4.2 Match Day Nutrition

Introduction

The team performance on "match day" is the focus for all players and staff. The primary objective on match day is to achieve a win over the opposing team. The success of the team depends on the mutual co-operation of individual players to score more goals than the opposition. On match day, there are many factors that may impact the "performance" of the individual player. However, out of all these factors, nutrition remains one variable over which the players may have direct control, and which can be easily influenced.

From the perspective of the football nutritionist, planning a nutritional strategy for match day begins by first knowing the time and location of the match (Williams & Serratosa 2006).

Thereafter, the nutritionist may determine the time available for meals and recommend their composition considering the culinary preferences of the players. Second, the nutritionist may implement acute strategies before and during the match with the objective of optimizing individual performances. Finally, after the match the objective is to speed the recovery (maximize adaptation) following exercise (Williams & Serratosa 2006).
The objective of this unit is to provide an overview of those studies that inform the nutrition practice of the player before, during and after the match, as well as to cover some of the practical issues in implementing these strategies.

DID YOU KNOW

Many factors may influence a player's performance during a match which they cannot control, including, but are not limited to, skill level of opponent, fitness of the opponent, tactics, formation, environmental conditions and official/refereeing decisions.

BEFORE THE MATCH

To develop a successful nutritional strategy for players on match day, it is important to recognize that in many football clubs the pre-match meal is largely dictated by tradition and routine. For many players, a departure from their favourite pre-match meal is regarded as much a disadvantage as beginning a match with a physical injury (Williams & Serratosa 2006).

A mistake would be for a sports nutritionist "new" to a team to enforce sweeping changes following their appointment. It is recommended to have

patience and dedicate time to observing and "understanding" the current nutrition "regime" of the team. To this end, the recommended nutritional strategy should be developed in the context of what is custom practice within a football club but also supported by sound scientific evidence. The standard recommendation is that players should eat an easy-to-digest high-carbohydrate meal no later than about 3 hours before a match. This recommendation has not changed since the publication of the Consensus Statement on Nutrition and Soccer over two decades ago (Ekblom & Williams 1994).

The commonly practiced recommendation to eat an easy-to digest high-carbohydrate meal about 3 hours before exercise does not usually include details of the type of carbohydrate. Nevertheless, it is assumed that they are high glycaemic index (HGI) carbohydrates that are digested and absorbed more quickly than low-glycaemic (LGI) index carbohydrates.

Eating an HGI carbohydrate meal, that provided 2.5 g/kg body mass (BM), 3 h before exercise, increases muscle glycogen levels by about 11–15% (Wee et al., 2005). This relatively modest increase in muscle glycogen is a consequence of the early removal of systemic glucose by the liver and allowing 3 h may be insufficient for the complete digestion and absorption of the carbohydrate meal. In contrast, when an energy-matched LGI carbohydrate meal was consumed, there was no measurable increase in muscle glycogen levels. It is reasonable to assume that the slower digestion and absorption of the high-fibre carbohydrate meal results in a delayed delivery of glucose to the systemic circulation and hence skeletal muscles (Williams & Rollo 2015).

Consuming an LGI carbohydrate pre-exercise meal results in a smaller rise in plasma insulin level than is the case following HGI carbohydrate meals. As a consequence, the inhibition of fatty acid mobilisation is reduced, the rate of fat metabolism during subsequent exercise is increased, and so muscle glycogen is oxidised more slowly. This more economic use of the limited glycogen stores is an advantage during prolonged submaximal exercise; however, brief periods of sprinting rely on a high rate of glycogenolysis and phosphocreatine degradation. Therefore, as mentioned in previous modules, even a higher rate of fat metabolism, following an LGI carbohydrate meal, cannot provide ATP fast enough to support high-intensity (Williams & Rollo 2015).

Therefore, it is not surprising that the few studies that compared the impact of HGI and LGI carbohydrate pre-exercise meals on performance during intermittent brief high-intensity exercise failed to show any performance differences (Bennett et al., 2012; Williams & Rollo 2015).

Figure 3: Example of high and low glycaemic index meals.

Characteristics of the High and Low GI meals (for a 70kg subject)		
Meal	**Description**	**Macronutrient content**
High-GI breakfast	72 g Corn Flakes®, 300 ml skimmed milk, 93 g White bread, 12 g Flora spread, 23 g jam, 181 ml Lucozade Original®	852 kcal 162g carbohydrate 12g fat 23g protein **GI = 78***
Low-GI breakfast	100 g muesli (without raisins), 300 ml skimmed milk, 78 g Apple, 120g tinned peaches, 149g yogurt, 300ml Apple juice	855 Kcal 162g carbohydrate 11g fat 27g protein **GI = 44***
*Calculated by teh method of Wolever (1986). Glycaemic index values from Foster-Powell *et al. (2002).* Registered trade marks: Corn Flakes® (Kellogg's Ltd, Manchester, UK); Lucozade Original® (GlaxoSmithKline, Brentford, UK)		

Source: Foster-Powell et al., 2002

When considering objectives of the pre-match meal, it is important to make considerations beyond "topping up" muscle glycogen. The pre-match meal should also be formulated to optimize the "gut comfort" and feelings of satiety of the player. Overall, the objective is for the player to feel "ready" to play. For example, when considering the merits of HGI and LGI pre-exercise meals, it is important to remember that to achieve the same amount of carbohydrate and energy, the LGI meal will have a greater amount of food than in the HGI meal (Figure 1) (Williams & Rollo 2015). This is because LGI carbohydrates generally have higher fibre content and so more food has to be consumed to match the amount of carbohydrate in HGI foods. On the one hand, the higher fibre content of LGI carbohydrate foods may result in players feeling "fuller" earlier in comparison to ingesting HGI carbohydrate foods. Consequently, players may consume less carbohydrate than recommended when eating LGI foods which may be insufficient to increase their glycogen stores. On the other hand, feelings of "fullness" and satiety may improve the players' perception for "readiness" to play.

Most players will have their routine pre-match meal. It is difficult for the player to break with tradition as typically it is a meal that they have been ingesting during their "rise" in the profession. It is for this reason that changes to the pre-match meal and recommendations should be based individually and practiced in training first. Practicing the pre-match meal in training allows a "safe" environment, allows trial and error, which should ultimately lead to the player having confidence in their dietary choices. As

players will complete approximately 50+ games a season, that equates to 50+ pre-match meals. It is encouraged for the players to have options for pre-match meals to avoid monotony/flavour fatigue. Although, carbohydrate intake should be prioritized, meals should also include protein and there is no need for them to be devoid of nutrients.

DID YOU KNOW

The glycemic index ranks carbohydrate-based foods relative to how they affect the player's blood glucose concentrations. Low glycemic index carbohydrates are digested, absorbed and metabolized slowly, resulting in a lower and slower rise in blood glucose and insulin levels compared to high glycemic index carbohydrates. (Morton, 2014)the opponent, tactics, formation, environmental conditions and official/refereeing decisions.

Balsom and colleagues examined the influence of carbohydrate loading on the performances of six soccer players during a 90 minute four-a-side soccer match (Balsom et al., 1999; Williams & Rollo 2015). In this study, muscle glycogen levels were lowered 48 hours earlier when players completed a variable-speed shuttle running test. This protocol would be representative of playing a 90-minute match. Thereafter, the players changed the carbohydrate content of their diet to one with either 30 or 65% of daily energy intake. Following the high-carbohydrate diet, muscle glycogen level was 28% higher than after the low-carbohydrate diet. Importantly, the analysis of the movement patterns during the simulated four-a-side soccer match showed that after the high-carbohydrate diet, players performed 30% more high-intensity running in comparison to the low-carbohydrate pre-match diet. There was no difference between the performances of technical skills during the four-a-side matches following the two dietary preparations (Williams & Rollo 2015).

CAFFEINE

Supplementation in football will be covered in later courses. However, it is important to discuss the role of caffeine in pre-match nutrition due to its prevalence amongst players. Caffeine is found in a variety of drinks and foodstuffs (e.g., tea, coffee, cola, chocolate, etc.) and is perhaps the most widely studied and research-proven of all ergogenic aids. Indeed, caffeine has been consistently shown to improve both cognitive and physical performance across a range of endurance sports (Morton 2014). However, numerous data suggest that caffeine also improves the physical and technical elements of performance that are inherent to football match play. For example, caffeine can enhance repeated sprint and jump performance (Gant et al., 2010), reactive agility (Duvnjak-Zaknich et al., 2011) and passing accuracy (Foskett et al., 2009) during intermittent-type exercise protocols.

The ergogenic effects of caffeine are typically achieved with ingestion of 2-5 mg/kg BM (Burke et al., 2013). Given that plasma caffeine levels peak approximately 45-60 minutes after ingestion (Graham & Spriet 1995) it is recommended to consume caffeinated drinks, capsules or gels (depending on players' preferences) within the warm-up period prior to kick-off (Morton 2014).

DURING THE MATCH

During the match, the priority is to maintain player performance for the duration of game. We have learnt in previous modules how football-specific exercise depletes the body's limited store of glycogen (carbohydrate) and causes a loss of body water through sweating. To this end, the available evidence suggests that carbohydrate and fluid delivery should be prioritized during a football match to provide an exogenous source of energy for the body, and prevent significant hypohydration.

Studies have been conducted showing a close association with carbohydrate ingestion and player performance during "live" matches. For example, in a study by Kirkendall et al., (1988) the physical performances of 10 players were captured on video on two separate occasions, separated by one day. For each match, players drank either a carbohydrate solution or sweetened placebo before the game and the same volume at halftime. It was reported that the players who drank the carbohydrate solution ran approximately 40% greater distance during the second half of the game, in comparison to when the placebo beverage was consumed (Kirkendall 1998). Interestingly, a similar study in which players consumed 0.5 L of a 7% glucose solution 10 min before a practice match and the same volume again at halftime, reported a 39% reduction in muscle glycogen use compared to players drinking a sweetened placebo (Leatt & Jacobs 1989). An important consideration when interpreting "performance" data during football matches is the high variability observed between games. For example, different tactical formations and levels of competition will have a great influence on the distance a player covers at high speed and sprint distances achieved (Gregson et al., 2013). Thus, although an interesting measure, assessing the impact that nutrition strategies have on match "performance" is challenging due to the complex interaction between physical and technical components. To this end, controlled experimental trials have offered excellent insights into the impact that carbohydrate ingestion during exercise has on multiple sprint performances and repeated skill execution (Rollo 2014).

Using a test specially designed to mimic the physical demands of football (Loughborough Intermittent Shuttle Run Test: LIST), Nicholas, Williams, Lakomy, Phillips, & Nowitz (1995) performed a series of studies to investigate the effect that drinking a carbohydrate-electrolyte solution has on performance (Nicholas et al., 1995; Nicholas et al., 2000). In the first

study, players drank a 6.9% carbohydrate-electrolyte solution or sweetened placebo immediately before (5 ml/kg BM) exercise and during the 3-min breaks (2 ml/kg BM) between each 15-min block of exercise. This regime provided carbohydrate at a rate of approximately 1 g/min or 60 g/h. Repeated sprint performance was no different between trials. However, similar to observations from field studies, players were able to sustain high-intensity running for 2 min 10 s (33%) longer during the second part of the test when drinking the carbohydrate- electrolyte solution compared to the placebo (Nicholas et al., 1995). In a follow-up study, players repeated six 15-min blocks of intermittent running up to 90 min, drinking the same volume and concentration (6.9%) of carbohydrate-electrolyte solution or sweetened placebo. In this study, muscle biopsy analysis revealed a significant reduction in muscle glycogen concentrations in both type 1 and type 2 muscle fibre types. However, muscle glycogen use was reduced by 22% when players ingested the carbohydrate solution throughout exercise in comparison to placebo (Nicholas et al., 1994). Thus, the preservation of muscle glycogen offers a viable mechanism to explain why players are able to offset fatigue and sustain high-intensity running in the second half of football matches (Rollo 2014).

It is important to note the vital role of skill execution in football performance. Using a modified version of the LIST, McGregor, Nicholas, Lakomy, & Williams (1999) reported fluid ingestion during exercise had a significant benefit to the maintenance of soccer-specific skill (dribble track test) compared to no fluid intake (McGregor et al., 1999). However, of relevance to this review, the ingestion of carbohydrate in addition to fluid has been reported to be superior to maintaining skill in comparison to the ingestion of fluid alone. Specifically, Ali and Williams (2009) developed a soccer passing and shooting performance test, which was performed before and immediately after the LIST (90 min). In this study, 16 male soccer players ingested either a 6.4% carbohydrate-electrolyte solution or placebo solution, 5 ml/kg BM before and 2 ml/kg BM every 15 min during exercise (~60 g of carbohydrate per hour). Passing performance was well maintained in both trials. However, a reduction in the deterioration of shooting performance was associated with carbohydrate ingestion (Ali & Williams 2009). At a similar time Currell and colleagues also developed a football test protocol, which allowed the assessment of football specific skill performance (Currell et al., 2009). Importantly, the execution of football skills was reported to show little day-to-day variation, with CVs of 1.2%, 2.2% and 2.8% for agility, dribbling and kicking accuracy, respectively. In this study, the ingestion of a 7.5% maltodextrin solution, 30 min before (6 ml/kg BM), at half-time (4 ml/kg BM) and routinely throughout exercise (1 ml/kg BM/12 min) was associated with a significant reduction in the deterioration of skill performance over 90 min of exercise, in comparison to the ingestion of a placebo solution (Figure 3). The ability to sustain skill execution during a football match has clear performance implications. For example, in Italy, teams with the smallest decrease in skill performance

over a match were found to finish the season in a higher league position (Rampinini et al., 2009).

Interestingly, carbohydrate ingestion has been reported to improve both sprint (15 m) and skill performance during the early stages (0-45 min) of simulated football protocols (Ali & Williams, 2009; Currell et al., 2009). When adequate recovery time is allowed for phosphocreatine replenishment, and sufficient glycogen remains in the muscle, a clear metabolic benefit of carbohydrate ingestion to support football performance is not immediately apparent. However, there is accumulating evidence that carbohydrate ingestion may have a "non-metabolic" central effect. Studies in running have reported a benefit on endurance performance by simply mouth rinsing and expectorating a carbohydrate solution (Rollo et al., 2011). The ergogenic effect may be mediated via the activation of brain pathways associated with reward and motivation, in response to carbohydrate recognition in the mouth (Rollo & Williams).

For example, the serial mouth-rinsing of a concentrated carbohydrate solution (10%), without ingestion, has been reported to be 86% likely of improving repeated 15-m sprint performance between 75 and 90 min of intermittent running in comparison with a taste-matched placebo (Rollo et al., 2015). However, not all studies have reported this (Dorling & Earnest 2013). Nevertheless, carbohydrate ingestion has also been reported to preserve the function of the central nervous system during prolonged exercise, which may have important implications for the successful execution of skills and decision making in football (Russell & Kingsley 2014).

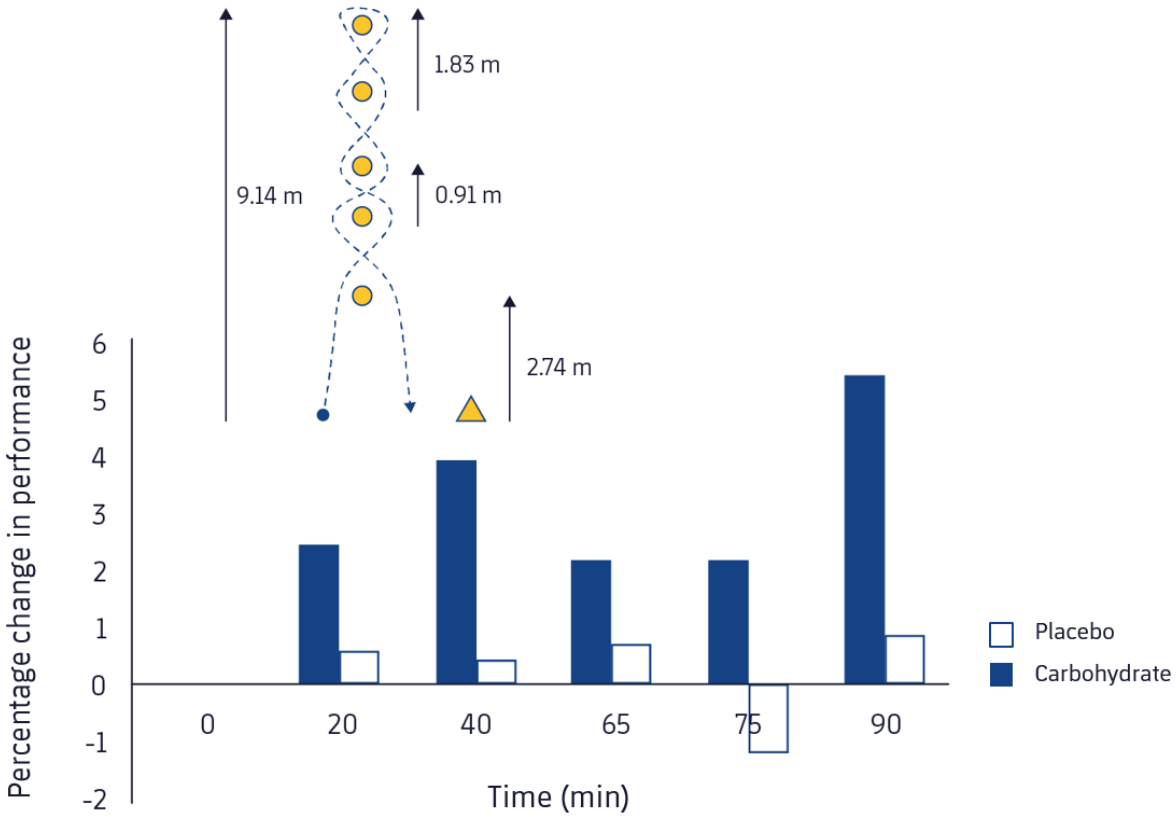
The available literature suggests that the ingestion of an appropriate carbohydrate-electrolyte solution during football-specific exercise will benefit performance. Players with compromised glycogen stores will be able to sustain their level of skill proficiency and repeated sprint performance, in comparison to no fluid or the ingestion of fluid alone. As discussed, fatigue during football and prolonged exercise is associated with the decrease in muscle glycogen. The ingestion of carbohydrate has been shown to attenuate the decline in blood glucose concentrations during prolonged exercise and to spare muscle glycogen during a football match (Coyle et al., 1986; Leatt & Jacobs, 1989). Thus, carbohydrate ingestion is advised for matches, where players aim to gain performance advantages as well as for intense training, where players should aim to gain maximal benefits from the session and practice their match day nutrition strategy. The opportunity to ingest carbohydrate during football matches is often limited to unscheduled stoppages in play (Rollo 2014).

It is vital that carbohydrate is readily available, and players are aware of the benefits of ingesting a carbohydrate so that these opportunities are not missed. Finally, it is important to note that carbohydrate can be provided to players in a variety of different forms. For example, carbohydrate is oxidised effectively, whether it is provided in solid, i.e., in bars, chews, semi-solid

gels, or in a drink (Pfeiffer et al., 2010). Thus, strategies to provide approximately 40-60 g of carbohydrate per hour can be modified according to player preference, in context of other nutritional requirements such as the fluid needs of the player (Laitano et al., 2014). The main benefit of drinking well formulated carbohydrate-electrolyte beverages is that fuel and fluid needs are addressed simultaneously (Rollo 2014).

The fluid lost during a match will depend upon the sweat rates of the player. The sweat rates of players have been reported to vary greatly between players, and will be influenced by the environmental conditions, intensity of exercise, and acclimation status (Duffield et al., 2012). During matches sweat rates have been reported to reach up to 2.5 L/h (Baker et al., 2016). In female players sweat rates are generally lower because of lower body mass and absolute work rates (Da Silva et al. 2012; Kilding et al. 2009; Horowitz, 2014). Hypohydration as a consequence of sweating may impair football performance due to increased cardiovascular strain (Armstrong et al., 1985), impaired cognitive function (Ganio et al., 2011) increased perception of effort (McGregor et al., 1999), reduced physical function (Mohr et al., 2013) and reduced technical skills (McGregor et al., 1999). Therefore, for matches, players should aim to drink sufficient fluids to prevent a deficit of >2% of pre-exercise body mass during exercise (Sawka et al., 2007), whilst avoiding gains in body mass (hyperhydration) (McDermott et al., 2017; Montain et al., 2001), and also ensuring their carbohydrate needs are met (Williams et al., 2015).

Figure 4: The percentage change in time taken to dribble a ball round a set of 5 cones and back over a distance of 9.14 m



Source: adapted from Currell et al., 2009.

DID YOU KNOW

The Loughborough Intermittent Shuttle Run Test (LIST) was developed in 2000, to study the physical demands of football under laboratory conditions. Participants run between cones spaced 20 m apart at variable speeds. Since its development, several different versions of the LIST have been used to also analyse aspects of football skill and self-selected running performance.

DID YOU KNOW

A "placebo" treatment in sports nutrition studies provides an intervention (drink, bar, gel) to a participant which lacks the "active" ingredient of being studied. The placebo should ideally be indistinguishable from the other trials so that the person feels as if they are getting the same intervention on each trial. For example, in many studies investigating sports drinks, the placebo beverage would contain the same level of electrolytes, fluid and be flavour matched, but contain no carbohydrate.

GI COMFORT

To examine whether gastric emptying is slowed during variable-speed running, Leiper and colleagues completed two studies in which game players ingested CHO-E solutions before and during exercise. In the first study, they monitored gastric emptying of a 6% CHO-E solution before and after two 15-min periods of play during an indoor, competitive five-a-side soccer match (Leiper et al., 2001). The same gastric emptying and timing was repeated while the soccer players performed two 15-min periods of walking with the same 10-min rest between the two activity periods. Gastric emptying was slower during the first 15-min period than during the walking-only trial, but during the second 15 min of the soccer game there was no statistical difference in the emptying rate. In total, the volume of fluid emptied from the stomach was less than during the same period while walking. In the second running study, gastric emptying of a 6.4% CHO-E solution and a CHO-free solution were monitored before and after two 15-min periods of the LIST and also after two 15-min periods of walking (Leiper et al., 2005). The exercise intensities during the two 15-min activity cycles of the LIST were higher and more closely controlled than those self-selected exercise intensities achieved during the five-a-side football mach. Nevertheless, the results were quite similar in that gastric emptying was slower during the first 15 min of exercise both for the CHO-E and the placebo solutions than while walking for the same period. However, during the second 15 min, gastric emptying of both solutions was similar during both the running and the walking trials with a trend for slightly faster emptying rates. Whether or not this greater gastric emptying later in exercise suggests an acute adaptation to coping with large gastric volumes remains to be determined. Even with an intensity-induced reduction in gastric emptying, the available evidence does not suggest that team sport players should drink carbohydrate-free solutions (Williams & Rollo 2015). In recent studies which have provided more concentrated carbohydrate (12%) beverages before and at half time during modified LIST protocols, there has been no evidence of gastrointestinal complaint (Funnell et al., 2017; Harper et al., 2017; Rodriguez-Giustiniani et al., 2018). This would suggest that

carbohydrate requirements can be achieved and are well tolerated when consumed at more ecologically valid times of ingestion.

DID YOU KNOW

A beverage containing carbohydrate and electrolytes is commonly known as a sports drink. Sports drinks are formulated to provide the right quantity of carbohydrate, electrolytes (sodium) and fluid, to ensure that the ingested fluid is emptied rapidly from the stomach and absorbed into the body.

EXTRA TIME

The ingestion of CHO-E solutions during prolonged, intermittent variable-speed running has been shown to improve endurance capacity [24, 52, 55]. This is of relevance to those matches which the duration exceeds 90 min or enters extra-time.

The use of carbohydrate gels is common in football, both before and during the match.

Carbohydrate gels provide a convenient means of ingesting carbohydrate whilst "on the go" such as when running or quickly during unscheduled breaks in play. However, there are only a few studies on the benefits of ingesting carbohydrate gels during variable speed shuttle running. Of the two available studies, both report that ingesting carbohydrate gels improves endurance running capacity. One of the studies reported that when game players ingested either an isotonic carbohydrate gel or an artificially sweetened orange placebo while performing the LIST protocol, their endurance capacity was greater during the gel (6.1 min) than during the placebo (4.2 min) trial (Williams & Rollo 2015). In the second study, on intermittent shuttle running, Phillips and colleagues compared the performances of game players when they ingested either a carbohydrate gel or non-carbohydrate gel before and at 15-min intervals while completing the LIST protocol. They reported that during the carbohydrate-gel trial, game players ran longer in Part B (4.6 min) than during placebo trial (3.8 min) but there were no differences in sprint speeds. Concerns about the potential delay in gastric emptying when ingesting carbohydrate gels before and during exercise are allayed by the performance benefits reported in the above studies (Williams & Rollo 2015).

The physiological and performance effects of carbohydrate-electrolyte gels consumed before the 30 minute extra-time period of prolonged soccer-specific exercise have only recently been investigated (Harper et al., 2016). In this study, English Premier League academy soccer players performed

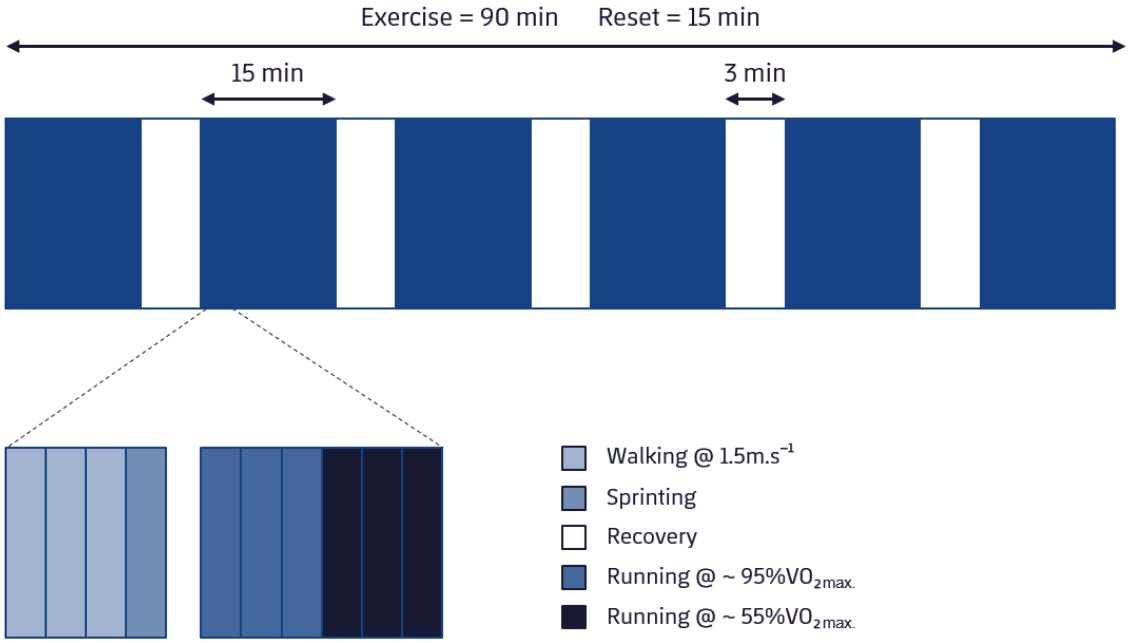
120 min of soccer-specific exercise on two occasions while consuming fluid-electrolyte beverages before exercise, at half-time and at 90 minutes. Players either ingested approximately 50 g of carbohydrate via a carbohydrate-electrolyte gel, or energy-free placebo, 5 minutes before extra-time. It was found that the ingestion of carbohydrate raised blood glucose concentrations and improved dribbling precision during the extra-time period (Harper et al., 2016).

However, the carbohydrate ingestion did not attenuate the gradual reduction in 30 m sprint performance observed during both trials over time (Harper et al., 2016).

DID YOU KNOW

As players ingest food or beverages, they first enter the stomach. Gastric emptying is the movement of food from the stomach to the intestine (duodenum).

Figure 5: Schematic diagram of the movement pattern of the LIST.



Prepared by author.

AFTER THE MATCH

Appropriate strategies to support a player's recovery after matches are fundamental to the team's overall ability to maintain their level of performance over the season. The aggressiveness of the recovery strategy

will depend on when the player is next required to play, be it in training or competition, and becomes increasingly important in tournament situations (Rollo 2014).

Following football matches a complete depletion of muscle glycogen has been reported in a proportion of both slow and fast twitch muscle fibre (Krustrup et al., 2006). The resynthesis of glycogen in these fibres is most rapid in the hours immediately post exercise, in comparison to when carbohydrate is provided several hours later (Piehl, 1974). A general recommendation to achieve high rates of glycogen resynthesis is for players to ingest approximately 1 g of carbohydrate/kg BM immediately after exercise (Ivy et al., 1988). Nicholas et al. (1997) completed a study in which players performed the LIST to exhaustion on four occasions separated by one week. On one occasion, players ingested a diet rich in carbohydrate and repeated the shuttle-run protocol 22 h later. The high-carbohydrate recovery diet resulted in an increase in the players' normal daily energy intake from 2,600 kcal to 3,818 kcal. Absolute carbohydrate intake was increased from a daily average of 381 g to 705 g for the recovery period (5 g to 10 g of carbohydrate/kg BM respectively) (Rollo 2014). On another occasion, the players performed the shuttle-run protocol again. However, players ingested a mixed diet during the 22 h recovery period. The mixed diet contained their normal amounts of carbohydrate (381 g), with protein and fat consumed to match the energy intake of the carbohydrate diet. When players ingested the mixed diet, they could not achieve the previous day's performance. However, the ingestion of the carbohydrate-rich diet was associated with an improved performance. Specifically, players were able to sustain high-intensity running for 3.3 min longer than that achieved on the previous day, which equated to an additional 7.4 min of running in comparison to the time achieved following the mixed diet (Nicholas et al., 1997).

Recent studies have suggested that the rate of muscle glycogen resynthesis may be slowed following a competitive football match. This is based on the observations that glycogen stores can remain lower than pre-match concentrations 48 h post-match, despite the ingestion of a high carbohydrate diet (Bangsbo et al., 2006; Krustrup et al., 2011). Football-specific activities, such as frequent change in direction and decelerations from sprints, have a high eccentric component. Eccentric contractions in combination with contact between players results in muscle damage, which in turn may impair glycogen synthesis (Krustrup et al., 2011). This phenomenon is not alleviated by a diet high in carbohydrate and whey protein (Gunnarsson et al., 2013). Of note, no super compensation of muscle glycogen concentrations have been reported 48 h after a football match, a typical response reported following prolonged running or cycling exercise (Rollo 2014).

To speed player recovery and reduce muscle soreness, many clubs utilize cryotherapy "ice baths". However, due to the vasoconstrictive consequence

of cryotherapy, concerns have risen as to whether glycogen resynthesis would be impaired due to reduced availability of substrate to the muscle (Rollo 2014). Reassuringly, 10 min of lower limb cold water immersion (8°C), following exhaustive exercise, resulted in no impairment in glycogen restoration, in comparison to being seated at rest, when appropriate quantities of carbohydrate were ingested (Gregson et al., 2013).

During times of the season when players are exposed to more frequent matches, i.e., playing two to three matches a week, the importance of maintaining the players' vigour and motivation to perform should not be underestimated. To this end, studies have reported that athletes' "mood" state is better maintained by an increased daily intake of carbohydrate from 5.5 g to 8.5 g carbohydrate/kg BM/day during intensive periods of training (Achten et al., 2004;(Rollo 2014).

DID YOU KNOW

An eccentric muscle contraction occurs when the player's muscle is activated, and force is produced, but the muscle lengthens. This is common in football as the player decelerates following a sprint or when they need to change direction. Eccentric muscle contractions are associated with more muscle damage and increased feelings of soreness, typically 48 h after exercise.

It is important to note that the provision of protein should not be forgotten in the context of an optimal recovery strategy post football match. (Rollo 2014) In the context of glycogen resynthesis, the co-ingestion of relatively small amounts of protein with carbohydrate can be used to augment postprandial insulin secretion and accelerate muscle glycogen synthesis rates (van Loon, 2007). Although, additional protein ingestion will not increase muscle glycogen resynthesis when sufficient quantities of carbohydrate are available (Betts & Williams, 2010). Nevertheless, research suggests that the inclusion of protein (~0.25 g/ kg/ BM) in concert with an appropriate carbohydrate intake will aid the rebuilding of muscle tissue and support adaptation specific to football performance (Res, 2014). In addition, the ingestion of protein prior to sleep may be another opportunity to aid the player's recovery following a match (Trommelen et al., 2016). The ingestion of 40g of casein protein before sleep has been reported to improve jump and reactive strength scores in professional football players at 12 and 36 hours following a match (Abbott et al., 2018).

After a match, as a general principle, players should be encouraged to replace any fluid and electrolyte deficit. In most situations there is sufficient time to restore euhydration and electrolyte imbalances with normal eating/drinking practices, combined with carbohydrate and protein dietary objectives. Nevertheless, during pre-season or periods of fixture

congestion, rapid and complete rehydration can be achieved by drinking 1.5 L of a sodium-containing fluid for each 1 kg of a player's body mass loss. Knowledge of sweat losses and electrolyte composition will also allow individualized rehydration strategies.

Recommendations for Match Day Nutrition

1. On MD-1, MD and MD+1, carbohydrate intake should range between 6-8 g/kg body mass with the aim of elevating muscle glycogen stores.

2. Three to four hours before a match, players should ingest a "pre-match meal" that is high in carbohydrates (2-4 g/kg) to replenish liver glycogen stores.

4. Before (after the warm up) and during a match (half-time) an intake of 30-60 g carbohydrate should be targeted.

5. It is recommended to start restoration of glycogen and protein synthesis as soon as possible after a match by providing 1 g of carbohydrate/ kg of the player's BM/h plus 0.3 g of high-quality protein/kg of the player's body mass.

6. When sweat losses are high, players should be encouraged to drink adequate volumes of fluid with electrolytes to aid the fluid retention.

7. It is recommended to practice all match day strategies in training first.

8. It is recommended to adjust all guidelines to the individual player needs and preferences.

MANAGING MATCH DAYS

The fixture schedule allows the nutritionist to plan for match days. Most preparation for matches should be completed in advance of the match day itself. For example, ordering of sports beverages (the correct quantity/flavour for each player), washing and preparation of bottles/shakers, sports nutrition and foods for before, during and after the match strategies should all be organized in advance. Home matches allow a degree of certainty around many factors which need to be considered when planning match day nutrition. These include the location and format of the pre-match meal. For home matches, there are not usually issues in sourcing foods or drinks and hygiene standards are known. It is important to cater for the whole squad. This begins with the pre-match meal and providing sufficient options in the menu to cater for all player preferences. One of the challenges for the nutritionist is to provide the appropriate quantity of food. Too little and players and staff will be unhappy. However,

too much food leads to excess and wastage, which should be avoided. If the team has a chef, then meal offerings can be refined by trial and error.

When traveling for away games, food safety is the biggest priority. For away games, it is recommended to call and if possible, meet the kitchen staff to ensure that they understand the catering requirements. Food health and safety standards should be met and inspection of the kitchens prior to the team's arrival is also recommended. The challenge is to maintain the quality of food when traveling away from home. If possible, some teams solve this by traveling with their own chef, who can cook and prepare meals on the team bus for example. If a chef cannot travel with the team, preparing (and storing appropriately) well formulated picnic food boxes for the players is also a good option. Finally, it is also important to check which foods can be transported internationally. For example, protein powders may need to be sourced at the country of destination. Therefore, knowledge of these issues in advance will allow time to find an appropriate alternative.

Summary

- The match time and location are key information for the nutritionist.
- The ingestion of 2.5 g of carbohydrate per kg of the player's body mass is recommended in the "pre-match meal", no later than three hours prior to kick off, to "top up" stores of glycogen in the muscle and liver.
- The ingestion of 40-60 g of carbohydrate per hour and preventing hypohydration, is associated with improved running and skill performance during a match.
- After the match, the ingestion of carbohydrate, fluid and protein is required to speed the recovery of the player in preparation for the next match or training session.

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