NO	☐
9	Has permission to undertake the research has been provided by the partner organisation?	(If YES attach copy) If NO the application cannot continue	YES	☐	NO	☐

Where research activity is carried out in collaboration with an external organisation

10	Does this organisation have its own ethics approval system?	YES	☐	NO	☐
If Yes, please attach a copy of any final approval (or interim approval) from the organisation (this may be a copy of an email if appropriate).					

SECTION E: Details of Research Activity

1	Indicative title:	Assessing fuelling and recovery strategies of professional academy rugby players around a match day			
2	Proposed start date:	September 21 st 2025	Proposed end date:	April 1 st 2026	
Introduction to the Research (maximum 300 words per section) Ensure that you write for a <u>Non-Specialist Audience</u> when outlining your response to the points below: <i>Purpose of Research Activity</i> <i>Proposed Research Question</i> <i>Aims of Research Activity</i> <i>Objectives of Research Activity</i> Demonstrate, briefly, how <u>Existing Research</u> has informed the proposed activity and explain <i>What the research activity will add to the body of knowledge</i>					

	<i>How it addresses an area of importance.</i>
3	Purpose of Research Activity This study aims to provide insight into a Welsh professional rugby academy's players knowledge and habits towards fuelling and recovery for athletic performance. By gathering this data, the study will highlight any potential gaps in players knowledge if intakes go against current research. By gathering this data, it will highlight if any interventions need to be put into place to better the knowledge of academy players on the subject. (this box should expand as you type)
4	Assessing fuelling and recovery strategies of professional academy rugby players around a match day
5	Aims of Research Activity • To explore fuelling strategies used by the academy players the day before a game. • To explore fuelling strategies used by the academy players the day of the game • To investigate the recovery strategies used after the game (this box should expand as you type)
6	Objectives of Research Activity • Discovering if fuelling and recovery strategies align with current research, which will include timings of meals, amount of each macronutrient, hydration and recovery methods • To identify any potential barriers player's face while trying to optimise fuelling ready for a match • To provide recommendations for improving the nutritional strategies undertaken by the players around a match day (this box should expand as you type)
	Proposed methods (maximum 600 words) Provide a brief summary of all the methods that may be used in the research activity, making it clear what specific techniques may be used. If methods other than those listed in this section are deemed appropriate later, additional ethical approval for those methods will be needed. You do not need to justify the methods here, but should instead describe how you intend to collect the data necessary for you to complete your project.
7	Research methods will include questionnaires which will be uploaded to the academy's online learning database. These questionnaires will cover 3 days, the day before a match, matchday and the day after a match to gather a holistic image of each player's nutritional habits within season. As the players are all from the same professional academy, the data will aim to highlight any obvious differences and similarities to the players' habits. The questionnaires will allow for a quantitative

	method of data analysis allowing the study to compare findings to known research around the topic. Alongside questionnaires the study will implement food diaries as another data collection method. From the data gathered by these food diaries, a comparison can be made to previous research done on adequate fuelling intakes. (this box should expand as you type)
	Location of research activity Identify all locations where research activity will take place.
8	Parc Y Scarlets (this box should expand as you type)
	Research activity outside of the UK If research activity will take place overseas, you are responsible for ensuring that local ethical considerations are complied with and that the relevant permissions are sought. Specify any local guidelines (e.g. from local professional associations/learned societies/universities) that exist and whether these involve any ethical stipulations beyond those usual in the UK (provide details of any licenses or permissions required). Also specify whether there are any specific ethical issues raised by the local context in which the research activity is taking place, for example, particular cultural and/or legal sensitivities or vulnerabilities of participants. If you live in the country where you will do the research then please state this.
9	(this box should expand as you type)

10	Use of documentation not in the public domain: Are any documents NOT publicly available?	NO	☒
		YES	☐
11	If Yes, please provide details here of how you will gain access to specific documentation that is not in the public domain and that this is in accordance with the current data protection law of the country in question and that of England and Wales. (this box should expand as you type)		

	Does your research relate to one or more of the seven aims of the Well-being of Future Generations (Wales) Act 2015?	YES	NO
12	A prosperous Wales	☐	☒
13	A resilient Wales	☐	☒
14	A healthier Wales	☐	☒
15	A more equal Wales	☐	☒
16	A Wales of cohesive communities	☐	☒
17	A Wales of vibrant culture and thriving Welsh language	☐	☒
18	A globally responsible Wales	☐	☒

19	If YES to any of the above, please give details:
	(this box should expand as you type)

SECTION F: Scope of Research Activity

	Will the research activity include:	YES	NO
1	Use of a questionnaire or similar research instrument?	☒	☐
2	Use of interviews?	☐	☒
3	Use of focus groups?	☐	☒
4	Use of participant diaries?	☒	☐
5	Use of video or audio recording?	☐	☒
6	Use of computer-generated log files?	☒	☐
7	Participant observation with their knowledge?	☐	☒
8	Participant observation without their knowledge?	☐	☒
9	Access to personal or confidential information without the participants' specific consent?	☐	☒
10	Administration of any questions, test stimuli, presentation that may be experienced as physically, mentally or emotionally harmful / offensive?	☐	☒
11	Performance of any acts which may cause embarrassment or affect self-esteem?	☐	☒
12	Investigation of participants involved in illegal activities?	☐	☒
13	Use of procedures that involve deception?	☐	☒
14	Administration of any substance, agent or placebo?	☐	☒
15	Working with live vertebrate animals?	☐	☒
16	Procedures that may have a negative impact on the environment?	☐	☒
17	Other primary data collection methods. Please indicate the type of data collection method(s) below.		
	Details of any other primary data collection method:	☐	☐
	(this box should expand as you type)		

If NO to every question, then the research activity is (ethically) low risk and **may** be exempt from **some** of the following sections (please refer to Guidance Notes).

If YES to any question, then no research activity should be undertaken until full ethical approval has been obtained.

SECTION G: Intended Participants

If there are no participants then do not complete this section, but go directly to section H.

Who are the intended participants:		YES	NO
1	Students or staff at the University?	☐	☒
2	Adults (over the age of 18 and competent to give consent)?	☒	☐
3	Vulnerable adults?	☐	☒
4	Children and Young People under the age of 18? (Consent from Parent, Carer or Guardian will be required)	☐	☒
5	Prisoners?	☐	☒
6	Young offenders?	☐	☒
7	Those who could be considered to have a particularly dependent relationship with the investigator or a gatekeeper?	☐	☒
8	People engaged in illegal activities?	☐	☒
9	Others. Please indicate the participants below, and specifically any group who may be unable to give consent.	☐	☐
	Details of any other participant groups: (this box should expand as you type)		

Participant numbers and source Provide an estimate of the expected number of participants. How will you identify participants and how will they be recruited?		
10	How many participants are expected?	25-30 (this box should expand as you type)
11	Who will the participants be?	Scarlets Senior Academy Players (this box should expand as you type)
12	How will you identify the participants?	Participants will be coded (this box should expand as you type)

Information for participants:		YES	NO	N/A
13	Will you describe the main research procedures to participants in advance, so that they are informed about what to expect?	☒	☐	☐
14	Will you tell participants that their participation is voluntary?	☒	☐	☐
15	Will you obtain written consent for participation?	☒	☐	☐

16	Will you explain to participants that refusal to participate in the research will not affect their treatment or education (if relevant)?	☐	☐	☒
17	If the research is observational, will you ask participants for their consent to being observed?	☐	☐	☒
18	Will you tell participants that they may withdraw from the research at any time and for any reason?	☒	☐	☐
19	With questionnaires, will you give participants the option of omitting questions they do not want to answer?	☒	☐	☐
20	Will you tell participants that their data will be treated with full confidentiality and that, if published, it will not be identifiable as theirs?	☒	☐	☐
21	Will you debrief participants at the end of their participation, in a way appropriate to the type of research undertaken?	☐	☐	☒
22	If NO to any of above questions, please give an explanation			
	<i>(this box should expand as you type)</i>			

	Information for participants:	YES	NO	N/A
24	Will participants be paid?	☐	☒	☐
25	Is specialist electrical or other equipment to be used with participants?	☐	☒	☐
26	Are there any financial or other interests to the investigator or University arising from this study?	☐	☒	☐
27	Will the research activity involve deliberately misleading participants in any way, or the partial or full concealment of the specific study aims?	☐	☒	☐
28	If YES to any question, please provide full details			
	<i>(this box should expand as you type)</i>			

SECTION H: Anticipated Risks

	Outline any anticipated risks that may adversely affect any of the participants, the researchers and/or the University, and the steps that will be taken to address them. If you have completed a full risk assessment (for example as required by a laboratory, or external research collaborator) you may append that to this form.		
1	Full risk assessment completed and appended?	Yes	☒
		No	☐
2	Risks to participants For example: sector-specific health & safety, emotional distress, financial disclosure, physical harm, transfer of personal data, sensitive organisational information		
	Risk to participants: Some questions may be triggering to some individuals as they may feel pressured to answer. <i>(this box should expand as you type)</i>	How you will mitigate the risk to participants: All questions will be checked and structured in a way that will be appropriate. Local mental health services will be identified before data collection starts. <i>(this box should expand as you type)</i>	
3	If research activity may include sensitive, embarrassing or upsetting topics (e.g. sexual activity, drug use) or issues likely to disclose information requiring further action (e.g. criminal activity), give details of the procedures to deal with these issues, including any support/advice (e.g. helpline numbers) to be offered to participants. Note that where applicable, consent procedures should make it clear that if something potentially or actually illegal is discovered in the course of a project, it may need to be disclosed to the proper authorities		
	<i>(this box should expand as you type)</i>		
4	Risks to the investigator For example: personal health & safety, physical harm, emotional distress, risk of accusation of harm/impropriety, conflict of interest		
	Risk to the investigator: If questions aren't structured properly, this may cause risk to the investigator if participants are unsettled. <i>(this box should expand as you type)</i>	How you will mitigate the risk to the investigator: All questions will be checked and structured in a way that will be appropriate. <i>(this box should expand as you type)</i>	
5	University/institutional risks		

	For example: adverse publicity, financial loss, data protection	
	Risk to the University: Data breaches could occur. <i>(this box should expand as you type)</i>	How you will mitigate the risk to the University: All data will be saved safely onto the university one drive and stored on a password protected laptop. <i>(this box should expand as you type)</i>
6	Environmental risks For example: accidental spillage of pollutants, damage to local ecosystems	
	With paper-based questionnaires there may be an excessive amount of paper used. <i>(this box should expand as you type)</i>	How you will mitigate the risk to environment: Paper consumption will be kept to a minimum. <i>(this box should expand as you type)</i>

	Disclosure and Barring Service			
	If the research activity involves children or vulnerable adults, a Disclosure and Barring Service (DBS) certificate must be obtained before any contact with such participants.	YES	NO	N/A
7	Does your research require you to hold a current DBS Certificate?	☐	☒	☐
8	If YES, please give the certificate number. If the certificate number is not available please write "Pending"; in this case any ethical approval will be subject to providing the appropriate certificate number.			

SECTION I: Feedback, Consent and Confidentiality

1	Feedback What de-briefing and feedback will be provided to participants, how will this be done and when?
	An email address will be provided for all participants to contact for further details or results. <i>(this box should expand as you type)</i>
2	Informed consent Describe the arrangements to inform potential participants, before providing consent, of what is involved in participating. Describe the arrangements for participants to provide full consent before data collection begins. If gaining consent in this way is inappropriate, explain how consent will be obtained and recorded in accordance with prevailing data protection legislation.
	On the first page of the questionnaire participants will see a statement stating 'by filling out this questionnaire I give consent to participating in this study'. <i>(this box should expand as you type)</i>
3	Confidentiality / Anonymity Set out how anonymity of participants and confidentiality will be ensured in any outputs. If anonymity is not being offered, explain why this is the case.
	No names will be collected in the questionnaire to provide anonymity.

	(this box should expand as you type)
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SECTION J: Data Protection and Storage

	Does the research activity involve personal data (as defined by the General Data Protection Regulation 2016 “GDPR” and the Data Protection Act 2018 “DPA”)?	YES	NO
1	“Personal data” means any information relating to an identified or identifiable natural person (‘data subject’). An identifiable natural person is one who can be identified, directly or indirectly, in particular by reference to an identifier such as a name, an identification number, location data, an online identifier or to one or more factors specific to the physical, physiological, genetic, mental, economic, cultural or social identity of that natural person. Any video or audio recordings of participants is considered to be personal data.	☐	☐
	If YES, provide a description of the data and explain why this data needs to be collected:		
2	(this box should expand as you type)		
	Does it involve special category data (as defined by the GDPR)?	YES	NO
3	“Special category data” means sensitive personal data consisting of information as to the data subjects’ – (a) racial or ethnic origin, (b) political opinions, (c) religious beliefs or other beliefs of a similar nature, (d) membership of a trade union (within the meaning of the Trade Union and Labour Relations (Consolidation) Act 1992), (e) physical or mental health or condition, (f) sexual life, (g) genetics, (h) biometric data (as used for ID purposes),	☐	☐
	If YES, provide a description of the special category data and explain why this data needs to be collected:		
4	(this box should expand as you type)		

	Will data from the research activity (collected data, drafts of the thesis, or materials for publication) be stored in any of the following ways?	YES	NO
5	Manual files (i.e. in paper form)?	☒	☐
6	University computers?	☒	☐
7	Private company computers?	☐	☒
8	Home or other personal computers?	☒	☐
9	Laptop computers/ CDs/ Portable disk-drives/ memory sticks?	☒	☐
10	"Cloud" storage or websites?	☒	☐
11	Other – specify:	☐	☒
12	For all stored data, explain the measures in place to ensure the security of the data collected, data confidentiality, including details of backup procedures, password protection, encryption, anonymisation and pseudonymisation:		
	All data will be kept in password protected cloud storage on the University Office 365 system which will not be shared. All USB sticks will be password protected. Coding will be used for all participants to allow for anonymity. <i>(this box should expand as you type)</i>		

Data Protection			
	Will the research activity involve any of the following activities:	YES	NO
13	Electronic transfer of data in any form?	☒	☐
14	Sharing of data with others at the University outside of the immediate research team?	☐	☒
15	Sharing of data with other organisations?	☐	☒
16	Export of data outside the UK or importing of data from outside the UK?	☐	☒
17	Use of personal addresses, postcodes, faxes, emails or telephone numbers?	☐	☒
18	Publication of data that might allow identification of individuals?	☐	☒
19	Use of data management system?	☐	☒
20	Data archiving?	☐	☒
21	If YES to any question, please provide full details, explaining how this will be conducted in accordance with the GDPR and Data Protection Act (2018) (and any international equivalents, where appropriate):		
	All data will be kept in password protected cloud storage on the University Office 365 system which will not be shared. All USB sticks will be password protected. Coding will be used for all participants to allow for anonymity. Data will be stored until the completion of the project and then deleted. <i>(this box should expand as you type)</i>		
22	List all who will have access to the data generated by the research activity:		
	The principal researcher (William David Icke) Supervisor (Dr Chris Cashin) and external examiners. <i>(this box should expand as you type)</i>		
23	List who will have control of, and act as custodian(s) for, data generated by the research activity:		
	The principal researcher (William David Icke) <i>(this box should expand as you type)</i>		
24	Give details of data storage arrangements, including security measures in place to protect the data, where data will be stored, how long for, and in what form. Will data be archived – if so how and if not why not.		
	All data will be encrypted and kept in a password protected cloud storage on the University Office 365/Sharepoint system which will be reformatted at the end of the project to destroy the data. The data will be stored until completion of the project and then deleted. <i>(this box should expand as you type)</i>		
25	Please indicate if your data will be stored in the UWTSD Research Data Repository (see https://researchdata.uwtسد.ac.uk/). If so please explain. <i>(Most relevant to academic staff)</i>		
	<i>(this box should expand as you type)</i>		
26	Confirm that you have read the UWTSD guidance on data management (see https://www.uwtسد.ac.uk/library/research-data-management/)	YES	☒

27	Confirm that you are aware that you need to keep all data until after your research has completed or the end of your funding	YES	☒
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SECTION K: Declaration

	The information which I have provided is correct and complete to the best of my knowledge. I have attempted to identify any risks and issues related to the research activity and acknowledge my obligations and the rights of the participants. In submitting this application I hereby confirm that I undertake to ensure that the above named research activity will meet the University's Research Ethics and Integrity Code of Practice which is published on the website: https://www.uwtsd.ac.uk/research/research-ethics/		
1	Signature of applicant:	Will Icke	Date: 26/08/2025

For STUDENT Submissions:

2	Director of Studies/Supervisor:		Date:
3	Signature:		

For STAFF Submissions:

4	Academic Director/ Assistant Dean:		Date:
5	Signature:		

Checklist: Please complete the checklist below to ensure that you have completed the form according to the guidelines and attached any required documentation:

☒	I have read the guidance notes supplied before completing the form.
☒	I have completed ALL RELEVANT sections of the form in full.
☒	I confirm that the research activity has received approval in principle
☐	I have attached a copy of final/interim approval from external organisation (where appropriate)
☐	I have attached a full risk assessment (where appropriate) ONLY TICK IF YOU HAVE ATTACHED A FULL RISK ASSESSMENT
☒	I understand that it is my responsibility to ensure that the above named research activity will meet the University's Research Ethics and Integrity Code of Practice.
☒	I understand that before commencing data collection all documents aimed at respondents (including information sheets, consent forms, questionnaires, interview schedules etc.) must be confirmed by the DoS/Supervisor, module tutor or Academic Director.

RESEARCH STUDENTS ONLY

Once complete, submit this form via the **MyTSD Doctoral College Portal** at (<https://mytsd.uwtsd.ac.uk>).

RESEARCH STAFF ONLY

All communications relating to this application during its processing must be in writing and emailed to pgresearch@uwtsd.ac.uk , with the title 'Ethical Approval' followed by your name.

STUDENTS ON UNDERGRADUATE OR TAUGHT MASTERS PROGRAMMES should submit this form (and receive the outcome) via systems explained to you by the supervisor/module leader.

Appendix 2- Recorded use of AI

AI software used	Used for
Chatgpt	Structure, Submission timeline, Paraphrasing
Gemini	Structure, Paraphrasing

Appendix 3- Literature review mind map



Appendix 4- Submission Timeline



Appendix 5- Questionnaire and food diary

Nutrition habits questionnaire and food dairy

Please complete the following questionnaire honestly. Give as much detail as possible regarding types of foods eaten and explain what 'other' is, if/ when it applies.

- 1. Name?**
- 2. Age?**
- 3. Height**
- 4. Weight**
- 5. Playing Position?**

Matchday -1

- 6. What do you typically eat the day before a game (matchday -1)?**

Be as specific as possible (Pictures to be sent of each meal via WhatsApp to Will Icke)

- 7. What are your focuses nutritionally the day before a game? And how do you achieve this?**

Matchday

8. What do you typically eat and drink before a match? (afternoon kick off)

Timings for when these foods are consumed are needed. Be as specific as possible (Pictures to be sent of each meal via WhatsApp to Will Icke)

9. For an evening kick off do these meals change? If yes state what is eaten and when, if no state why.

10. What is consumed during a match or during half time?

- Banana(s) ☐
- Energy Gels ☐
- Sugary sweets ☐
- Sports drinks ☐
- Water ☐
- Juice/squash ☐
- ☐

- Jaffa cakes
- Nothing ☐
- Other (Write bellow) ☐

Next to the ticked box please give details of the quantity consumed during a match, and the brand name, for the foods and or drinks selected in the previous question (e.g. 2 x SIS energy gels and 4 x McVities Jaffa cakes)

11. Is there a specific amount of Carbohydrates you aim to consume before kick-off?

12. How do you gauge how much fluid to consume during a match?

- Drink to thirst (whenever I feel like I need to) ☐
- Whenever there is a stoppage in play ☐
- Dependent on what minute of play it is ☐
- A specific amount each half ☐

13. Do you specifically target a certain amount of fluid during a match?

- Yes ☐
- No ☐

14. If yes, please specify quantity below. If no, please leave this question blank

- 500ml ☐
- 500ml- 1 L ☐
- 1-2L ☐
- Other ☐

Post match

15. What do you typically eat or drink immediately post-match for recovery (within 0-60 minutes)? *Be as specific as possible (Pictures to be sent of each meal via WhatsApp to Will Icke)*

16. What do you typically eat or drink within three hours' post-match for recovery? *Be as specific as possible (Pictures to be sent of each meal via WhatsApp to Will Icke)*

17. What do you typically eat or drink before bed post-match for recovery? (i.e., the same night as the match) *Be as specific as possible (Pictures to be sent of each meal via WhatsApp to Will Icke)*

Recovery/ Matchday +1

18. Are there any specific recovery strategies you implement? Nutritional or otherwise?

- Ice baths ☐
- Hot baths ☐
- Compression clothing ☐
- Foam Rolling ☐
- Protein shakes ☐
- Other ☐
- None ☐

Please tick the predominant reason for using the recovery strategies (if applicable).

	Scientific Literature	Peers, Coaches, Teammates	Saves Money	Easily Available	Saves Time	Personal Preference
Ice baths						
Hot baths						
Compression clothing						
Foam Rolling						
Protein shakes						
Other						

19. Are there any macronutrient targets Matchday+1, or meals/ specific food you look to consume?

END

Thank you for taking the time to complete this questionnaire, please return a paper copy to Will Icke or email a completed digital copy

Appendix 6- Excel dataset

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1	Code name	Age	Weight	Height	Playing Position	M-1 Carbs	M-1 CHO g/kg	Amount Off I	Sugar	Protein	M-1 Pro g/kg	Amount Off I	Fat	Amount Off by f	Sat Fat
2	P1	19	130	180	Prop	407	3.1	120	51	272	2.1 over by 83g	128	0	47.7	
3	P2	18	106	185	Backrow	468	4.4	2	142	190	1.8 over 40	136	over 30	59.6	
4	P3	19	115	177	Prop	421	3.7	65	23	233	2 over 60	81	0	24.3	
5	P4	19	107	182	Backrow	416	3.9	54	39	193	1.8 over 42	102	10	36	
6	P5	20	93.5	177	Backrow	289	3.1	160	16.5	162	1.7 over 29	95	0	27	
7	P6	19	100	177	Hooker	327	3.3	130	9.2	182	1.8 Over 40	74	40	21	
8	P7	19	119	177	Prop	482	4.1	50	123	194	1.6	0	88	0	26
9	P8	18	114	195	Second Row	455	4	80	116	193	1.7	0	126	Over 10	39
10	P9	19	125	197	Second Row	363	2.9	190	45	255	2 Over70	90	37	26	
11	P10	19	108	190	Second Row	522	4.8	0	213	179	1.7	0	107	0	38
12	P11	21	98	182	Centre	283	2.9	200	85	180	1.8 over 40	108	0	40.8	
13	P12	20	88	175	Wing	388	4.4	60	36	184	2.1 Over 58	91	0	33.3	
14	P13	19	90	177	Wing	380	4.2	73	34.4	158	1.8 Over 20	73.9	30	73.9	
15	P14	19	93	190	Fly half	198	2.1	276	21	139	1.5	0	97	0	31
16	P15	18	90	177	Centre	239	2.7	210	58	173	1.9 Over 40	127	Over 30	37	
17	P16	19	76.1	172	Wing	374	4.9	40	42	173	2.3 Over 60	76	10	22.9	
18	Forwards	18.9	111.75	183.7		415	3.73	85.1	77.77	205.3	1.82	102.7	10.875	34.46	
19	Backs	19.3	89.2	178.8		310.3	3.5	143.2	46.1	167.8	1.9	95.5	8.0	39.8	
20	Both	19.1	103.3	181.9		375.8	3.7	106.9	65.9	191.3	1.9	100.0	9.8	36.5	
21	SD F	0.6	11.1	7.8		72.1	0.6	63.8	67.2	35.7	0.2	21.2	17.4	12.1	
22	SD B	1.03	7.30	6.37		81.72	1.11	97.80	22.54	16.68	0.28	20.09	13.04	17.76	
23	SD Both	0.77190241	14.817866	7.4554231	#DIV/0!	89.906247	0.8107353	80.454438	55.963574	34.751499	0.2065591	0	20.42092	15.3522737	14.167038
24															
25															

	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF
1	Kcal	Amount Off I	Iron mg	Calcium mg	Vit Dug	M Carbs	M CHO g/kg	Amount Off I	Pre Match C	Pre Match C	Post Match C	Post match C	Sugar	Protein	M- Protein G	Amount Off I	Fat
2	3865	90	15	693	9.1	336	2.5	191 (2.6)	154	1.1	139	1	86.4	90	0.7	99	115
3	3855	over by 400	10.9	765	10.2	390	3.7	80	231	2.1	159	1.5	92	210	2	Over 60	64
4	3348	255	20.1	553	5.6	404	3.5	80	271	2.3	133	1.1	81	286	2.5	Over 120	64
5	3354	88	16.5	658	6.8	354	3.3	114	255	2.3	99	0.9	115	138	1.3	0	20
6	2664	650	14.2	455	27.7	324	3.5	124	195	2.1	129	1.3	106.1	135	1.4	0	60
7	2706	770	13.4	698	11.5	455	4.6	10	260	2.6	195	1.9	142	143	1.4	0	110
8	3498	380	24.4	1472	9.4	547	4.6	Over 10	272	2.3	276	2.3	221	180	1.5	0	106
9	3722	150	20.2	756	2.6	510	4.5	20	328	2.9	181	1.5	127	267	2.3	Over 100	122
10	3282	900	23.6	667	20	446	3.6	130	295	2.4	150	1.2	157	202	1.6	0	125
11	3757	0	21.6	797	2.1	482	4.5	30	323	3	158	1.4	257	183	1.6	0	80
12	2822	654	15.5	1494	10.3	412	4.2	68	298	3	115	1.1	141	192	1.9	Over 50	102
13	3112	40	35.7	754	15.6	387	4.4	58	265	3	122	3	130	210	2.4	Over 90	72
14	2821	400	23.1	807	11.2	443	4.9	10	272	3	172	1.9	100	159	1.8	Over 20	89
15	2226	1100	16.4	409	13.2	325	3.5	150	200	2.1	125	1.3	87	277	3	Over 140	107
16	2793	420	17.6	1125	8.6	277	3.1	168	160	1.7	90	1	45.5	199	2.2	Over 68	77
17	2875	10	14.7	1085	1.9	357	4.7	60	160	2.1	196	2.6	84	153	2	Over 40	56
18	3405.1	364.77778	17.99	751.4	10.5	424.8	3.83	73.5	258.4	2.31	161.9	1.41	138.45	183.4	1.63		86.6
19	2774.8	437.3	20.5	945.7	10.1	366.8	4.1	85.7	225.8	2.5	136.7	1.8	97.9	198.3	2.2		83.8
20	3168.8	393.8	18.9	824.3	10.4	403.1	3.9	78.7	246.2	2.4	152.4	1.6	123.3	189.0	1.9		85.6
21	435.4	330.8	4.6	273.0	7.9	75.7	0.7	48.2	54.1	0.5	48.4	0.4	58.8	60.9	0.5		34.4
22	293.13	407.00	8.02	373.15	4.70	60.27	0.70	60.63	60.35	0.58	39.41	0.83	34.50	44.65	0.44		19.26
23	491.59991	350.79587	5.9837245	317.13478	6.6938654	74.068859	0.6937519	51.991758	56.903683	0.5347897	45.60551	0.617387	53.685144	54.24881	0.5597619	37.418483	28.925119

	AG	AH	AI	AJ	AK	AL	AM	AN	AO	AP
1	Amount Off I	Sat Fat	Kcal	Amount Off I	Iron	Calcium	Vit D	What is consumed during	How much fluid	M-1 Recovery strats
2	0	33.3	2735	1215	10.9	732	6	Energy Gels, Sugary Sweets, Water	Whenever there is a stoppage in play	Ice baths, Compression clothing, Prote
3	40	33.4	2985	450	7.6	893	1.4	Bananas, Energy Gels, Sugary Sweets, Water	Drink to thirst, Whenever there is a stoppage in pla	Ice baths, Foam rolling, Protein shakes
4	50	21	3336	260	21.6	1032	10.1	Water	Drink to thirst	Protein shakes, Other
5	75	11.8	2243	1203	9.9	1543	5.6	Energy gels, Water	Drink to thirst	Ice baths, Hot Baths, Shakes
6	50	23	2375	910	15.1	909	1.4	Bananas, Water, Jaffa Cakes	Whenever there is a stoppage in play	None
7	0	33	3384	90	23.1	1558	6.6	Energy Gels, Sugary Sweets, Water	Drink to thirst	Compression clothing, Foam rolling, P
8	0	44	3861	0	18.5	2410	1.4	Energy Gels, Sports drinks	Whenever there is a stoppage in play	Ice baths, Compression clothing, Prote
9	0	35	4200	over320	19.2	1159	29.9	Energy Gels, Sugary Sweets, Water, sports d	Whenever there is a stoppage in play	Ice baths, Hot baths, Compression clo
10	0	31.9	3715	400	21.1	716	13	Energy Gels, Sugary Sweets, Water, sports d	Whenever there is a stoppage in play	Protein shakes, Foam Rolling
11	30	31	3376	340	17.6	1638	1.7	Energy Gels, Sugary Sweets, Water, sports d	Whenever there is a stoppage in play	Hot baths, Walking
12	0	35	3341	90	12.7	1122	2.7	Energy gels, Water	Drink to thirst	protein shakes
13	10	17.5	3033	129	32.8	813	12.2	Water	Whenever there is a stoppage in play	None
14	Over 5	30.9	3208	11	30.4	548	11.9	Energy gels, sports drinks, water	Whenever there is a stoppage in play	protein shakes
15	over 3	41	3365	0	25	655	12.8	Bananas, Energy Gels, water, jaffa cakes	Drink to thirst, Whenever there is a stoppage in pla	None
16	0	28	2600	622	16.3	759	9.3	Sugary sweets, water	Drink to thirst	Compression clothing, Foam rolling, P
17	32	17	2550	340	12.4	815	7	Energy gels, Sugary Sweets, water	Whenever there is a stoppage in play	Ice baths, Hot baths, Protein shakes
18	24.5	29.74	3221	540.9	16.46	1259	7.71			
19	10.5	28.2	3016.2	198.7	21.6	785.3	9.3			
20	20.5	29.2	3144.2	404.0	18.4	1081.4	8.3			
21	28.1	8.9	636.0	457.2	5.4	530.1	8.8			
22	15.09	9.56	361.88	241.05	9.02	194.42	3.91			
23	25.367302	8.8824546	544.80066	412.69498	7.1402964	487.1283	7.1935967			