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1 **MANUSCRIPT TITLE:** The effects of an increased calorie breakfast consumed prior to
2 simulated match-play in Academy soccer players

3

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24 **ABSTRACT**

25 Dietary analysis of Academy soccer players' highlights that total energy and carbohydrate
26 intakes are less than optimal; especially, on match-days. As UK Academy matches kick-off
27 at ~11:00 h, breakfast is likely the last pre-exercise meal and thus may provide an
28 intervention opportunity on competition day. Accordingly, the physiological and performance
29 effects of an increased calorie breakfast consumed ~135-min before soccer-specific exercise
30 were investigated. English Premier League Academy soccer players ($n=7$) repeated a 90-min
31 soccer match simulation on two occasions after consumption of habitual (B_{hab} ; ~1100 kJ) or
32 increased (B_{inc} ; ~2100 kJ) energy breakfasts standardised for macronutrient contributions
33 (~60% carbohydrates, ~15% proteins and ~25% fats). Countermovement jump height, sprint
34 velocities (15-m and 30-m), 30-m repeated sprint maintenance, gut fullness, abdominal
35 discomfort and soccer dribbling performances were measured. Blood samples were taken at
36 rest, pre-exercise, half-time and every 15-min during exercise. Although dribbling precision
37 ($P=0.522$; 29.9 ± 5.5 cm) and success ($P=0.505$; $94\pm 8\%$) were unchanged, dribbling speed was
38 faster ($4.3\pm 5.7\%$) in B_{inc} relative to B_{hab} ($P=0.023$; 2.84 vs 2.75 m·s⁻¹). Greater feelings of gut
39 fullness ($67\pm 17\%$, $P=0.001$) were observed in B_{inc} without changes in abdominal discomfort
40 ($P=0.595$). All other physical performance measures and blood lactate and glucose
41 concentrations were comparable between trials (all $P>0.05$). Findings demonstrate that
42 Academy soccer players are able to increase pre-match energy intake without experiencing
43 abdominal discomfort; thus, contributing to the amelioration of energy deficits on match
44 days. Furthermore, whilst B_{inc} produced limited benefits to physical performance, increased
45 dribbling speed was identified, which may be of benefit to match-play.

46

47 **KEYWORDS:** nutrition; skill; performance; metabolism

48

49 Introduction

50 The demands of Academy soccer include a requirement to cover distances of ~7-9 km
51 (Goto, Morris, & Nevill, 2015), perform explosive bouts of skill-based work (Stolen,
52 Chamari, Castagna, & Wisloff, 2005) and run at high intensities for up to 375 ± 120 m per
53 half (Russell, Sparkes, Northeast, & Kilduff, 2015a). However, given the importance of
54 optimised nutritional intake on the day of competition for team sports players (Williams &
55 Serratos, 2006), it is surprising that the dietary practices of Academy soccer players
56 (specifically higher age Youth Development phase ~U15-U16 and lower age Professional
57 Development phase ~U18) seldom meet recommended values (Briggs et al., 2015; Russell &
58 Pennock, 2011). With regards to total energy intake, consistent observations highlight less
59 than optimal practices when food is consumed *ad libitum* in free-living conditions (Briggs et
60 al., 2015; Russell & Pennock, 2011). Notably, energy deficits of 2278 ± 2307 kJ·d⁻¹ have
61 been reported on match days (Briggs et al., 2015), with a mean habitual breakfast intake of
62 1165 ± 129 kJ (Briggs, unpublished observations).

63
64 Whilst a periodised approach to nutrition is advised to compensate for multiple
65 matches played within close proximity and fluctuating daily training volumes (Anderson et
66 al., 2016), a pre-exercise meal containing ~1200-4700 kJ of primarily carbohydrates (1-4
67 g·kg⁻¹; 70-280 g for a 70 kg athlete) is recommended to be consumed >60 min before activity
68 commences (AND, DC & ACSM, 2016). However, in the case of the UK-based Academy
69 soccer player, competitive matches generally kick-off earlier in the day when compared to
70 their senior counterparts (e.g., 11:00 h vs. 15:00 h). Thus, limited time separates waking and
71 the onset of exercise. A multitude of reasons may explain sub-optimal pre-match energy
72 intakes in Academy soccer players (e.g., focus on sleep, home vs. away logistical issues etc.);

73 however, the failure to modify habitual food and beverage intake practices in the context of
74 proximity to kick-off is likely a contributing factor. Notably, habitual breakfast intake fails to
75 meet pre-exercise recommendations in terms of energy (i.e., 1165 ± 129 kJ; Briggs
76 unpublished observations) and carbohydrate (i.e., 40-65 g; Naughton et al., 2016) intake;
77 albeit in comparison to recommendations for adult populations (~ 1200 - 4700 kJ; AND, DC &
78 ACSM, 2016) in the absence of population-specific data.

79

80 While it is evident that the days preceding competition provide an opportunity to
81 positively impact upon performance with respect to macronutrient intake (e.g., carbohydrate;
82 Souglis et al., 2013), match-day itself also allows practitioners to optimise pre-competition
83 practices (Russell, West, Harper, Cook, & Kilduff, 2015b). As liver and muscle glycogen
84 depletion is attributed as one of the main mechanisms of fatigue in soccer (Krustrup et al.,
85 2006), modified breakfast intake may provide an intervention opportunity on match-day. In
86 the context of morning events, a small pre-exercise meal (~ 1700 - 2100 kJ) primarily
87 consisting of carbohydrate has also been recommended 2-3 h before exercise commences
88 (ACSM, 2015). The rationale for modified breakfast intake is further substantiated by data
89 linking the omission of breakfast to impaired exercise performance thereafter (Clayton,
90 Barutcu, Machin, Stensel, & James, 2015) and studies examining the modulation of pre-
91 exercise nutritional status (Anderson et al., 2016) and overnight fasting (Burke, 2007) on
92 endogenous energy storage. Accordingly, the primary aim of the study was to examine the
93 effects of a prescribed (recommended meal composition; ACSM, 2015) versus habitual
94 breakfast on performance measures and physiological responses of Academy players during a
95 90 min soccer match simulation.

96

97 **Methods**

98 *Study Design*

99 Using a randomised, counterbalanced and cross over design, professional Academy
100 soccer players completed a simulated soccer match with physiological and performance
101 measurements taken at regular intervals. The dependent variables included in this study were
102 indices of exercise intensity (i.e., heart rate, rating of perceived exertion, blood lactate and
103 glucose concentrations), performance (i.e., 15-m and 30-m sprint speeds, 30-m repeated
104 sprint maintenance, countermovement jump height, soccer dribbling performance), subjective
105 measures of pre-exercise nutritional intake (i.e., abdominal discomfort and gut fullness), and
106 hydration status (i.e., plasma and urine osmolality, plasma volume and body mass changes).

107

108 *Participants*

109 Seven male soccer players (age: 16 ± 1 y; stature: 1.75 ± 0.04 m; body mass: $69.4 \pm$
110 5.2 kg; Body Mass Index: 22.6 ± 1.5 kg·m⁻²; estimated $\dot{V}O_{2\max}$: 56 ± 3 ml·kg⁻¹·min⁻¹) playing
111 for an English Premier League Academy participated in the study. The maturity offset was
112 3.9 ± 0.8 y beyond Peak Height Velocity (PHV) indicating that all of the participants had
113 reached their predicted PHV (positive maturity offset) and thus were of a similar maturation
114 status (Mirwald et al., 2002). All players were actively engaged in full Academy training and
115 competition for ~20 h per week. Once institutional ethical approval was granted, written
116 informed consent was obtained from both players and their respective parents or guardians
117 prior to study involvement.

118

119 *Procedures*

120 Following an initial protocol familiarisation (to reduce trial-order effects) and
121 estimation of $\dot{V}O_{2\max}$ (Yo-Yo Intermittent Recovery Test; Bangsbo, Iaia, Krstrup, 2008),
122 players were required to attend two trials. Trials were separated by 9 ± 4 days; ensuring
123 training days (45 min tactical-specific training session) of comparable intensities preceded
124 testing. Players were asked to replicate free-living dietary intake, whilst also refraining from
125 consumption of caffeine and supplements in the 24 h preceding each trial. Pre-trial energy
126 intakes (8.7 ± 0.7 MJ·d⁻¹) and macronutrient contributions were similar (carbohydrates,
127 proteins, fats: 3.16, 1.88, 1.02 g·kg⁻¹, respectively) between trials (all $P > 0.05$) for the 24 h
128 prior to testing. Players were required to attend the training ground at 08:00 h (i.e., ~180 min
129 before commencing exercise) following an overnight fast. Body mass and stature (Seca
130 GmbH & Co., Germany) were then measured prior to a resting fingertip capillary blood
131 sample and mid-flow urine sample being obtained.

132

133 At ~08:45 h, players consumed an increased calorie breakfast (B_{inc} : 2079 kJ, 77 g
134 carbohydrate, 14 g protein and 12 g fat) that adhered to recommendations specific to morning
135 exercise (ACSM, 2015), or a habitual breakfast (B_{hab} : 1122 kJ, 39 g carbohydrate, 10 g
136 protein and 8 g fat). Pilot testing of the free-living dietary habits of Academy soccer players
137 supported the habitual pre-exercise energy intakes used in this study in B_{hab} (Briggs,
138 unpublished observations) and replicated previously published data with respect to pre-match
139 carbohydrate intake (Naughton et al., 2016). Whilst the total energy intake increased
140 approximately two-fold between trials, this was primarily achieved via manipulation of
141 absolute carbohydrate content as macronutrient contributions to the total energy yield
142 remained similar for carbohydrates (i.e., 61% vs. 59%), proteins (14% vs. 15%), and fats

143 (25% vs. 26%) for B_{inc} and B_{hab} respectively. After having been pre-weighed by the research
144 team, both breakfasts consisted of cereal and buttered toast and were provided with 500 mL
145 of a fluid-electrolyte beverage (Mineral Water, Highland Spring, UK). Thereafter, players
146 remained in a rested state for ~90 min; upon which a pre-exercise blood sample was taken. A
147 standardised warm-up (consisting of soccer-specific dynamic movements, stretches and
148 skills; ~10 min) was performed, during which players were required to consume an additional
149 200 ml of fluid-electrolytes. Measures of physical performance including countermovement
150 jump height (CMJ) and 30-m repeated sprint maintenance (RSM) were tested prior to the
151 Soccer Match Simulation (SMS) commencing (Russell, Rees, Benton, & Kingsley, 2011a). A
152 timeline schematic of trial day procedures is outlined in Figure 1.

153

154

INSERT FIGURE 1. HERE

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The SMS is comprised of two 45 min bouts of soccer-specific exercise, with 15 min
of passive recovery replicating half-time (HT). During HT players consumed 500 mL of
fluid-electrolytes in line with typical behaviours of youth soccer players. Assessments of
soccer dribbling (Russell, Benton, & Kingsley, 2010) and 15-m sprinting were performed
alternatively during each cycle of the protocol. Full details of the SMS protocol are outlined
by Russell et al. (2011a). The repeatability of the SMS, and responses to this exercise
protocol, has previously been determined (Harper et al., 2016; Russell, Benton, & Kingsley,
2011b).

166 Participant CMJ height and 30-m RSM were tested at four time points (pre-exercise;
167 post-first half; pre-second half; post-second half), each requiring three CMJ's separated with
168 10 s of passive recovery and three 30-m sprints with 25 s of active recovery (light jogging).
169 In both performance tests the mean value of the three attempts was used for analysis. CMJ
170 height was determined using an optical measuring system (OptoJump Next, Microgate Corp,
171 Italy). Players began each repetition from a standing position and performed a preparatory
172 crouching action (at a consistent, self-determined level) before explosively jumping out of the
173 dip for maximal height. Hands were isolated at the hips for the entire movement to eliminate
174 any influence of arm swing. For RSM testing, players commenced each repetition from a
175 standing start at a distance of 0.3-m behind the first timing gate (Brower Timing, Utah) and
176 verbal encouragement was provided throughout each attempt.

177

178 Integrated 15-m sprints and 18-m dribbles (assessed for precision, percentage success
179 and average speed) were recorded throughout the SMS. Players were required to dribble the
180 ball as fast and as accurately as possible between cones spaced every 3-m as per Russell et al.
181 (2011a). All dribbles were video recorded (50 Hz; 103 DCR-HC96E; Sony Ltd, UK) and
182 digitisation processes (Kinovea version 0.8.15; Kinovea Org., France) derived speed (time
183 taken to successfully complete the distance) and precision (distance of the ball from each
184 cone) data. The test-retest reliability for all components of the SMS have been determined,
185 including physiological (CV: 2.6%), metabolic (CV: 16.1%) and performance (CV: 2.1%)
186 responses (Russell et al., 2011b).

187

188 Fingertip capillary blood samples (170 μ l) were taken at rest, pre-exercise, HT and at
189 the end of each 15 min period of the protocol. Blood samples were analysed for variables

190 associated with exercise intensity and fatigue (i.e., blood glucose and lactate concentrations
191 via GEM Premier 3000; Instrumentation Laboratory, UK; CV's: 0.6-2.2%) (Beneteau-
192 Burnat, Bocque, Lorin, & Martin, 2004). Urine and plasma osmolality (Advanced Model 121
193 3300 Micro-Osmometer; Advanced Instruments Inc., USA; CV: 1.5%) and urine corrected
194 mass changes were determined and the rate of perceived exertion (RPE) (Borg, 1973) was
195 recorded every 15 min. Environmental conditions were measured during exercise
196 (Technoline WS-9032; Technotrade GmbH, Germany). Heart rate (HR) was continuously
197 recorded (Polar S610; Polar, Finland), with gut fullness (paper-based 100mm Visual
198 Analogue Scale (VAS), ranging from 'not full at all' to 'very full') recorded immediately
199 after breakfast, 30 min post, 60 min post and 90 min post/immediately prior to exercise.
200 Abdominal discomfort (based on a self-perceived subjective rating 0-10; 'no discomfort' to
201 'worst possible discomfort') was determined at the end of each 15 min block of the protocol.
202 Post exercise body mass was also recorded in addition to a mid-flow urine sample.

203

204 *Statistical Analysis*

205 For parametric data expressed over multiple time-points, two-way repeated measures
206 analysis of variance (within-participant factors: treatment x time) were performed (once
207 confirmed by normality and variance assessments), which included dribbling (precision,
208 speed and success), sprint velocities (15 and 30-m), CMJ height, 30-m RSM, RPE, heart rate
209 (HR), gut fullness, abdominal discomfort and blood glucose and lactate concentrations.
210 Mauchly's test was consulted and Greenhouse-Geisser correction was applied if the
211 assumption of sphericity was violated. Significant main effects were further investigated
212 using multiple pairwise comparisons with LSD confidence interval adjustment (95%
213 Confidence Intervals; CI). Partial eta-squared (η^2) values were calculated and Cohen's *d*

214 effect size examined between-trial differences. A paired samples *t*-test was used to analyse
215 differences in mean body mass pre and post-exercise. For η^2 and effect size data, thresholds
216 of 0.2, 0.5, and 0.8 were considered small, medium and large, respectively (Fritz, Morris, &
217 Richler, 2012). All data are presented as mean \pm SD, with level of significance set at $P \leq 0.05$
218 using SPSS (Version 22; SPSS Inc., USA) for all analyses.

219

220 Results

221 Pre-exercise plasma osmolality was similar amongst players between each trial ($312 \pm$
222 $6 \text{ mOsmol}\cdot\text{kg}^{-1}$, $P=0.936$). Ambient temperature ($18.5 \pm 1.5^\circ\text{C}$), humidity ($74 \pm 7\%$) and
223 barometric pressure ($1017 \pm 3 \text{ mmHg}$) were also consistent between trials ($P>0.05$).

224

225 Compared to B_{hab} , gut fullness was greater ($F_{(1,7)} = 7.262$, $p = 0.027$, $\eta^2 = 0.548$)
226 immediately (60 ± 15 vs. 19 ± 15 , $P=0.002$, $d = 2.8$, CI: 22-60), 30 min (58 ± 13 vs. 18 ± 13 ,
227 $P=0.001$, $d = 3$, CI: 23-58), 60 min (46 ± 11 vs. 15 ± 13 , $P=0.003$, $d = 2.5$, CI: 15-47) and 90
228 min after ingestion and immediately pre-exercise (40 ± 11 vs. 13 ± 10 , $P=0.001$, $d = 2.6$, CI:
229 15-38) during B_{inc} . Abdominal discomfort was similar between trials ($F_{(5,30)} = 0.746$,
230 $P=0.595$, $\eta^2 = 0.111$).

231

232 Mean dribbling precision ($F_{(2,10)} = 0.856$, $P=0.433$, $\eta^2 = 0.125$) and success ($F_{(2,10)} =$
233 0.666 , $P=0.505$, $\eta^2 = 0.100$) was comparable between trials whereas mean dribbling speed
234 was faster ($-4.3 \pm 5.7\%$) in B_{inc} ($F_{(5,30)} = 3.072$, $P=0.023$, $\eta^2 = 0.339$) (Figure 2). Post hoc
235 comparisons were unable to isolate these specific differences but dribbling speed was $13.3 \pm$
236 10.1% and $7.1 \pm 10.2\%$ greater at 61-75 min and 76-90 min respectively during B_{inc} .

237

238 ***INSERT FIGURE 2. HERE***

239

240 Breakfast did not influence 15-m ($F_{(2,12)} = 0.668$, $P=0.534$, $\eta^2 = 0.100$) or 30-m sprint
241 velocities ($F_{(3,18)} = 0.136$, $P=0.938$, $\eta^2 = 0.022$). Similarly, 30-m RSM ($F_{(3,18)} = 0.072$,
242 $P=0.974$, $\eta^2 = 0.012$) and CMJ ($F_{(3,18)} = 0.946$, $P=0.439$, $\eta^2 = 0.136$) performance was similar
243 between trials. However, an exercise effect was observed in all these variables (all $P<0.05$;

244 medium effect size). Sprint velocities over 15-m were significantly reduced in the periods 31-
 245 45 min ($5.72 \pm 0.43 \text{ m}\cdot\text{s}^{-1}$), 46-60 ($5.64 \pm 0.47 \text{ m}\cdot\text{s}^{-1}$) and 76-90 min ($5.59 \pm 0.63 \text{ m}\cdot\text{s}^{-1}$) when
 246 compared to 0-15 min ($5.94 \pm 0.53 \text{ m}\cdot\text{s}^{-1}$; all $P < 0.05$). Sprint velocity over 30-m and 30-m
 247 RSM both demonstrated decrements in performance in post 1st half, pre 2nd half and post 2nd
 248 half when compared to pre-exercise (all $P < 0.01$; see Table 1). Likewise, CMJ height was
 249 reduced ($P < 0.05$) pre 2nd half ($32.5 \pm 3.5 \text{ cm}$) when compared to pre-exercise ($35.3 \pm 2.9 \text{ cm}$;
 250 Table 1).

251

252 ***INSERT TABLE 1 HERE***

253

254 Heart rate was similar between trials ($F_{(5,30)} = 2.353$, $P = 0.065$, $\eta^2 = 0.282$), with no
 255 trial effect identified ($F_{(1,9)} = 1.294$, $P = 0.307$, $\eta^2 = 0.177$). Likewise, RPE was not influenced
 256 by trial ($F_{(5,30)} = 0.691$, $P = 0.634$, $\eta^2 = 0.103$), despite increases at 46-60 min (13 ± 3), 61-75
 257 min (14 ± 3) and 76-90 min (15 ± 3), when compared to 0-15 min (11 ± 3) values (all
 258 $P < 0.01$). Mean differences in body mass pre and post-exercise were not influenced by trial
 259 ($t_{(6)} = -0.337$, $P = 0.747$). Mean body mass changes (pre: 69.6 kg, post: 68.9 kg) equated to a
 260 mean difference of 0.75 kg in B_{hab} , similar to B_{inc} (pre: 70.5 kg, post: 69.8 kg, mean
 261 difference: 0.70 kg).

262

263 Blood lactate was similar between trials ($F_{(2,11)} = 0.728$, $P = 0.495$, $\eta^2 = 0.108$) as were
 264 blood glucose ($F_{(3,19)} = 2.983$, $P = 0.055$, $\eta^2 = 0.332$) concentrations. Exercise effects were
 265 observed in both of these variables ($F_{(2,10)} = 9.618$, $P = 0.007$, $\eta^2 = 0.616$; $F_{(3,19)} = 10.563$,
 266 $P = 0.0001$, $\eta^2 = 0.638$, respectively). Blood lactate was significantly higher during 0-15 min
 267 ($P = 0.009$), 31-45 min ($P = 0.006$), HT ($P = 0.0001$), 46-60 min ($P = 0.018$), 61-75 min

268 (P=0.008), 76-90 min (P=0.045) in comparison to pre-exercise concentrations (Table 2).
269 Blood glucose was significantly reduced (all P<0.05) during 31-45 min ($-6.9 \pm 7.3\%$), HT (-
270 $10.9 \pm 6.4\%$), 46-60 min ($-11.6 \pm 7.9\%$), 61-75 min ($12.6 \pm 7.5\%$), and 76-90 min ($11.2 \pm$
271 9.6%) in comparison to 0-15 min (Table 2).

272

273

INSERT TABLE 2 HERE

274

275 Discussion

276 The primary aim of the study was to examine the effects of increasing pre-exercise
277 energy intake (via manipulation of absolute carbohydrate content) on performance measures
278 and physiological responses of Academy players during a 90 min soccer match simulation.
279 Although dribbling precision and success were unchanged, dribbling speed was improved in
280 B_{inc} relative to B_{hab} . Unsurprisingly, greater feelings of gut fullness were observed in B_{inc} but
281 not at the expense of changes in abdominal discomfort. Therefore, although limited physical
282 benefits were observed, modified breakfast content may offer an intervention opportunity on
283 match day that addresses the previously identified energy deficits common in this population
284 (Briggs et al., 2015).

285

286 When compared to B_{hab} , mean dribbling speed was $4.3 \pm 5.7\%$ faster than B_{inc} .
287 Although post hoc comparisons were unable to detect differences between particular time-
288 points, dribbling speeds were $13.3 \pm 10\%$ and $7.1 \pm 10\%$ greater at 61-75 min and 76-90 min
289 respectively during B_{inc} . Interestingly, more successful Academy players are associated with
290 conducting movement patterns at higher speeds (Goto et al., 2015), therefore an increased
291 dribbling speed may have positive implications for match-play, especially during phases of
292 the game related to higher fatigue (Krustrup et al., 2006). Although not isolated to breakfast
293 intake, match-day carbohydrate ingestion has previously been demonstrated to improve
294 soccer-skills in adolescents (Russell, Benton, & Kingsley, 2012); namely, soccer shooting
295 performance. Current findings are in agreement that the nutritional intervention was
296 beneficial to aspects of soccer skill performance.

297

298 The B_{inc} breakfast (2079 kJ, 77 g carbohydrate, 14 g protein and 12 g fat) contained a
299 carbohydrate intake equivalent to $1.11 \text{ g}\cdot\text{kg}^{-1}$ BM which is higher than prescribed in studies
300 with similar populations ($0.78 \text{ g}\cdot\text{kg}^{-1}$ BM; Phillips et al., 2010; Phillips et al., 2012). Despite
301 methodological variation regarding the timing of pre-match energy intake, current findings
302 support the notion of limited effects of pre-exercise carbohydrate consumption on maximal
303 sprint performance (Phillips et al., 2010; Phillips et al., 2012). The SMS required ~33
304 maximal sprints interspersed with both high and low-intensity running to mimic movement
305 patterns associated with soccer match-play. However, whilst sprint performance appears
306 maintained when multiple 15-m sprints are separated by 30 s passive recovery (Balsom,
307 Seger, Sjodin, & Ekblom, 1992), such activity patterns are not congruent with the SMS
308 protocol and indeed match-play itself.

309

310 The lack of improvement in CMJ height during B_{inc} is not uncommon as previous
311 research involving adolescent athletes has highlighted a reduction in peak power output when
312 participants do not engage in passive recovery between multiple bouts (Thevenet, Tardieu-
313 Berger, Berthoin, & Prioux, 2007). Despite the higher calorie intake and increased
314 carbohydrate content during B_{inc} , blood glucose concentrations were not significantly
315 enhanced ($P=0.055$); although a trend towards significance and a small effect ($\eta^2 = 0.332$)
316 was found (Table 2). In addition, blood lactate concentrations, HR and RPE were also similar
317 (all $P>0.05$) between trials (Table 2). Therefore, the standardisation of the physiological
318 demands between trials and the limited glycaemic response of B_{inc} versus B_{hab} may explain
319 the similar between-trial findings for specific physical variables.

320

321 Academy soccer players have been found to display poor nutritional practices with
322 reports of mean daily energy deficits of $1302 \pm 1662 \text{ kJ}\cdot\text{d}^{-1}$ (Briggs et al., 2015) and $3299 \pm$
323 $329 \text{ kJ}\cdot\text{d}^{-1}$ (Russell & Pennock, 2011). Furthermore, match day energy balance within this
324 population is less than optimal; demonstrating mean deficits of $2278 \pm 2307 \text{ kJ}\cdot\text{d}^{-1}$ (Briggs et
325 al., 2015). Despite limited evidence of performance benefits with increased energy intake
326 during B_{inc} , the additional calorie content may be worthwhile to simultaneously reduce the
327 energy deficits observed on match-day. Additionally, the increased calorie intake apparent in
328 B_{inc} did not induce any abdominal discomfort versus B_{hab} ($P=0.595$). Conversely, feelings of
329 gut fullness were increased immediately after consumption until the onset of exercise (all
330 $P<0.01$), potentially providing an additional subjective preparatory benefit.

331

332 **Conclusion**

333 The study findings demonstrate that Academy soccer players are able to increase pre-
334 match energy intake without experiencing detrimental effects of abdominal discomfort. Such
335 an approach may help to address previously identified concerns of energy deficits on
336 competition days. This finding may be of interest to applied practitioners working with
337 Academy soccer players who typically demonstrate less than optimal pre-match nutritional
338 habits. Furthermore, whilst B_{inc} produced limited benefits to physical performance, increased
339 dribbling speed was identified compared to B_{hab} , a finding which may be of benefit to match-
340 play. However, further investigations in to match-day strategies are warranted to help further
341 reduce energy deficit and elicit subsequent performance improvements.

342

343

344

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351

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461 Table 1. Performance variables as a function of timing and trial

Variable	Trial	Timing			
		Pre-exercise	Post-1 st Half	Pre-2 nd Half	Post-2 nd Half
30 m Sprint Velocities (m·s⁻¹)	<i>B_{inc}</i>	6.95 ± 0.25	6.80 ± 0.23	6.61 ± 0.33	6.70 ± 0.31
	<i>B_{hab}</i>	7.09 ± 0.16	6.88 ± 0.20	6.61 ± 0.23	6.76 ± 0.30
30 m RSM (%)	<i>B_{inc}</i>	99 ± 1	96 ± 4	93 ± 7	94 ± 4
	<i>B_{hab}</i>	98 ± 2	97 ± 3	94 ± 7	95 ± 3
CMJ Height (cm)	<i>B_{inc}</i>	35.0 ± 2.9	34.3 ± 2.7	32.8 ± 3.1	33.7 ± 2.7
	<i>B_{hab}</i>	35.7 ± 2.8	34.5 ± 5.2	32.0 ± 4.1	34.7 ± 4.3

462

463 RSM = Repeated Sprint Maintenance, CMJ = Countermovement Jump, *B_{inc}* = Intervention464 Trial, *B_{hab}* = Habitual intake trial. Data presented as mean ± SD.

465 Table 2. Blood metabolite data as a function of timing and trial

466

Variable	Trial	Timing (min unless stated)								
		Rest	Pre-exercise	0-15	16-30	31-45	HT	46-60	61-75	76-90
Lactate (mmol·l ⁻¹)	<i>B_{inc}</i>	0.7 ± 0.1	1.4 ± 0.5	5.1 ± 3.4	3.7 ± 3.8	4.9 ± 3.6	3.1 ± 1.1	3.9 ± 3.6	4.1 ± 2.9	3.4 ± 2.9
	<i>B_{hab}</i>	0.9 ± 0.3	1.2 ± 0.4	3.4 ± 1.1	2.8 ± 0.7	3.3 ± 0.5	2.6 ± 0.6	3.3 ± 1.2	2.9 ± 0.5	2.2 ± 0.3
Glucose (mmol·l ⁻¹)	<i>B_{inc}</i>	5.0 ± 0.7	5.7 ± 0.7	5.1 ± 0.5	4.7 ± 0.6	4.8 ± 0.5	4.5 ± 0.6	4.3 ± 0.4	4.2 ± 0.2	4.5 ± 0.5
	<i>B_{hab}</i>	4.9 ± 0.3	5.0 ± 0.5	5.1 ± 0.3	4.8 ± 0.3	4.7 ± 0.2	4.6 ± 0.3	4.7 ± 0.3	4.7 ± 0.7	4.5 ± 0.6

467 *B_{inc}* = Intervention Trial, *B_{hab}* = Habitual intake trial. HT = half-time. Data presented as mean ± SD.

Figure Legends

Figure 1. Schematic of trial day procedures.

Figure 2. Dribbling speed throughout each trial (mean \pm SD). B_{inc} = Intervention Trial, B_{hab} = Habitual intake trial. Treatment effect between B_{inc} and B_{hab} ($F_{(5,30)} = 3.072$, $P=0.023$, $\eta^2 = 0.33$)