APPLICATION FOR BASES ACCREDITATION (RESEARCH)

NAME REMOVED

INSTITUTION REMOVED

MEMBERSHIP NUMBER XXXXXX

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BASES
The British Association of
Sport and Exercise Sciences

INSTITUTION LOGO REMOVED

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3.0 Case Study

3.1 Personal Philosophy

The overarching goal of research in the Sport and Exercise Sciences is to have a positive *impact* on particular end users. For example, in Exercise Science research, interventions that target increasing physical activity levels or the health (physical and/or mental) of the general population predominate. Conversely, in Sport Science research, the dissemination of findings is typically conducted with the aim of improving applied practices and ultimately, athletic performance (as well as athlete health). Of course, within Sport Science there are a number of sub-disciplines; my main areas of research are physiology and nutrition.

Academics have been, and continue to be, guilty of being sat in 'ivory towers', disconnected from the population which the research they conduct is ostensibly for. As an early career researcher, my philosophy is to move away from this school of thinking, and ensure that research is conducted with the input of the end user (practitioners, coaches, and where possible; athletes). This is not to say that any research that does not have practical implications for applied practitioners is not without worth. 'Basic' science such as benchtop biochemical analyses and experimental and mechanistic research has an important role in Sport Science, particularly physiology. Mechanistic research can allow academics to identify areas of therapeutic/performance enhancing intervention, targeting particular metabolic and molecular pathways to enhance current training and nutritional practices. Furthermore, in a teaching context, it helps students understand the *why* and the *how* rather than just the *what*.

A potential barrier to research that is applied in nature is the Research Excellence Framework (REF). Although the REF requires the submission of at least two impact case studies per unit of assessment, where evidence of real world impact is provided in the context of research effectiveness, Universities are conscious that only 3* or 4* star research is of economic worth (i.e., distribution of research funding is predicated upon the 'quality' of the research outputs). Typically, research that is not sophisticated in terms of physiological measures such as venous blood sampling or muscle biopsies will likely be considered as a 2* publication. This is despite the fact that a lot of research of this nature has had, and will continue to have, a direct and positive impact on the work of applied practitioners. As such there is now a dichotomy for Sport Science researchers; pressure from University hierarchy to ensure research is of 3* or 4* quality (which will typically require grant funding), whilst also conducting research that will have immediate benefit for applied practitioners.

The REF also provides a barrier to the dissemination of research. Typically, academics will publish research in academic journals that will usually require a paid subscription. As such, practitioners who are not affiliated to a University may find it difficult to access original research articles. Social media, and particularly Twitter, provides a platform for practitioners to keep up to date with current research, with relevant research articles sometimes summarised in the form of visual infographics. Whilst infographics are a welcome addition to dissemination, they do not allow for critique of a particular piece of research and it is worrying that in a recent survey we circulated, practitioners working in team sport prefer to receive research findings through this method (Paper in Review). Open Access journals exist, however; this then places a financial cost on the authors. The development of free open access web-based platforms to submit pre-prints of articles and also 'real-world' research (i.e., Sport Performance & Science Reports) allows end users to access research and facilitates discussion and collaboration. However, the latter would not be considered as part of a REF submission so I hope to find an effective balance of publishing in traditional journal article formats (whilst taking advantage of preprint websites such as SportRχiv) and also in more practitioner-oriented platforms.

In [redacted], my colleague [redacted] and I published an invited commentary in the [redacted] Within the commentary published we discuss how we can better connect practitioners and researchers. One particular methodology that has become more prevalent in recent years is the use of qualitative research. Qualitative research is a methodological approach used in a wide range of disciplines, predominately to investigate human behaviour and the factors influencing behavioural processes. Examples of qualitative methods include the use of online surveys, one-on-one interviews, and focus groups. Sport Science researchers have acknowledged the role that qualitative research could play in benefitting the applied environment. In David Bishop's "Applied Research Model for the Sport Sciences", stages one and two refer to 'defining the problem' and 'descriptive research' (Bishop, 2008). These stages not only involve the researcher using their own knowledge of the sport and the fundamental science underpinning performance, but also approaching coaches, athletes, and practitioners to gather their opinions and perceptions of pertinent issues influencing performance. Thus, using qualitative methodologies can be the starting point of pertinent and practically relevant research (both quantitative and qualitative in nature).

To conclude, my personal philosophy to my research is one that is collaborative, inclusive, and pragmatic, whereby from conceptualisation to dissemination, I try to ensure the end user is at the forefront of everything that I do. As discussed, mechanistic research may not hold any immediate benefit, but it will provide further avenues of enquiry, and advance scientific knowledge in our field.

3.2 Explanation of the issue

The following case study discusses a series of studies completed as part of a doctoral program of research.

Soccer (also known as association football) is a high-intensity intermittent team sport, typically played over two 45 min halves that are separated by a 15 min break. Due to soccer's worldwide popularity and the large economic incentives associated with successful performance, there is a large canon of literature investigating a diverse range of soccer-related topics. Indeed, a PubMed search for the term "soccer" derives over 9100 published research articles (as of May 2018). Within these research articles, many have quantified the performance and physiological responses to 90 min of match-play, whilst also investigating the effect of various ergogenic aids on soccer-specific performance. One aspect of soccer research that had received relatively little attention prior to 2014 is the extra-time (ET) period. In matches where an outright winner is required, this 30 min period of soccer match-play commences five minutes after the cessation of normal time and is split into two 15 min halves that are each separated by a two minute break. Since 1986, 35% of senior FIFA World Cup knockout matches have required ET, including 50% of matches at the 2014 competition, up from 25% at the 2002 and 2010 FIFA World Cup's, and 38% at the 2006 competition. Furthermore, in the annually held English League Cup competition, 22% of matches required ET from August 2011 to February 2017. Despite the prevalence of ET in international and domestic cup competitions, until 2014, a paucity of research related to this additional period of play existed. This was surprising, as the rewards for winning a match in ET are both large from an economic stand point (teams receive money for every match won in a cup competition) and also means that a penalty shootout that follows ET is no longer required, which is often considered as a "lottery". Therefore, having a better understanding of what occurs both physiologically and performance-wise during ET can provide practitioners, coaches and players with key information related to this important period of play.

3.3 Needs analysis

As discussed in section 3.1, I believe engaging applied practitioners in the design of research is extremely valuable. Therefore, as part of my doctoral research I designed an online survey for practitioners working in professional football to complete. Practitioners were contacted either electronically or *via* between July and September 2015. Completed responses were returned by staff from 46 individual teams (one per team). All responses were anonymous, with practitioners not being required to disclose their name or affiliation, but only their role, competitive level, and general location. The survey contained eleven main questions with nine sub questions which were related to the following areas: ET and match success, current ET regulations, nutritional interventions and ET, research paradigms, current preparation, training, match-day and post-match practices.

The majority of practitioners (63%, n = 29) either agreed or strongly agreed that *extra-time is an important period for determining success in football match play* whereas 30% (n = 14) neither agreed nor disagreed, with the remaining 7% of respondents (n = 3) disagreeing with this statement. Notably, respondents were mostly positive towards the need for further research into ET (i.e., 91%, n = 42) with only 9% (n = 4) of practitioners disagreeing with this statement, with nutritional intervention studies and profiling of fatigue responses the two most important areas of research. Consequently, the findings of this survey helped me identify what practitioners, who are working on the 'coal-face' of professional football would like to see in terms of research in ET.

3.4 Underpinning technical/theoretical rationale

3.4.1 Introduction

Although nutritional interventions were seen as the number one research priority by practitioners, before such an intervention can be implemented it is important to investigate what the underpinning physiological changes are during a period of exercise so as to optimise nutrient delivery. The physiological demands of 90 min of actual and simulated soccer match-play are well known (Stolen et al., 2005; Bangsbo et al., 2007; Reilly et al., 2008). However, no data profiling these responses during matches of 120 min duration (i.e., inclusion of an ET period) existed prior to undertaking this research program.

Due to inherent match-to-match variability (i.e., large coefficient of variations for physical outputs such as distances covered, sprinting etc.), and restrictions associated with competitive match-play, assessing physiological changes (i.e., heart rate, blood sampling) is impractical. To overcome variability and logistical issues a number of research groups have developed simulations of soccer match-play. These have been developed to provide a comparable exercise stimulus to actual match-play but with more robust experimental control and the ability to assess physiological and metabolic changes during exercise. These include the Soccer Match Simulation (SMS; Russell et al., 2011a). The SMS incorporates not only the physical movement patterns of match-play but also technical actions (i.e., shooting and dribbling). The SMS and the constituent technical components have been shown to be both reliable (Russell et al., 2010; Russell et al., 2011b) and valid in the same group of players (Russell et al., 2011b). Therefore, due to the lack of data profiling the physiological and performance responses in an ET period, the aim of a study during my PhD was to assess these responses during 120 min of simulated match-play using the SMS as an analogue of soccer match-play.

3.4.2 Methods

Following institutional ethical approval, we recruited 22 University standard soccer players, and habituated them with the SMS through a full 120 minute familiarisation session. The SMS requires players to cover ~14.4 km (reflecting matches requiring extra-time; Russell et al., 2015) at various running intensities, with backwards and sideward movements over a 20 m distance, while intermittently performing 15 m sprints and soccer ball dribbling. In line with UEFA playing regulations, a 15-min passive recovery period (half-time; HT) separated the two 45-min halves whereas a two min passive recovery period separated each extra-time half and a five min rest period preceded extra-time (Figure 1). Performance changes across the protocol were assessed by measuring dribbling performance (speed dribbling through cones and distance from the ball to the cone [precision]) and 15 m sprint times. Furthermore, 20 m sprint times, countermovement jump (CMJ) height and shooting performance (speed, precision and success) was assessed pre-exercise, at the end of the first half, prior to the second half, at 90 min, and at 120 min; PT on Figure 1).

Upon arrival at the laboratory participants had a cannula inserted in the antecubital fossa of one of their arms. While participants were in a recumbent position, venous blood was drawn at rest, pre-exercise, at HT, and every 15 min during exercise. Blood was collected in two six ml vacutainers (EDTA and Lipid Heparin) and a two ml luer at each time-point. Vacutainers were centrifuged at 3000 revolutions·min^{-1} for 10 min (Allegra X-22R; Beckman Coulter Ltd., California, USA) with the resultant plasma subsequently frozen at -80°C. Blood from the luer was used to determine glucose and lactate concentrations (Biosen C-Line Clinic; EKF Diagnostics, Cardiff, UK). The frozen plasma samples were defrosted at a later date for the analysis of the concentration of various blood metabolites including plasma insulin, interleukin-6 (IL-6), adrenaline, glycerol, and non-esterified fatty acids (NEFA).

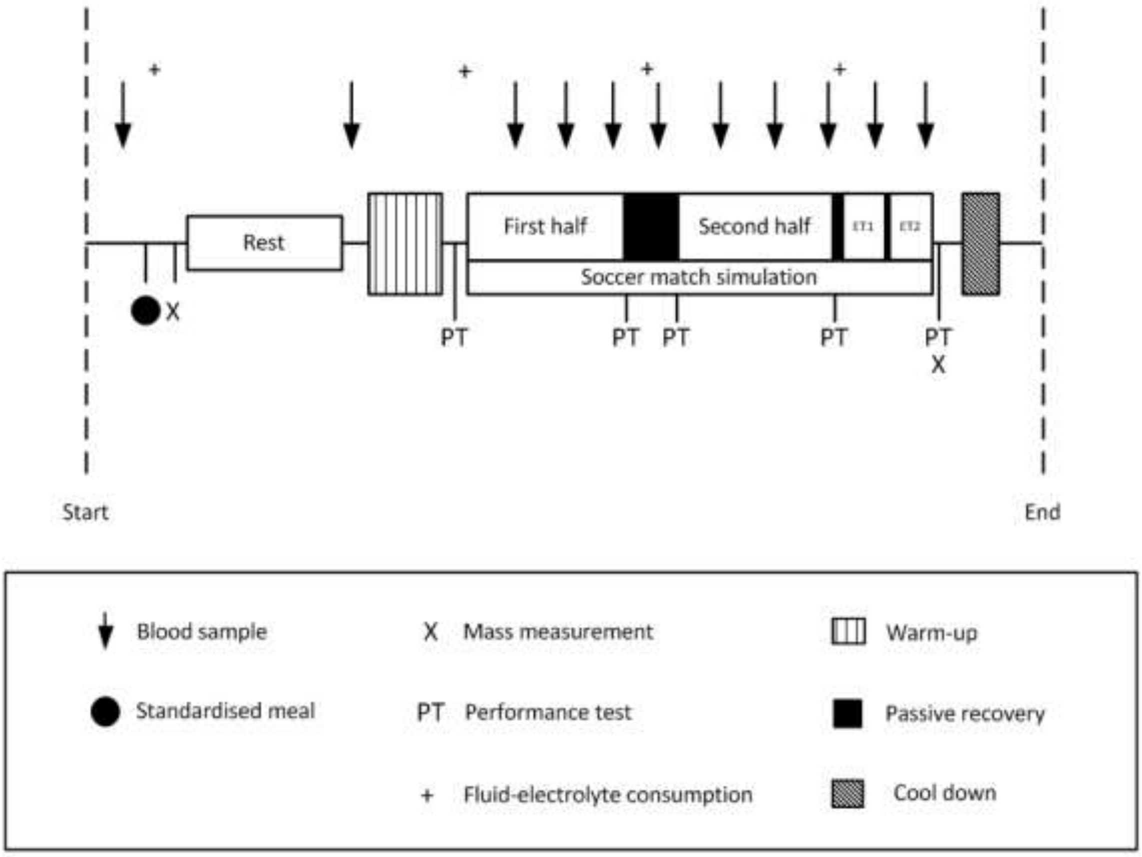

Figure 1 General overview of testing day procedures

Statistical analyses were carried out using SPSS software (Version 21.0; SPSS Inc., IL, USA). All results are reported as the mean ± standard deviation (SD). The level of statistical significance was set at $p \leq 0.05$. Data was sampled for normality and repeated measures analysis of variance (ANOVA) established whether any significant effects existed in the physiological and performance responses due to time. Mauchly's test was consulted and Greenhouse–Geisser correction applied if the assumption of sphericity was violated. LSD corrected post-hoc tests were performed to isolate significant findings between time-points.

3.4.3 Results

Exercise influenced blood glucose and blood lactate concentrations (both $p \leq 0.0005$). Blood glucose concentrations were lower at 120 min (3.88 ± 0.47 mmol·l^{-1}) compared to the first half (15-45 min) (4.63-4.87 mmol·l^{-1}; $p \leq 0.002$) and 75 min (4.49 ± 0.54 mmol·l^{-1}; $p = 0.015$; Figure 5a.2A). Furthermore, blood glucose concentrations were lower at 105 min (3.70 ± 0.52 mmol·l^{-1}) vs. baseline (4.29 ± 0.51 mmol·l-1; $p = 0.038$), the first half, ($p \leq 0.002$) and 60-90 min (4.30-4.49 mmol·l^{-1}; $p \leq 0.047$). Blood lactate concentrations were lower in ET (105-120 min; 3.25-3.73 mmol·l^{-1}) compared to the first half (4.94-5.42 mmol·l^{-1}; $p \leq 0.014$) and higher compared to baseline (0.79 ± 0.26 mmol·l^{-1}), pre (0.85 ± 0.21 mmol·l^{-1}), and HT (2.17 ± 1.06 mmol·l^{-1}) (all $p \leq 0.0005$).

Exercise influenced plasma insulin and adrenaline concentrations (both $p \leq 0.0005$). Plasma insulin concentrations were lower at 120 min compared to all other time-points except 105 min ($p \leq 0.05$). Plasma adrenaline concentrations were higher at 120 min (12.7 ± 8.6 ng·ml^{-1}) compared to all other time points ($p \leq 0.001$). Exercise influenced plasma NEFA and glycerol concentrations (both $p \leq 0.0005$). Plasma NEFA concentrations were higher at 120 min (1.5 ± 0.4 mmol·l^{-1}) and at 105 min (1.24 ± 0.4 mmol·l^{-1}) compared to all other time points ($p \leq 0.044$), except when directly compared with each other. Plasma glycerol concentrations were higher at 120 min (361 ± 95 µmol·l^{-1}) compared to all other time points ($p \leq 0.001$) and higher at 105 min (287 ± 78 µmol·l^{-1}) compared to all other time points, except 90 min (257 ± 63 µmol·l^{-1}; $p \leq 0.0005$). Exercise also influenced plasma IL-6 concentrations ($p \leq 0.0005$), with elevated concentrations at 120 min compared to all other time-points except 105 min ($p \leq 0.0005$).

Shot precision and success were unaffected by exercise whereas shot velocity reduced ($p = 0.019$). Shot velocities at 120 min (17.6 ± 2.5 m·s^{-1}) were slower compared to all time-points except pre-second half ($p \leq 0.017$). Exercise reduced 20 m sprint velocities ($p \leq 0.0005$) with reduced velocities at 120 min (5.67 ± 0.48 m·s^{-1}) compared to all other time points ($p \leq 0.038$). Exercise also influenced 15 m sprint velocities ($p \leq 0.0005$). Sprint velocities over 15 m were depressed during ET (both 90-105 and 105-120 min; 5.1 ± 0.3 m·s^{-1} and 4.9 ± 0.3 m·s^{-1}, respectively) compared to the rest of exercise ($p \leq 0.002$). Countermovement jump heights were influenced by exercise ($p = 0.023$), however; there were no differences at 120 min compared to any other time-point ($p > 0.05$).

3.4.4 Discussion

Sprint velocities over 15-m and 20-m were lower during ET and at 120 min compared to all other time-points, and shot velocity was lower at 120 min compared to all other time points except after a passive HT break. Reductions in sprint performance were accompanied by elevated plasma IL-6, adrenaline, NEFA, and glycerol concentrations, and decreased plasma insulin and blood glucose and lactate concentrations during ET. These changes are indicative of a shift in substrate utilisation during ET towards predominately fat oxidation. This has implications for high-intensity intermittent exercise, which is reliant on substrate level phosphorylation as a primary source of energy (Reilly, 1997). Interleukin-6 concentrations were elevated during ET. Interleukin-6 is a pleiotropic cytokine and myokine, with a plethora of mechanistic roles in homeostatic negative and positive feedback loops (Ball, 2015). Indeed, contractile activity of the muscle leads to systemic release of IL-6 (Reihmane & Dela, 2014). Previous research has demonstrated a role for increased IL-6 concentrations in hepatic glycogenolysis through a 'contractile factor' (Keller et al., 2001; Pedersen & Febbraio, 2008). However, more recent research would suggest that IL-6 is not involved in the mobilisation of liver glucose stores (O'Neill et al., 2013), and is actually a negative regulator of hepatic glucose output (Dent et al., 2016). Although the effect of IL-6 on liver glycogen remains equivocal, it is known that increased IL-6 concentrations are linked to low availability of intramuscular glycogen (Keller et al., 2001; Steensberg et al., 2001) and also to increased fat metabolism through the augmentation of the sympathoadrenal system (Wolsk et al., 2010; Ball, 2015). Other metabolic data collected in the present investigation would corroborate this, with elevated plasma adrenaline, glycerol and NEFA concentrations and dampened plasma insulin and blood lactate concentrations during ET.

Adrenaline accelerates glycogenolysis through its downstream activation of phosphorylase α (Chasiotis et al., 1983; Watt et al., 2001) as well as acting as a stimulator of hormone sensitive lipase (HSL), a major enzyme involved in lipolysis (Watt & Spriet, 2004). As both insulin and lactate are inhibitors of HSL, the observed decrease in these metabolites during ET further strengthens the evidence for a shift in substrate utilisation in ET, with increased reliance on fat oxidation to fuel the exercise. Furthermore, low glycogen levels have been associated with impaired sprint performance during soccer match-play (Krustrup et al., 2006; Rollo, 2014). This is possibly due to a depressed muscle sarcoplasmic reticulum calcium release rate, which contributes to reductions in force production and fatigue when muscle glycogen levels are diminished (Ortenblad et al., 2011; Gejl et al., 2014). Despite an increased taxing of muscle glycogen, blood glucose concentrations remained dampened during ET, with 50% of participants exhibiting values indicative of hypoglycemia (<3.6 $mmol.l^{-1}$; Cryer, 2003). Reductions in blood glucose have been shown to impair physical output (Welsh et al., 2002; Winnick et al., 2005; Ali et al., 2007) and cognitive function (Benton, 2002; Benton & Nabb, 2003), which are crucial to successful soccer performance. Therefore, these metabolic perturbations during ET may explain the reductions in performance observed. The observed lower blood lactate concentrations in ET provide further evidence for a shift from substrate level phosphorylation to fat oxidation as a match progresses. These changes are likely to be compensatory mechanisms for the progressive decline in muscle glycogen during soccer match-play so as to maintain blood glucose concentrations. Overall, these changes in substrate utilisation are likely to impact on the ability to perform bouts of high-intensity running, which are crucial for successful soccer performance (Reilly, 1997; Faude et al., 2012).

In a separate investigation, we also observed reductions in technical performance (number of passes, number of successful passes and number of successful dribbles) during the ET period of actual match-play (18 matches from professional European domestic competitions). Furthermore, Lago-Penas et al., (2015) examined seven matches from the 2014 FIFA World Cup that required ET and observed reductions in total distance covered and distances covered at low (≤11.0 $km \cdot h^{-1}$), medium (11.1-14.0 $km \cdot h^{-1}$) and high (≥14.1 $km \cdot h^{-1}$) speeds in ET compared to the first 45 min of the match. Top speed was greater during the first 45 min compared to ET, and maximal running speed was lower in ET compared to both the first and second halves, with concomitant increases in the time spent in low intensity activities during ET. Morevover, while observing five professional players wearing GPS units during a English Premier League reserve match, Russell et al., (2015) detected reductions in total distance covered, high-intensity distance covered, and the number of sprints, accelerations, and decelerations in the last 15 min of ET compared to the last 15 min of normal time (i.e., 76-90 min). Therefore, with this evidence base, we aimed to assess the effectiveness of a nutritional intervention on performance.

3.5 The intervention

3.5.1 Introduction

With the knowledge of previous investigations, we attempted to incorporate a nutritional intervention to try and offset reductions in performance and perturbations in physiology. Notably, from the survey we did with professional football practitioners, we identified that 87% of them advocated a particular nutritional supplementation strategy prior to ET, with hydration and energy provision (in the form of high carbohydrate drinks or gels) as the two main strategies. Ergogenic effects have been observed following provision of carbohydrates on physical and skilled actions performed throughout simulated soccer match-play (Ali et al., 2007; Russell et al., 2012; Kingsley et al., 2014). Increased exogenous energy provision, maintenance of blood glucose concentrations, and improved intermittent exercise capacity has been reported following carbohydrate gel ingestion (Patterson & Gray, 2007; Havemann & Goedecke, 2008; Kingsley et al., 2014). Although the ingestion of carbohydrate gels prior to ET is common in professional soccer (as observed anecdotally and from the results of the survey) the physiological and performance responses to this nutritional strategy are unknown.

Therefore, the aim of this study was to evaluate the physiological and performance responses to carbohydrate-electrolyte gels consumed before the ET period of a simulated soccer match.

3.5.2 Methods

Following institutional ethical approval, male soccer players recruited from an English Premier League club (n = 8, age: 16 ± 1 years, mass: 68.5 ± 5.3 kg, stature: 1.73 ± 0.05 m, estimated $\dot{V}O_{2\,max}$: 55 ± 9 ml·kg^{-1}·min^{-1}) provided written informed consent (and parental consent where players <18 years). Players trained for ~16 hours per week and played for a professional academy for >12 months before the study started. Two main trials (carbohydrate: CHO and placebo: PLA), separated by 9 ± 4 days, were completed using a double-blind, randomised, counterbalanced and cross-over design. In the 5 min break prior to ET we provided the players with either a carbohydrate-electrolyte (0.7 ± 0.1 g•kg-1 BM) or energy-free placebo gels. We took fingerprick blood samples before exercise, at HT and every 15 min during exercise to monitor changes in blood glucose and lactate concentrations. Furthermore, we measured changes in dribble performance, 15 m and 30 m sprint speed, and CMJ height throughout, following a similar protocol to the study discussed earlier.

Statistical analyses were carried out using SPSS Statistics software (IBM Inc., USA) with significance set at $p \leq 0.05$. Data are reported as mean ± standard deviation (SD). Two-way repeated measures analysis of variance (within-participant factors: treatment x time) were performed. Where significant interactions were observed, supplementation was deemed to have influenced responses and simple main effects were performed. LSD corrected *post-hoc* tests (with 95% Confidence Intervals; CI) with Cohen's *d* calculations examined between-trial differences.

3.5.3 Results

NB. For ease of reading, only main effects and post-hoc analyses relative to the influence of supplementation are reported, with no reference to the effect of exercise only.

Supplementation influenced mean dribbling precision (p = 0.015) with dribbles performed during the last 15 min of ET being 29 ± 20% more accurate in CHO than PLA (p = 0.014, *d* = 1.3, CI: 3.24-21.01 cm). Dribbling speed (p = 0.671) and success (p = 0.677), CMJ height (p = 0.188) and 15 (p = 0.772) and 30 m sprint velocities (p = 0.599) were not influenced by supplementation. Supplementation (p = 0.026) influenced blood glucose concentrations with CHO values being 16 ± 17% greater than PLA during the first 15 min of ET (5.6 ± 0.9 mmol·l^{-1} vs. 4.6 ± 0.2 mmol·l^{-1}, p = 0.028, *d* = 4.2, CI: 0.18-1.93 mmol·l^{-1}).

3.5.4 Discussion

We observed increased blood glucose concentrations and improved dribbling precision during ET with carbohydrate supplementation. Although not reported in the results section, as before, we also observed reductions in physical performance (sprint velocities) throughout 120 min of soccer-specific exercise with evidence highlighting further performance reductions during ET compared to the end of normal time. Therefore, consumption of carbohydrate-electrolyte gels offers an ergogenic strategy for players preparing to engage in an ET period, however; not all performance decrements were ameliorated by carbohydrate provision.

Improved skill performance (i.e., shot velocity and success) has been observed following carbohydrate ingestion (Ali et al., 2007; Russell et al., 2012). However, the efficacy of carbohydrate provision was unknown when 120 min of soccer-specific exercise is performed. In eight professional academy soccer players, a 0.7 ± 0.1 $g \cdot kg^{-1}$ BM dose of carbohydrate raised blood glucose concentrations by 16 ± 17% (large effect; d = 4.2) and resulted in a 29 ± 20% improvement (large effect; d = 1.3) in dribbling precision throughout the last 15 min of ET. Improved performance of sports skills following carbohydrate consumption has previously been associated with enhanced cerebral glucose supply and preserved central nervous system integrity (Duell & Kuschinsky, 2001; Nybo, 2003) even when participants remain euglycaemic (Russell et al., 2012). Additionally, elevated blood glucose concentrations induce muscle glycogen sparing (Havemann & Goedecke, 2008), augmented neuromuscular function (Nybo, 2003) attenuated central fatigue *via* serotonergic neurotransmitter release (Ali et al., 2007) and modified motor output resulting from stimulation of afferent brain signals *via* oropharyngeal receptor activation (Chambers et al., 2009). Although the precise mechanisms of skill performance regulation have yet to be delineated and are likely multifaceted in origin, our data expands the findings of previous studies that have observed enhanced skill performance with carbohydrate supplementation (Ali et al., 2007; Russell et al., 2012) by demonstrating ergogenic effects of carbohydrate ingested prior to ET on dribbling precision.

Further work is required to optimize the hydro-nutritional strategies of players who may be exposed to a period of ET. Future research should look to examine the effect of providing carbohydrate throughout a match requiring ET (i.e., during the warm-up and at HT, not just prior to ET). The administration of a stimulant such as caffeine in the form of chewing gum provided prior to ET may also infer ergogenic benefits, due to its quick absorption time. However, as ET periods are typically played during evening matches, this may subsequently have a detrimental impact on post-match sleep.

3.6 Resultant impact/outcome

The series of studies led to a number of publications in sport and exercise science specific journals, and successful completion of a PhD thesis. I presented my research at seven international conferences building up a network of collaborators and colleagues whom I continue to do research with to this day. My research has led to two invited talks, including a webinar to over 200 people, and as part of a seminar series at another institution. Assessing the impact that this work has had on football without intimate knowledge of the practices of staff working in that environment is difficult. However, I hope this research has further enhanced practitioner awareness of their practices relative to ET, and that they have sought their own novel interventions to try and improve performance and accelerate recovery. Furthermore, the research has led to subsequent grant applications with projects designed to further investigate the impact of ET.

3.7 Personal reflection/evaluation of the process

Undergoing just under three years as a PhD candidate had a profound effect on me as a student of sport and exercise science, and as a person. I was fortunate enough to work and collaborate with a number of fantastic academics and practitioners, developing lifelong friendships and research partnerships. Research of this nature is time consuming and intensive; with some of the projects taking upwards of 12 months to complete. For example, the study where we had 22 players go through the simulated protocol took 6 months for recruitment and data collection, and a further 6 months to analyse all the blood samples we collected during exercise. The biochemical analysis was something I particularly enjoyed, and I worked in the laboratory doing enzyme-linked immunosorbent assays (ELISAs) and clinical chemistry analysis myself, rather than having technical staff do the analysis or sending off to other laboratories as many PhD students do. I believe the process of data collection and compiling a doctoral thesis greatly developed my practical and people skills, as well as my critical thinking.

The goal of any PhD thesis is to create new knowledge which is not only ‘interesting’ but is also ‘valuable’ to the end user and to other researchers. I hope that the research output has been valuable, and that influenced practice in some small way. I now hope to supervise a PhD student starting in September 2018 who will be assessing the impact of ET on subsequent recovery which is a natural continuation of my doctoral research. The process has made me place great value on collaborative work; most of my studies involved the help of others, and from publishing my work and attending conferences I have forged a number of research collaborations with academics and practitioners alike, which makes i) the research questions more robust and diverse, ii) allows for more time-consuming and intensive periods of data collection, and iii) enhances the subsequent dissemination of the research.

Overall, I believe I have made a contribution, albeit small, to the football science community, conducting research that has practical implications and whilst answering some questions, has created many more for future investigation. Furthermore, I believe I have developed markedly as a person, a researcher, and as a Sport and Exercise Scientist.

Word Count: 4966

Biomechanics Hours

Activity			Flexible learning
	Content/delivery	Supporting study	
Marking of UG biomechanics exam scripts	5	5	
Assisting colleague in data collection for ankle strength and force using isokinetic dynamometer and force plate	30	0	
Attending conference presentations/posters	75	0	
Lectures on Movement Screening	4	8	
Textbook reading (2016-2018)	n/a	n/a	150 (1 h per week)
Peer-review of relevant articles (2018)	3	2	
Review on football fixture congestion and injury risk (still in preparation)	10	15	
Teaching resistance exercise technique for Level 3 Personal Trainer qualification (16/17, 17/18)	16	10	
UG Teaching of Force Plate Analyses	8	4	
UG Teaching of Performance and Biomechanical Analysis using Dartfish Software	24	10	
Total (379)	**175**	**54**	**150**
	229		

EXPERIENCE: The candidate should be able to demonstrate that he/she has worked in an environment that has enabled the individual to receive training and gain experience relevant to the competences set out below.

1 – Scientific Knowledge

Be able to demonstrate a detailed scientific knowledge and understanding relevant to the domain of expertise

	AREA OF COMPETENCE	**INDICATE SECTION(S) IN PORTFOLIO WHERE COMPETENCE IS DEMONSTRATED**
1.1	• Know and understand the key concepts of the bodies of knowledge which are relevant to their professional practice	• BSc Sport and Exercise Science (First Class Honour's) – Page 16 • MSc Sports Physiology (Distinction) – Page 19 • PhD in Exercise Physiology – Page 40 • Peer Reviewed Publications – Pages 41-42 • Developing and leading Sport Science related programmes and modules – Pages 45-50 • Case Study – Pages 2-15
1.2	• Understand the structure and function of the human body relevant to their practice, together with knowledge of health, disease, disorder and dysfunction	
1.3	• Understand and be able to apply the theoretical concepts underpinning sport and exercise science delivery within their domain of expertise	
1.4	• Understand the theoretical basis of, and the variety of approaches to, assessment and intervention	
1.5	• Understand how sport and physical activity affect and influence the structure and function of the human body	
Examples of how this could be achieved:	• Evidence of a BUES (or equivalent) sport and exercise science undergraduate degree • Evidence of a BASES recognised postgraduate qualification in sport and exercise science	

EXPERIENCE: The candidate should be able to demonstrate that he/she has worked in an environment that has enabled the individual to receive training and gain experience relevant to the competences set out below.

2 – Technical Skills

Be able to demonstrate full understanding and application of relevant scientific techniques

	AREA OF COMPETENCE	INDICATE SECTION(S) IN PORTFOLIO WHERE COMPETENCE IS DEMONSTRATED
2.1	• Be able to gather appropriate information via undertaking or arranging investigations as appropriate	• Case study – Pages 2-15 • Peer Reviewed Publications – Pages 41-42 • Phlebotomy Trained – Page 44 • Development of seminar and laboratory practical workbook for second year module – Page 51 • Use of online surveys in research – Page 43
2.2	• Be able to select, undertake and record a thorough, sensitive and detailed assessment, using appropriate techniques and equipment	
2.3	• Be able to analyse and critically evaluate the information collected	
2.4	• Be able to demonstrate a level of skills in the use of information technology appropriate to their practice	
2.5	• Be able to conduct appropriate diagnostic or monitoring procedures, treatment, therapy or other actions safely and skilfully relevant to the domain of expertise	
Examples of how this could be achieved:	• Evidence of BASES endorsed / recognised undergraduate and postgraduate degrees • Certification from relevant recognised training courses • Case study/reflective accounts • Completion of laboratory manual or similar • Refereed publications	

EXPERIENCE: The candidate should be able to demonstrate that he/she has worked in an environment that has enabled the individual to receive training and gain experience relevant to the competences set out below.

3 – Application of Knowledge and Skills

Ability to demonstrate the application of knowledge and technical skills to the relevant delivery environment

	AREA OF COMPETENCE	INDICATE SECTION(S) IN PORTFOLIO WHERE COMPETENCE IS DEMONSTRATED
3.1	• Be able to evaluate intervention plans using recognised outcome measures and revise the plans as necessary in conjunction with the service user	• Case study – Pages 2-15 • Peer Reviewed Publications ([redacted] was an industry-funded study I managed during my PhD) – Pages 41-42 • Development of an MSc in Sport and Exercise Nutrition (co-developed with a colleague) – Pages 49-50 • Module Descriptors Pages 45-48 • Curriculum Vitae – Page 1
3.2	• Exercise sound judgement in the absence of complete information and in complex or unpredictable situations.	
3.3	• Scope, plan and manage multifaceted projects	
3.4	• Be able to set goals and construct tailored individual and group sport and exercise science development programmes	
3.5	• Know and be able to apply the key concepts which are relevant to safe and effective practice within their domain of expertise as a sport and exercise scientist	
3.6	• Understand and be able to apply the theoretical concepts underpinning sport and exercise science delivery within their domain of expertise	
3.7	• Use specialist experiential knowledge and broader scientific understanding to optimise the application of existing and emerging science and technology	
Examples of how this could be achieved:	• Case study (following BASES guidelines) • Reflective accounts • Research plan - ethics submission • Teaching plan - curriculum development	

EXPERIENCE: The candidate should be able to demonstrate that he/she has worked in an environment that has enabled the individual to receive training and gain experience relevant to the competences set out below.

4 – Understanding and Use of Research

Be able to demonstrate a training in research which enables the understanding and application of research findings

	AREA OF COMPETENCE	INDICATE SECTION(S) IN PORTFOLIO WHERE COMPETENCE IS DEMONSTRATED
4.1	• Demonstrate critical evaluation of relevant scientific information and concepts to propose solutions to problems	• PhD in Exercise Physiology – Page 40 • Case Study – Pages 2-15 • Peer Reviewed Publications – Pages 41-42 • Conference Presentations – Pages 52-53 and 54-56 • Peer Reviewer for academic journals – Page 57 • Development of a Women's Football Research Group – Page 58
4.2	• To recognise the value of research to the critical evaluation of practice	
4.3	• Be able to engage in evidence-based practice, evaluate practice systematically and participate in audit processes	
4.4	• Be aware of a range of research methodologies	
4.5	• Be able to use appropriate statistical and other research skills to gather and interpret evidence in order to make reasoned judgements with respect to sport and exercise science practice	
4.6	• Be aware of the principles and applications of scientific enquiry, including the evaluation of effectiveness of practice and the research process	
Examples of how this could be achieved:	• Evidence of BASES endorsed / recognised undergraduate and postgraduate degree - research projects • Critique of published research papers • Research proposal • Literature review • Postgraduate dissertation / PhD	• Further research activity including published refereed papers • Presentations at conferences and workshops • Case study and intervention • Review of how own research could impact on practice

EXPERIENCE: The candidate should be able to demonstrate that he/she has worked in an environment that has enabled the individual to receive training and gain experience relevant to the competences set out below.

5 – Self Evaluation and Professional Development

Ability to self-reflect, take responsibility for own actions, and to demonstrate continuous professional development

	AREA OF COMPETENCE	INDICATE SECTION(S) IN PORTFOLIO WHERE COMPETENCE IS DEMONSTRATED
5.1	• Work autonomously and take responsibility for the work of self and others	• Course Leader on MSc Sport and Exercise Nutrition – CV (page 1) • Conference and Workshop attendance – Pages 52-53 • Postgraduate Certificate in Higher Education Portfolio – Page 59-60 • Sport and Exercise Nutrition Register Accreditation – Page 61 • UK Anti-Doping Advisor – Page 62 • Yearly appraisal with line manager – Pages 63-64 • Teaching observations – Pages 65-66 • Internal validator for postgraduate courses at [redacted] – Page 67
5.2	• Be able to adapt their practice as a result of new and emerging ideas and information within the area of sport and exercise science	
5.3	• Be able to maintain an appropriate audit trail and work towards continual improvement	
5.4	• Understand the value of reflection on practice and evidence of engagement in the process	
5.5	• Take responsibility for continuous performance improvement both at a personal level and in a wider organisational context	
5.6	• Understand the principles of quality control and quality assurance	
Examples of how this could be achieved:	• Documented evidence of attendance of the 4 mandatory and 2 optional BASES SE workshops • Documented evidence of other courses run or attended • Case study examples showing how own practice has been adapted • Testimonials • Video evidence • Evidence of adherence to BASES Code of Conduct	• Reflective accounts maintained over the 2 years of supervised experience • Reflective accounts corresponding to own practice and case study meetings • Career development plan • Attendance at other workshops • Peer review

EXPERIENCE: The candidate should be able to demonstrate that he/she has worked in an environment that has enabled the individual to receive training and gain experience relevant to the competences set out below.

6 – Communication

Ability to communicate orally and in writing to colleagues, peers and clients

	AREA OF COMPETENCE	INDICATE SECTION(S) IN PORTFOLIO WHERE COMPETENCE IS DEMONSTRATED
6.1	• Demonstrate the ability to communicate effectively with specialist and non-specialist audiences	• BASES The Sport and Exercise Scientist article – Page 68 • Conference poster presentations – Pages 52-53 and 69-70 • Delivery of lectures to all three levels of UG and also PG (CV – Page 1, Pages 71-74) • Peer Reviewed Publications – Pages 41-42 • Case Study – Pages 2-15 • Webinar for ISSN diploma – Page 75 • References – Pages 24-29
6.2	• Be able to select, move between and use appropriate forms of verbal and non-verbal communication with service users and others	
6.3	• Understand the need to provide service users (or people acting on their behalf) with the information necessary to enable them to make informed decisions	
6.4	• Recognise the need to use interpersonal skills to encourage active participation of service users	
6.5	• Be able to discuss and explain the rationale for the use of sport and exercise science interventions	
6.6	• Be aware of the characteristics and consequences of non-verbal communication and how this can be affected by culture, age, ethnicity, gender, religious beliefs, nationality, sexuality and socio-economic status	
Examples of how this could be achieved:	• Documented evidence of attendance at the 4 mandatory and 2 optional BASES SE workshops • Report from supervisor • Documented evidence of the presentation of information to different groups (peers, client groups etc) via different media (oral, written) • Delivery of a workshop • Video of delivery/communication • Assessment of learning styles • Marketing materials	• Documented examples of written material such as client reports, scientific material etc. • Case study examples where your communication skills have influenced the outcome • Conferences, posters/presentations, scientific articles • Lectures, curricula and lecture notes • Evaluation forms • Peer and client review • Role play • Ability to translate and communicate scientific detail to the end user

EXPERIENCE: The candidate should be able to demonstrate that he/she has worked in an environment that has enabled the individual to receive training and gain experience relevant to the competences set out below.

7 – Problem Solving and Impact

Ability to address problems in a scientific and evidence based manner which results in a positive and timely outcome

	AREA OF COMPETENCE	INDICATE SECTION(S) IN PORTFOLIO WHERE COMPETENCE IS DEMONSTRATED
7.1	• Be able to demonstrate a logical and systematic approach to problem solving	• Peer Reviewed Publications – Pages 41-42 • Case Study – Pages 2-15 • Conference presentations – Pages 52-53 • Teaching observations – Pages 65-66 • PGCHE Portfolio Reflection – Page 60
7.2	• Be able to monitor and review the ongoing effectiveness of planned activity and modify it accordingly	
7.3	• Be able to initiate resolution of problems and be able to exercise personal initiative	
7.4	• Be able to apply problem solving and scientific reasoning to assessment findings to plan and prioritise appropriate expertise specific interventions	
7.5	• Recognise the value of case conferences and other methods of review	
7.6	• Be able to make reasoned decisions to initiate, continue, modify or cease treatment or the use of techniques or procedures and record the decisions and reasoning appropriately	
Examples of how this could be achieved:	• Case study examples demonstrating the approach taken to solving problems • Examples of reflective accounts on practice • Needs analysis • Refereed publications • Presentations at conferences and workshops • Formal evaluation of teaching	

EXPERIENCE: The candidate should be able to demonstrate that he/she has worked in an environment that has enabled the individual to receive training and gain experience relevant to the competences set out below.

8 – Management of Self, Others and Practice

Be able to demonstrate an understanding of management requirements and how to manage self and others

	AREA OF COMPETENCE	INDICATE SECTION(S) IN PORTFOLIO WHERE COMPETENCE IS DEMONSTRATED
8.1	• Demonstrate the achievement of desired outcomes with the effective management of resources and risks	• Course Leader on MSc Sport and Exercise Nutrition - CV (Page 1) • PhD in Exercise Physiology – Page 40 • References – Pages 24-29 • Conference and workshop attendance – Pages 52-53 • PhD and MRes supervisor – CV (Page 1) • Ethics submissions and risk assessments – Pages 76-81 • Sport and Exercise Nutrition Register accreditation – Page 61 • Attendance at staff development sessions – Pages 82-83
8.2	• Demonstrate a commitment to professional development through continuing advancement of own knowledge, understanding and competence	
8.3	• Be able to maintain records appropriately	
8.4	• Be able to contribute effectively to work undertaken as part of a multi-disciplinary team	
8.5	• Promote and implement robust policies and protocols relating to health, safety and security	
8.6	• Promote and ensure compliance with all relevant regulatory requirements and quality standards	
8.7	• Demonstrate understanding and compliance with relevant codes of conduct	
Examples of how this could be achieved:	• Documented evidence of attendance at the 4 mandatory and 2 optional BASES SE workshops • Structured taught element of post graduate degree • Leading on projects • Risk assessment	• Attendance at relevant workshops and training days • Documented situations which demonstrate appropriate understanding • Team boundaries • Appropriate CPD activities

EXPERIENCE: The candidate should be able to demonstrate that he/she has worked in an environment that has enabled the individual to receive training and gain experience relevant to the competences set out below.

9 – Understanding of the Delivery Environment

Be able to demonstrate a knowledge of and integration into, the specific delivery environment

	AREA OF COMPETENCE	INDICATE SECTION(S) IN PORTFOLIO WHERE COMPETENCE IS DEMONSTRATED
9.1	• Oversee the implementation of solutions with due regard to the wider environment and broader context.	• References – Pages 24-29 • Collaboration with [redacted] (Memorandum of Understanding) – Pages 84-86 • Case Study – survey with professional practitioners and Sunderland AFC Academy – Pages 5 and 11 • Peer Reviewed Publications – Pages 41-42 • Module Design – Pages 45-50 • Case study reflection – Pages 14-15
9.2	• Demonstrate the ability to mediate, develop and maintain positive working relationships	
9.3	• Understand the structure and function of relevant services in the UK and current developments within which they operate; and be able to respond accordingly	
9.4	• Recognise that relationships with service users should be based on mutual respect and trust, and be able to maintain high standards of case even in situations of personal incompatibility	
9.5	• Understand the requirement to adapt practice to meet the needs of different groups distinguished by, for example, physical, psychological, environmental, cultural or socio-economic factors	
9.6	Understand the need to agree the goals, priorities and methods of the proposed intervention in partnership with the service user	
Examples of how this could be achieved:	• Feedback from clients • Letter of support • Voluntary work • Case study which demonstrates understanding of and adaptation to the delivery environment • Examples from own practice	

EXPERIENCE: The candidate should be able to demonstrate that he/she has worked in an environment that has enabled the individual to receive training and gain experience relevant to the competences set out below.

10 – Professional Relationships and Behaviours

Be able to demonstrate adherence to the highest standard of ethical and professional behaviour and team work in working with colleagues and clients

	AREA OF COMPETENCE	**INDICATE SECTION(S) IN PORTFOLIO WHERE COMPETENCE IS DEMONSTRATED**
10.1	• Be able to practice within the legal and ethical boundaries of their profession	• Attendance at staff development sessions – Pages 82-83 • Transgender Awareness Course – Page 87 • Ethics submissions and risk assessments – Pages 76-81 • Use of consent forms – Page 79 • Course Leader on MSc in Sport and Exercise Nutrition – CV (Page 1) • References – Pages 24-29
10.2	• Be able to practice in a non-discriminatory manner	
10.3	• Understand the importance of and be able to maintain confidentiality	
10.4	• Understand the importance of and be able to obtain informed consent	
10.5	• To be able to exercise a professional duty of care and to act in the best interests of service users at all times	
10.6	• Demonstrate effective leadership through the ability to guide, influence, inspire and empathise with others	
10.7	• Be aware of applicable health and safety legislation, and any relevant safety policies and procedures in force in the workplace, such as incident reporting and be able to act in accordance with these	
10.8	• Know the limits of their practice and when to seek advice or refer to another professional	
Examples of how this could be achieved:	• Relevant taught elements of postgraduate degree • Examples of forms and records kept • Attendance at appropriate training days • Testimonials from service users • Successful ethics submission • Case study examples of good practice • Consent forms	

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