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1 **Title:**

2 'Bridging the Gap': Differences in training and match physical load in 1st team and U23 players

3 from the English Premier League

4

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8 The authors report no conflict of interest.

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27 **ABSTRACT**

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29 **Objectives:** To explore the differences in training and match load in English Premier League
30 (EPL) 1st team and U23 players. Identifying differences in relative and absolute physical
31 outputs in relation to Maximal Aerobic Speed (MAS) and Maximal Sprint Speed (MSS) and
32 how this informs monitoring and training prescription. **Methods:** Two groups of full-time
33 professional football players (1st team, n = 24 and U23 squad, n = 27) participated in this study.
34 Training and match data were categorised into weekly blocks from Monday to Sunday. Each
35 player's weekly total was then averaged to provide a squad average for each metric examined.

36 **Results:** Match analysis identified significantly higher distance covered above 120% MAS and
37 distance between 120% MAS and 85% MSS ($p=0.04$, $ES=0.64$; $p<0.01$, $ES=1.13$) for the 1st
38 team. Distance above 85% MSS was significantly higher for the U23's ($p<0.01$, $ES=2.92$).
39 Training and match data during one-match weeks displayed significantly higher differences in
40 all high speed variables for 1st team players compared to U23 players ($p\leq 0.05$, $ES=0.82-1.78$).

41 Analysis of training and match data during a two -match week displayed no significant
42 differences for all physical variables ($p>0.05$). **Conclusions:** Practitioners should consider the
43 utilisation of individual relative thresholds to identify differences between physical
44 performance variables during training and matches for 1st team and U23 players. Utilising
45 these comparisons to inform training design, could maximise players physical development
46 and potential for successful transition. Importantly, these findings relate to only one EPL club
47 and ideally practitioners should assess their own players relative training and game outputs.

48 **Keywords:** football, MAS, speed thresholds, player development

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52

53 Introduction

54

55 Physical performance in football is characterised by its intermittent multi-directional nature,
56 that requires well-developed aerobic and anaerobic fitness (1, 2). In professional football the
57 management of high-speed running (HSR) is of huge importance from a performance and
58 injury prevention perspective (3). Historically, absolute HSR and sprint distance (SD) have
59 been represented by generic speed thresholds (or zones) of $5.5 \text{ m}\cdot\text{s}^{-1}$ and $7 \text{ m}\cdot\text{s}^{-1}$, respectively
60 (4). The quantification of high velocity metrics has been debated in the historical evidence base
61 since its inception, with a recent shift from absolute to relative thresholds (5, 6) to better align
62 the individualised nature of the exercise continuum (7). This focus provides a more accurate
63 representation of the actual individual player output, that are potentially underestimating when
64 absolute thresholds are applied (5). Current literature has paid particular attention to these high
65 velocity physical metrics to guide training approaches to optimise performance and reduce
66 injury risk (8, 9). That said, research surrounding ‘bridging the gap’ for these metrics between
67 U23 and 1st team players is still lacking. Transitional research for academy players into full-
68 time training has been completed, noting significant increases in training load, with no
69 differences noted between U18 and U23 teams (10). This body of work failed to consider the
70 transition from the U23 squad to the 1st team. Understanding these transitional differences and
71 subsequent physical demands is essential for player development (11).

72

73 Traditionally, high velocity thresholds and subsequent training zones have been determined by
74 training at a specific percentage of the athlete’s maximum speed (4) and thus **represents a**
75 **relative approach** to defining thresholds. Understanding the intensity of maximal speed efforts
76 across different age groups may support practitioners to optimise the long-term player
77 development process (12). However, the utilisation of this single method to determine a
78 player’s training prescription is limited, as no consideration has been made regarding the
79 players aerobic capacity (13, 14). **The existing literature states that total distance (TD)**
80 **correlates with high levels of aerobic fitness (1, 15, 16) and differentiates between the level of**
81 **player (17).** However, caution must be considered as TD alone does not **account for the**
82 **intensity at which the player has worked.** Essentially for a player to meet the demands of the
83 modern game, individualised aerobic and anaerobic capacities must be identified to accurately
84 prescribe training **for each player (18).**

85

86 The addition of Maximal Aerobic Speed (MAS) and Maximal Sprint Speed (MSS) has been
87 identified as an accurate method to provide greater context to training prescription, as it allows
88 the identification of each players aerobic and anaerobic capacity (19). Calculation of MAS
89 allows practitioners to identify the athletes anaerobic speed reserve (ASR) and optimise
90 specific match conditioning prescription (18). Maximal Aerobic Speed has been defined as a
91 practical and time efficient method to assess the aerobic energy system in team sport athletes
92 (20). One of the major benefits of MAS as a measure of aerobic fitness is the ease at which
93 practitioners can assess large groups of athletes without any expensive equipment required.
94 Recent evidence has identified a very large linear relationship between time above MAS (Time
95 >MAS) and changes in MAS ($r = 0.77$) (18). However, generic thresholds showed an unclear
96 correlation with changes in aerobic fitness (18). Therefore, the assessment of MAS as a
97 performance indicator is warranted within elite football. Maximal Aerobic Speed has
98 previously been used to identify changes in physical fitness in elite youth football players (18)
99 and its usefulness in an applied setting to prescribe training loads has been previously validated
100 (20). Individualising speed thresholds also provides a more 'player-centred' approach to
101 external workload which may support practitioners better understand the differences between
102 1st team and U23 players.

103

104 Currently there is scant literature examining 1st team and U23 physical outputs in professional
105 football. Employing individualised thresholds will provide more precise workload information
106 relative to the individual player's physical characteristics regardless of maturation status.
107 Physical outputs are monitored daily to ensure players are physically prepared for the demands
108 of match-play. The potential benefits of highly developed physical characteristics are important
109 to ensure U23 players are appropriately prepared for the potential demands of 1st team training
110 and match-play. Therefore, the aims of the present study were to analyse the physical
111 performance metrics within an elite English Premier League (EPL) football club, specifically;
112 1) to identify differences between 1st team and U23 players in relative physical outputs in
113 relation to MAS and MSS; 2) to identify the differences between 1st team and U23 players in
114 absolute physical outputs; and 3) to compare the differences between relative outputs (utilising
115 MAS and MSS) and absolute values and how this informs monitoring and training prescription.

116

117

118

119

120 **Methods**

121

122 The present study was designed to evaluate the differences in weekly training and match
123 demands between 1st team and U23 professional football players from an EPL Club using
124 absolute and relative speed thresholds. Training and match data was collected over a 7-month
125 period during the 2019-20 season. A full season of data was not obtained due to the COVID-
126 19 interruption. All players trained on a full-time basis and only completed Premier League,
127 Professional Development League and cup competitions, namely FA Cup, League Cup and
128 U23 Premier League Cup.

129

130 *Participants*

131

132 **Two groups of full-time professional football players were recruited to participate in this study.**
133 Players were recruited **from the 1st team (n = 24), age 29.8 ± 3.4 yrs; height 183.7 ± 5.2 cm;**
134 **weight 83.7 ± 6.9 kg and U23 team (n = 27), age 19.9 ± 1.5 yrs; height 184.9 ± 6.5cm; weight**
135 **81.9 ± 8.2 kg.** Although, all data was gathered as a condition of employment in which players
136 are routinely monitored over the course of the competitive season, approval for the study from
137 the club was obtained (21). Formal ethics was approved by the University of Central
138 Lancashire (BAHSS 646 dated 17/04/2019) and the study was conducted in accordance with
139 the Helsinki Declaration. To ensure confidentiality, all data were anonymised prior to analysis.
140 To be included in the weekly analysis players were required to complete all training sessions
141 during the study period and be included in the match-day squad. Players who did not complete
142 all sessions were removed from the analysis for each week. Relevant risk assessments and
143 safety protocols were completed and adhered to in accordance with the football governing
144 body, The Premier League and the academic institution.

145

146 *Experimental Design*

147

148 A global positioning system (GPS) (Apex, STATSports, Ireland) was used to quantify work-
149 load data collected from all pitch training sessions (1st team n = 139; U23 n = 132) and U23
150 competitive matches (n = 18). The GPS units were placed between the scapulae of the players
151 in bespoke vests. The GPS component sample rate was 10hz while the accelerometer within
152 the unit samples at 100hz. Such GPS devices have an acceptable level of accuracy and

153 reliability when measuring the speed of movement within intermittent exercise (22, 23).
154 Specifically, the Apex units have shown good levels of accuracy in sport specific metrics in
155 addition to non-significant and trivial differences when measuring peak velocity against the
156 gold standard measure (Stalker ATS 2,34.7 GHz, United States) (24). Competitive 1st team
157 match data (n = 24) was recorded using a semi-automated camera tracking system (Second
158 Spectrum, California, USA), which has previously been installed to standardise match data
159 collection in the EPL. The camera system is utilised due to the technological limitations of
160 GPS devices whereby satellite signal can be affected by stadiums and surrounding buildings,
161 which can lead to measurement error (25). Following each training session and match, data
162 was downloaded into STATSports (APEX 1.7) analysis software. Processing Second Spectrum
163 in this way allows for the raw optical tracking data to be subjected to the same smoothing
164 process that is employed by STATSports. Second Spectrum has previously met industry
165 standards as reported by the FIFA program (26). **Training and match data were categorised into**
166 **weekly blocks from Monday to Sunday. Squad average was calculated and examined for each**
167 **metric.**

168

169 Data collected for analysis from the GPS included: total distance (TD) covered, measured in
170 metres; explosive distance (ED), distance covered accelerating and decelerating greater than 2
171 $\text{m}\cdot\text{s}^{-2}$ measured in metres; HSR distance, distance covered above $5.5 \text{ m}\cdot\text{s}^{-1}$ measured in metres;
172 sprint distance (SD), distance covered above $7 \text{ m}\cdot\text{s}^{-1}$ measured in metres; distance covered at
173 speed above each player's MAS measured in metres; time spent at speed above each player's
174 MAS measured in minutes; distance above 120% MAS (relative high-speed running distance)
175 measured in metres, distance covered at speed above 120% of each players' individual MAS
176 measured in metres; distance above 85% MSS (relative sprint distance) measured in metres,
177 distance covered at speeds above 85% of each player's individual MSS (9) measured in metres;
178 Zone 5 speed, distance covered at speeds between $5.5 \text{ m}\cdot\text{s}^{-1}$ and $7 \text{ m}\cdot\text{s}^{-1}$ measured in metres;
179 distance between 120% MAS and 85% MSS (relative distance Zone 5) measured in metres,
180 distance covered at speeds between 120% of MAS and 85% MSS measured in metres.

181

182 *Maximal Aerobic Speed test*

183

184 During the pre-season period both the 1st and U23 players completed a **MAS test** to estimate
185 velocity at VO^2max . All players performed the MAS test during the first week of pre-season

186 and this was repeated during the third week of pre-season following three days of recovery
187 from the previous match. The previously validated MAS protocol was a 5-minute maximum
188 effort time trial (20). This 5-minute time trial has previously proven to correlate with MAS
189 assessed via laboratory gas analysis (20). A 500 m circular route was established prior to the
190 test (see Figure 1). Players were informed how much time was remaining at one-minute
191 intervals until test completion to ensure players were performing maximally (27). This verbal
192 encouragement has been shown to be a motivational requirement for laboratory assessments of
193 time to exhaustion and central fatigue (28).

194

195 ****Insert Figure 1****

196

197 Prior to the test protocol an extensive 15-minute dynamic warm up, including light jogging,
198 dynamic stretching and then intense, football specific movements were conducted. To
199 standardise the environment, testing was performed on an outdoor grass surface with players
200 wearing the same football boots throughout the investigation. The 5-minute test data was
201 examined using the STATSports (APEX, 1.7) software. **Maximal Aerobic Speed ($m\cdot s^{-1}$) was**
202 **determined by dividing TD covered by the test duration (300s) (20).**

203

204 *Maximum Sprint Speed*

205

206 During the pre-season period a linear speed phase consisting of twice weekly peak speed
207 exposures was conducted. Following this, each player's maximum speed reached during this
208 period was **established using GPS (Apex, STATSports, Ireland)**. The researchers decided to
209 take the maximum speed from this period as an average peak speed per session may be
210 influenced by session content and positional demands and therefore would not be a true
211 reflection of the players peak speed capacity. If a player produced a new MSS during the
212 season this was adjusted within the software. New speed bands were customised in the
213 STATSports (APEX, 1.7) software using each individuals MAS and 120% MAS to allow for
214 analysis of individualised running demands (18). Sprint entry speed was set at 85% of each
215 player's MSS using STATSports (APEX, 1.7) software. All peak speeds were validated
216 **visually by the researchers using STATSports (APEX, 1.7) software** to ensure no anomalies
217 were included in the analysis. Players that did not participate in full team training each week
218 were removed from analysis.

220

221 Prior to analysis, the data were checked for normality using a Shapiro-Wilk test. Data was
222 presented as mean \pm standard deviation, and 95% confidence intervals (CI). Data was analysed
223 using SPSS 26.0 (SPSS Inc., Chicago, IL, USA). All examined GPS metrics were compared
224 using independent-sample t-tests to determine if any significant differences between team total
225 match outputs, and between players weekly outputs, across all physical performance metrics
226 were observed. For weekly outputs, separate comparisons were made, respectively, for one-
227 match and two-match weeks. For each player, average weekly outputs were calculated related
228 to one-match or two-match weeks, and subsequently used for comparisons between 1st team
229 and U23 players. Statistical significance was set at $p < 0.05$. The absolute standardised mean
230 difference (Cohen's d) between 1st team and U23 players was taken as the effect size (ES). The
231 ES magnitude was interpreted according to the following criteria: < 0.2 , trivial; 0.2 to 0.5, small;
232 0.5 to 0.8, moderate; > 0.8 , large (18).

233

234 **Results**

235

236 For the 1st team players, the mean \pm standard deviation MAS and MSS were, $4.63 \pm 0.21 \text{ m}\cdot\text{s}^{-1}$
237 1 and $9.53 \text{ m}\cdot\text{s}^{-1} \pm 0.48 \text{ m}\cdot\text{s}^{-1}$ respectively, while the U23 players were $4.74 \pm 0.14 \text{ m}\cdot\text{s}^{-1}$ and
238 $9.34 \text{ m}\cdot\text{s}^{-1} \pm 0.44 \text{ m}\cdot\text{s}^{-1}$ respectively. The difference between 1st team and U23 players was not
239 statistically significant for both MAS ($p=0.17$) and MSS ($p=0.36$). Table 1 summarises the
240 differences between team total match outputs for 1st team and U23 players.

241

242

Insert Table 1

243

244 Analysis of match outputs identified significantly higher distance at speed $> 120\%$ MAS
245 ($p=0.04$, ES = 0.62, moderate) and distance between 120% MAS and 85% MSS ($p < 0.01$, ES
246 = 1.13, large), and significantly lower ($p < 0.01$) (ES = 2.92, large) distance at speed $> 85\%$
247 maximum speed, in 1st team vs. **U23 players**. No significant differences were observed for TD
248 ($p=0.06$), HSR ($p=0.15$), SD ($p=0.76$), time at speed $>$ MAS ($p=0.95$), distance at speed $>$ MAS
249 ($p=0.81$), Zone-5 distance ($p=0.09$), and ED ($p=0.08$) (Table 1).

250

251 Table 2 summarises the differences in average training and match output between 1st team and
252 U23 players in one-match weeks.

253

254 ****Insert Table 2****

255

256 Analysis of average weekly outputs for one-match weeks identified significantly greater values
257 for 1st team vs. U23 players in distance at speed >120% MAS (p<0.01, ES = 1.54, large), HSR
258 (p<0.01, ES = 1.78, large), SD (p=0.01, ES = 1.08, large), time at speed >MAS (p=0.04, ES =
259 0.82, large), distance at speed >MAS (p<0.02, ES = 1.10, large), Zone-5 distance (p<0.01, ES
260 = 1.48, large) and distance between 120% MAS and 85% MSS (p<0.01, ES = 1.63, large). No
261 significant differences were found for TD (p=0.59), distance at speed >85% MSS (p=0.10),
262 and ED (p=0.81).

263

264 Table 3 summarises the differences in average training and match output between 1st team and
265 U23 players in two-match weeks.

266

267 ****Insert Table 3****

268

269 No significant differences were found for TD (p=0.38), distance at speed >120% MAS
270 (p=0.24), HSR (p=0.15), SD (p=0.25), distance at speed >85% MSS (p=0.17), time at speed
271 >MAS (p=0.48), distance at speed >MAS (p=0.40), Zone-5 distance (p=0.40), distance
272 between 120% MAS and 85% MSS (p=0.06), and ED (p=0.52).

273

274 **Discussion**

275

276 The aim of the present study was to explore the differences in **weekly** training and match load
277 in EPL 1st team and U23 players. Identifying differences in relative and absolute physical
278 outputs in relation to MAS and MSS and how this informs monitoring and training prescription
279 is practically important. Previously, significant increases in all physical metrics for players
280 transitioning to full-time football have been noted, although no differences between U18 and
281 U23 teams were reported ([10](#)). In the present study match-play metrics displayed significantly
282 higher outputs for 1st team players in relative HSR and relative Zone-5 distance when utilising
283 MAS and MSS to calculate. The U23 players did display significantly **greater distance >85%**
284 **MSS** than the 1st team during **match**-play. Al Hadadd et al. ([12](#)) suggested sprinting speed is

285 age dependent in young football players and likely to discriminate between competitive
286 standards, although this study only explored U13–U18 players. No significant differences were
287 observed for any of the absolute HSR variables, highlighting the need for aerobic and anaerobic
288 relative thresholds to be set in addition to absolute thresholds (19, 29) to optimise match-
289 specific conditioning (18). The present study highlights that the 1st team players examined
290 cover significantly more distance >120% MAS than the U23 players during matches,
291 emphasising the physical gap between 1st team and U23 players. Clubs and practitioners should
292 consider this gap in order to reduce injury risk (30), increase performance (15, 16) and better
293 prepare players for the required level (11). However, it is important to note that these
294 differences may be attributed to the level of competition and thus further research should aim
295 to consider a wider population across the EPL.

296

297 *One-Match Weeks*

298

299 Significant differences were observed in weekly physical outputs across all examined metrics
300 except TD covered, distance covered at speed higher than 85% MSS and ED. The one-match
301 weekly differences between U23 and 1st team players may partly explain the reported variations
302 in training intensity and thus, although not substantiated in our findings, may result in U23
303 players being under prepared for the demands of the examined 1st team.

304

305 Results from the present study identified that during one-match weeks, 1st team and U23
306 players spend on average 10.1 minutes and 8.0 minutes above MAS, respectively. Maximal
307 Aerobic Speed has been described as an effective way to assess the aerobic energy system in
308 team sports (20). Fitzpatrick et al. (18) illustrated that time spent above MAS has a stronger
309 relationship with changes in aerobic fitness than time spent above generic thresholds. Indeed,
310 running at a speed >100% MAS may be a critical factor when aiming to increase aerobic
311 capacity in U18 youth soccer players (18). Although, caution must be considered when
312 comparing Fitzpatrick et al. (18) findings and our study, as U18 players are a significantly
313 different physical population to the present participants. Importantly, practitioners must
314 understand the benefits of increasing the aerobic capacity of players, with evidence
315 demonstrating greater tolerance to HSR and SD loads (8). Exposing players to time above MAS
316 (>8mins) in training and matches, as demonstrated in the 30-15IFT, has been shown to increase
317 absolute TD, SD and HSR output (18, 31). This may potentially aid the transition to the 1st

318 team for U23 players who are still developing technically, tactically, psychologically and
319 physically.

320

321 On average the U23 players cover approximately 26% less HSR during a training week when
322 adopting generic HSR zones, although this increases to 34% when the relative value of 120%
323 MAS is employed. By measuring the distance covered above 120% MAS, it may provide
324 practitioners with distance covered in a more effective training zone for improving aerobic
325 fitness (32). Additionally, by employing 120% MAS, practitioners can be certain that any
326 distance covered above this speed is forcing players to use their anaerobic energy system. Thus,
327 a more effective method of monitoring HSR distance may be to examine each player's ASR.

328

329 The current findings suggest that 1st team players cover more SD using generic speed
330 thresholds than U23 players, while U23 players cover more distance at a higher relative
331 intensity. This may be due to the U23 players having slightly lower MSS than the 1st team
332 players. However, the present study did not report statistically significant differences ($p=0.36$)
333 in MSS between 1st team and U23 players, $9.53 \text{ m}\cdot\text{s}^{-1} \pm 0.48 \text{ m}\cdot\text{s}^{-1}$ and $9.34 \text{ m}\cdot\text{s}^{-1} \pm 0.44 \text{ m}\cdot\text{s}^{-1}$
334 respectively. Previous evidence suggests that straight-line sprinting is the most frequent
335 powerful action leading to goals and assists in professional football (33). Therefore, improving
336 the peak speed capability of U23 players may arguably allow an easier transition to the
337 examined 1st team by coping with the sprinting demands.

338

339 In order to prepare players sufficiently for such physical demands, practitioners are required to
340 schedule exposures to rapid changes of direction and high speed running efforts (9). The first
341 study to examine high risk workload scenarios was conducted in Gaelic football (34). The
342 findings suggested that players who were exposed to >95% of individual peak speed had a
343 reduced injury risk when compared to players who were exposed to lower relative velocities.
344 Similarly, Colby et al. (9) found that low chronic sprint distance and a low number of peak
345 speed exposures during a training week had the greatest association with injury risk in elite
346 Australian Rules Football (AFL) players. Furthermore, exposure to very low chronic sprint
347 distance across the previous four weeks was associated with a 3-fold increase in injury risk (9).
348 While the number of exposures above this threshold have also been previously described as a
349 "speed vaccine" (8), it may be more beneficial to examine the distance covered at very high
350 velocities for players transitioning from the U23 to the 1st team.

351

352 *Two-Match Weeks*

353

354 During two-match weeks, no significant differences were observed between 1st team and U23
355 players for any examined metric. The primary aim of a standardised training week is to
356 optimally perform in matches and improve subsequent recover processes. In elite football,
357 incomplete recovery may increase injury risk and have adverse effects on future performances
358 (35). The training content of such weeks was very similar for both squads with players
359 completing two light training sessions between matches. By individualising the HSR threshold,
360 this metric can be accurately tracked across time to monitor the players specific “dose” arising
361 from competitive match-play (5). In the absence of any correction adjustments or
362 modifications, identical external training loads will elicit considerably contrasting internal
363 loads in players with different individual characteristics (36).

364

365 Thus, by exposing U23 players to similar 1st team relative physical demands, practitioners may
366 be able to ensure a smooth transition for the developing athlete (37). Having a similar level of
367 physical fitness and being accustomed to covering similar weekly loads, may allow U23
368 players to focus on other developmental areas such as technical, tactical, or mental. Further
369 research investigating individual drill analysis may also allow practitioners to mirror 1st team
370 training intensity and the absolute load by altering pitch dimensions and changing rules and
371 conditions. While this research focuses on external load, the athletes’ perception of internal
372 and external load may also need to be considered during the transition from the U23 to the 1st
373 team.

374

375 **Limitations**

376

377 Future research should attempt to include other confounding variables such as, match location,
378 score-line and quality of opposition that may help practitioners better understand in-match
379 differences between groups. The current authors decided not to utilise the equations proposed
380 by [Ellens et al. \(38\)](#) as the exact model intercept values reported represented less than 2% of
381 match values. Thus, the effect of any exact intercept value provided by the transformational
382 work of any distance and distance at 19.8 km - 25.2 km would be small. Future research should
383 also aim to re-test MAS at multiple stages across the season to ensure the individualised speed
384 thresholds accurately represent the players physical characteristics as the season progresses.

385

386 **Conclusions**

387

388 Employing individualised HSR and SD thresholds illustrates significant differences in match-
389 play physical outputs, that would not necessarily be identified employing traditional absolute
390 thresholds. Significant differences were evident across all examined metrics except TD during
391 one-match weeks. These differences did not exist during two-match weeks. **During one-match**
392 **weeks**, U23 staff should attempt to mirror the 1st team periodisation model to allow players to
393 adapt accordingly to the physical demands. Furthermore, 1st team and U23 sport science staff
394 should align fitness and conditioning ideologies across both teams focusing on 1st team
395 performance and U23 physical development. **Finally, exposing U23 players to two-match**
396 **weeks may be a viable method to emulate 1st team demands and prepare developing players.**

397

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399

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Table 1: Mean \pm SD value for team total match outputs for 1st team and U23 players and effect size (Cohen's d) of difference between squads.

	1st team (Second Spectrum)	95% CI	U23 (GPS)	95% CI	p-value	Effect size
Total Distance (m)	106127 \pm 3463	104665 to 107590	108196 \pm 3157	106626 to 109767	0.06	0.62
Distance at speed >120% MAS (m)	7513* \pm 760	7193 to 7835	7051 \pm 720	6693 to 7410	0.04	0.62
High-speed running distance (m)	8118 \pm 793	7783 to 8454	7854 \pm 640	7536 to 8172	0.15	0.37
Sprint distance (m)	1545 \pm 312	1414 to 1678	1572 \pm 219	1464 to 1682	0.76	0.10
Distance at speed >85% MSS (m)	320* \pm 168	249 to 391	872 \pm 208	769 to 976	<0.01	2.92
Time at speed >MAS (min)	52.6 \pm 5.5	49.3 to 53.9	51.4 \pm 6.6	48.1 to 54.7	0.95	0.03
Distance at speed >MAS (m)	17128 \pm 1709	16407 to 17851	16988 \pm 1958	16015 to 17962	0.81	0.08
Zone-5 distance (m)	6950 \pm 730	6044 to 7858	6724 \pm 532	6064 to 7385	0.09	0.35
Distance >120% MAS - <85% MSS (m)	7788* \pm 1000	6546 to 9029	6772 \pm 794	5786 to 7757	<0.01	1.13
Explosive distance (m)	15165 \pm 675	14327 to 16002	14718 \pm 698	13851 to 15585	0.08	0.65

* denotes significance (p<0.05) for 1st Team vs. U23.

Table 2: Mean \pm SD value for average player training and match output for 1st team and U23 players in one-match weeks and effect size (Cohen's d) of difference between squads.

Metric	1st team	95% CI	U23	95% CI	p-value	Effect size
Total Distance (m)	24158 \pm 3325	22768 to 25547	24661 \pm 2585	23528 to 25794	0.59	0.21
Distance at speed >120% MAS (m)	1395* \pm 334	1255 to 1535	1022 \pm 315	884 to 1160	<0.01	1.54
High-speed running distance (m)	1476* \pm 259	1368 to 1584	1141 \pm 265	1025 to 1257	<0.01	1.78
Sprint distance (m)	271* \pm 107	226 to 316	187 \pm 73	155 to 219	0.01	1.08
Distance at speed >85% MSS (m)	70 \pm 43	51 to 88	97 \pm 62	70 to 124	0.10	0.87
Time at speed >MAS (min)	10.1* \pm 3.1	8.8 to 11.4	8.0 \pm 3.3	6.6 to 9.5	0.04	0.82
Distance at speed >MAS (m)	3304* \pm 842	2952 to 3656	2633 \pm 95	2216 to 3050	0.02	1.10
Zone-5 distance (m)	1163* \pm 195	1082 to 1245	954 \pm 283	862 to 1046	<0.01	1.48
Distance >120% MAS - <85% MSS (m)	1315* \pm 331	1177 to 1453	925 \pm 283	801 to 1049	<0.01	1.63
Explosive distance (m)	3208 \pm 740	2899 to 3517	3252 \pm 416	3070 to 3435	0.81	0.08

* denotes significance (p<0.05) for 1st Team vs. U23

Table 3: Mean \pm SD value for average player training and match output for 1st team and U23 players in two-match weeks and effect size (Cohen's d) of difference between squads.

Metric	1st team	95% CI	U23	95% CI	p-value	Effect size
Total Distance (m)	23943 \pm 6620	21177 to 26710	25924 \pm 7341	22707 to 29141	0.38	0.41
Distance at speed >120% MAS (m)	1396 \pm 541	1170 to 1622	1194 \pm 526	964 to 1425	0.24	0.51
High-speed running distance (m)	1522 \pm 498	1314 to 1730	1333 \pm 496	1116 to 1550	0.24	0.52
Sprint distance (m)	297 \pm 136	240 to 354	248 \pm 126	193 to 303	0.25	0.49
Distance at speed >85% MSS (m)	87 \pm 112	40 to 134	133 \pm 97	90 to 175	0.17	0.56
Time at speed >MAS (min)	10.2 \pm 3.9	8.6 to 11.9	9.2 \pm 5.1	7.0 to 11.4	0.48	0.31
Distance at speed >MAS (m)	3395 \pm 1200	2894 to 3897	3030 \pm 1493	2376 to 3684	0.40	0.42
Zone-5 distance (m)	1187 \pm 402	1019 to 1355	1085 \pm 391	914 to 1257	0.42	0.35
Distance >120% MAS - <85% MSS (m)	1350 \pm 495	1143 to 1556	1061 \pm 457	861 to 1262	0.06	0.80
Explosive distance (m)	3215 \pm 1032	2783 to 3646	3424 \pm 999	2986 to 3862	0.52	0.28

* denotes significance (p<0.05) for 1st Team vs. U23

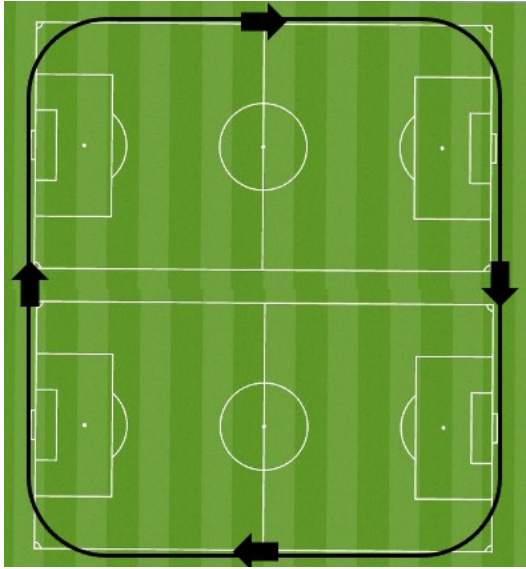


Figure 1: The MAS testing track design