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Locomotor and technical characteristics of female soccer players training: exploration of differences between competition standards

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ABSTRACT

Objectives: To (i) quantify the differences in locomotor and technical characteristics between different drill categories in female soccer and (ii) explore the training drill distributions between different standards of competition.

Methods: Technical (ball touches, ball releases, high-speed ball releases) and locomotor data (total distance, high-speed running distance [>5.29 $m \cdot s^{-1}$]) were collected using foot-mounted inertial measurement units from 458 female soccer players from three Women's Super League (WSL; n = 76 players), eight Women's Championship (WC; n = 217) and eight WSL Academy (WSLA; n = 165) teams over a 28-week period. Data were analysed using general linear mixed effects.

Results: Across all standards, the largest proportion of time was spent in technical (TEC) (WSL = 38%, WC = 28%, WSLA = 29%) and small-sided extensive games (SSGe) (WSL = 20%, WC = 31%, WSLA = 30%) drills. WSL completed more TEC and tactical (TAC) training whilst WC and WSLA players completed more SSGe and possession (POS) drills. Technical drills elicited the highest number of touches, releases and the highest total distance and high-speed activity. Position-specific drills elicited the lowest number of touches and releases and the lowest total distance. When the technical and locomotor demand of each drill were made relative to time, there were limited differences between drills, suggesting drill duration was the main moderating factor.

Conclusion: Findings provide novel understanding of the technical and locomotor demands of different drill categories in female soccer. These results can be used by coaches and practitioners to inform training session design.

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KEYWORDS
Female soccer training; technical actions; monitoring; microcycle; microtechnology

Introduction

Soccer is a multi-faceted sport with both physical and technical outputs required from players to perform at a high level. The purpose of training is to ensure that players are prepared for the physical, technical, and tactical demands of the game. Therefore, it is imperative that training programmes expose players to sufficient frequency, intensity and durations that elicit such adaptations (Morgans et al. 2014). Coaches utilise a range of training drills with the technical and tactical objectives often the primary focus in-season (Anderson et al. 2016). However, different drills can elicit different locomotor (Barrett et al. 2020) and technical (Marris et al. 2022) outputs. For example, locomotor activity (e.g., high-speed running and sprint outputs) has been reported to increase on larger pitches during various sized games, yet result in less technical actions per player (Owen et al. 2017), whereas technical actions were highest within technical drills (Marris et al. 2022). Practitioners should also consider the requirements of the different coaches they are working with when designing training drills as locomotor outputs differ within training drill categories when different coaches prescribe them (Barrett et al. 2020).

Knowledge of the typical intensities and durations of locomotor and technical activities elicited during different types of training drills can allow practitioners to plan and periodise a player's upcoming training programme and facilitate coaches to utilise certain drills to target specific technical outputs. However, while there has been a range of research studies exploring the locomotor and technical characteristics of training in male soccer (Marris et al. 2022; Barrett et al. 2020), limited information is available in the women's game. Several differences between sexegenders, including physiological characteristics, training background and playing style, suggest comparisons are not recommended (Bradley et al. 2014). For example, during match play, Bradley and colleagues (2014) reported that male players covered more total distance at higher speed thresholds than their female counterparts. Additionally, female players were also reported to lose the ball more often and had lower pass completion rates than male players (Bradley et al. 2014). However, it must be noted that there has been increased professionalism within women's soccer since the Bradley et al. (2014) study, with the reported increased athleticism of female players (Scott et al. 2020) resulting in high-speed running capabilities during match play (Scott et al. 2020). Therefore, there is a need for further contemporary

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research into the women's game and an up-to-date comparison to the locomotor and technical demands of the male game.

Quantifying the locomotor characteristics of female soccer players training outputs, on a given training day has previously been reported (, Romero-Moraleda et al. 2021). Romero-Moraleda et al. (2021) reported that the highest total distances were covered by female soccer players during conditioning and tactical sessions, which were typically conducted on match day (MD) minus four (MD-4) and MD-3 (MD-4: 4831 ± 860 m; MD-3: 4975 ± 1318 m) respectively. This was consistent with the findings of Trewin (2018) who reported similar findings for female soccer players during a preparation camp for international tournaments, involving a 7–10 day training block involving 5–7 sessions. While findings provide initial insights into the locomotor characteristics of female soccer players during training, neither study considered the technical characteristics of training. Furthermore, a global analysis of the training day formats does not provide insights into the locomotor and technical characteristics of different drill formats that comprise a given training session (Owen et al. 2017). This should better assist the design of training sessions across a programme that provides the desired locomotor and technical outputs to prepare players for the demands of the game.

Therefore, the aims of the current study were to (i) explore the differences between locomotor and technical actions for each drill and (ii) assess the distribution of different drill categories used by teams within female elite soccer. The findings of this study could allow technical coaches, sport scientists and conditioning coaches to better facilitate the design and implementation of different drill formats as part of a structured training program to maximise training time, efficiency and potentially reduce the risk of injury through more controlled variance of training intensity, duration and volume.

Methods

Participants

Four hundred and fifty-eight female soccer players from three Women's Super League (WSL: n = 76 players), eight Women's Championship (WC: n = 217 players) and eight WSL Academy (WSLA; n = 165 players) participated in this study. The players consisted of wide defenders (WSL = 13, WC = 41, WSLA = 28), central defenders (WSL = 14, WC = 31, WSLA = 29), central defensive midfielders (WSL = 11, WC = 32, WSLA = 19), central attacking midfielders (WSL = 8, WC = 29, AC = 22), wide midfielders (WSL = 10, WC = 33, WSLA = 27) and forwards (WSL = 11, WC = 31, WSLA = 22). This study was conducted according to the requirements of the Declaration of Helsinki and was approved by the university ethics committee of Leeds Beckett University (ref 73543).

Experimental Design

An observational study design was conducted in which training locomotor activity data were collected over a 28-week period during the 2020–2021 season (October 2020 to May 2021). Eighteen female soccer teams across 3 divisions (WSL, Championship and WSLA) wore foot-mounted inertial measurement units (IMU) during each training session. These units have previously been reported in the literature

For the purposes of the current study, data was collected in all pitch training sessions carried out by each team. This refers to training sessions in which both starting and non-starting players trained together. As this was an observational study design, training content was not influenced by the researchers.

Inertial Measurement Units

Technical actions were quantified using commercially available foot-mounted IMUs (PlayerMaker™, Tel Aviv, Israel). Each IMU incorporated two components from the MPU-9150 multi-chip motion tracking module (InvenSense, California, USA), being a 16 g triaxial accelerometer and a 2000°•s^{-1} triaxial gyroscope. Housed in manufacturer-supplied tightly-fitting silicone straps, each player was equipped with two IMUs (one for each foot), which were located at the lateral malleoli over the player's boots. These devices have been previously reported in the literature as having good inter-unit reliability ($p > 0.05$) for all time motion analysis variables (mean difference and 95% limits of agreement ranging from −3 ± 21 for acceleration count to distance covered [<1.5 m·s^{-1}] 1.22 ± 2.79 m) (Waldron et al., 2021), demonstrating reliability for measuring locomotor characteristics. Similarly, Marris et al. (2022) that the units had good concurrent validity (P_A = 95.1–100.0%) and intra-unit reliability (P_A = 95.9–96.9%, CV = 1.4–2.9%) for technical variables when compared with video analyses. To diminish issues related to inter-unit reliability, players used the same IMUs throughout the data collection period (Buchheit et al. 2014; Malone et al. 2020).

All devices were activated via a Bluetooth connection to an iPad (Apple Inc, California) prior to each training session. Data were uploaded to the manufacturer's cloud-based software (v.3.22.0.02) post-session by the club practitioners. The start and end of each training session was identified and tagged prior to data being exported from the manufacturer's cloud-based software into Microsoft Excel 2016. Practitioners recorded the timings of each session for the individual drills and total session time, with these timings then transferred into the company's cloud-based software.

Drill Categories

The operational definitions and drill categories can be found in Table 1. These are consistent with drill categories previously used in soccer research (Barrett et al. 2020; Marris et al. 2022). Practitioners from clubs within the project attended an online webinar during the global pandemic to educate them on how

Table 1. Operational definitions and drill categories.

Drill categories	Operational definition
Position-Specific Training (PS)	Drills where the demands of the exercise are aimed at specific units of the team, with positions separated and coached as a unit ((Goalkeeper (GK), Defender (D), Midfielder (M), Forward (F)), or an individual
Possession (POS)	Drills designed to mimic similar demands of match play, with the aim of the session to keep the ball away from the opposing team, with no goals to score in
Small-Sided Games Intensive (SSGi)	Drills designed to replicate the demands of a game with a reduced pitch size, reduced number of players and specific rules to elicit the required intensity from the players, with goals to score in. Including, 1-a-side, 2-a-side, 3-a-side games
Small-Sided Games Extensive (SSGe)	Including games with 4-a-side +. Drills designed to replicate the demands of a game with a reduced pitch size, reduced number of players and specific rules to elicit the required intensity from the players, with goals to score in.
Tactical (TAC)	Drills designed to educate the players in the tactical roles they play within a team shape. These include set pieces and open play team shape
Technical (TEC)	Drills aimed to specifically work on a skill aspect of soccer such as passing, shooting, defending and footwork with a ball, working as an entire group

to classify drills as outlined in Table 1. Further individual club follow-up calls were carried out to ensure that definitions and any potential overlapping drills that concerned the practitioners, where clarified during the initial phase of the data collection.

Data filtering

The initial extracted dataset included 19,926 individual player observations. Locomotor drills with no specific technical components (i.e., conditioning and speed, agility, acceleration drills) were then removed (observations = 5,798; 29%). Each dependent variable was subject to Tukey's Fences outlier detection (i.e., upper threshold = interquartile range [IQR] + upper quartile [75%]; lower threshold = IQR – lower quartile [25%]); Tukey 1977), where the entire observation was filtered if an outlier was found (observations = 1712; 9%). The final dataset included 12,416 observations.

Variable Selection

Initially, the included variables to represent the technical construct were number of touches (when a player interacted with the ball at their feet), number of releases (when a player kicked a ball resulting in the ball being out of possession), and number of high-speed releases (HSRe; releases with a limb speed of greater than 15 m·s^{-1}). These were selected as they have been previously used and validated to define the technical characteristics of soccer training (Marris et al. 2022; Lewis et al. 2022). However, the number of HSRe was removed entirely from any statistical analyses since it displayed near zero variance properties within the observed dataset, which was determined via the nearZeroVar function from the R package *caret* (Kuhn 2008).

Total distance (TD) and high-speed running (HSR; distance covered >5.29 m·s^{-1}) were selected to represent the locomotor characteristics of the drills (Lovell et al. 2019). These variables are commonly measured in soccer training and match play (, Akenhead and Nassis 2016). Finally, total drill duration was also included as a dependent variable to understand differences in training duration between drill types.

Statistical Analysis

All data and statistical analyses were performed in R (version 4.0.2). Initially the data were fit with several different parametric distributions using a maximum likelihood approach via the *fitdistrplus* package (Delignette-Muller and Dutang 2015). The best distribution for each variable was selected based upon inspection of the Q-Q and density plots, which compare the observed distribution with a theoretical distribution. All variables were found to follow a negative binomial distribution, which is typical of count data, aside from total distance and duration which both followed gamma distribution. Given the non-normal distributions of the data, all descriptive statistics are presented as median and quartile range (lower quartile [25%] – upper quartile [75%]), which can be found in Supplementary Data 1.

The current analysis located units of analysis (i.e., individual drill observations) nested within clusters of units (i.e., players), which were nested in larger clusters of clusters (i.e., teams). Units of analysis were also crossed with position. Since the data follow a naturally hierarchical structure, generalised linear mixed models were used to assess differences in locomotor and technical variables between competition standards. A log link function was used for all variables, and an offset term for the natural log of duration (mins) was also included for all models apart from the duration model. The inclusion of an offset variable means that the rate of each variable is modelled instead of the raw count. More specifically, this means all variables were modelled per minute). For the model building strategy, a 'step-up' approach was taken, whereby random intercepts (i.e., session ID, player ID, team ID, and position) were stepwise added to the model, and were only kept if the Akaike Information Criteria (AIC) value or the residual error had improved (West, 2006).

Pairwise differences between each drill type were then extracted from each model via the *emmeans* package. The magnitude and direction of the differences were compared and interpreted using the standardised rate ratio (RR) statistic and 90% confidence interval (CI) (Halsey et al. 2015), with the following descriptors attached: trivial (0.90–1.11), small (0.70–0.90 or 1.11–1.43), moderate (0.50–0.70 or 1.43–2.00) and large (<0.50 or >2.00) (Hopkins et al. 2009).

Results

For the final models, the only random intercept that was dropped was 'team', meaning between-team variability for all variables is effectively null. Box plots with kernel density estimations for each raw technical (i.e., number of touches, number of releases, number of HSRe) and locomotor (i.e., total distance and HSR) variable are displayed in Figure 1. Descriptive statistics for the same variables are included in Supplementary Data 1.

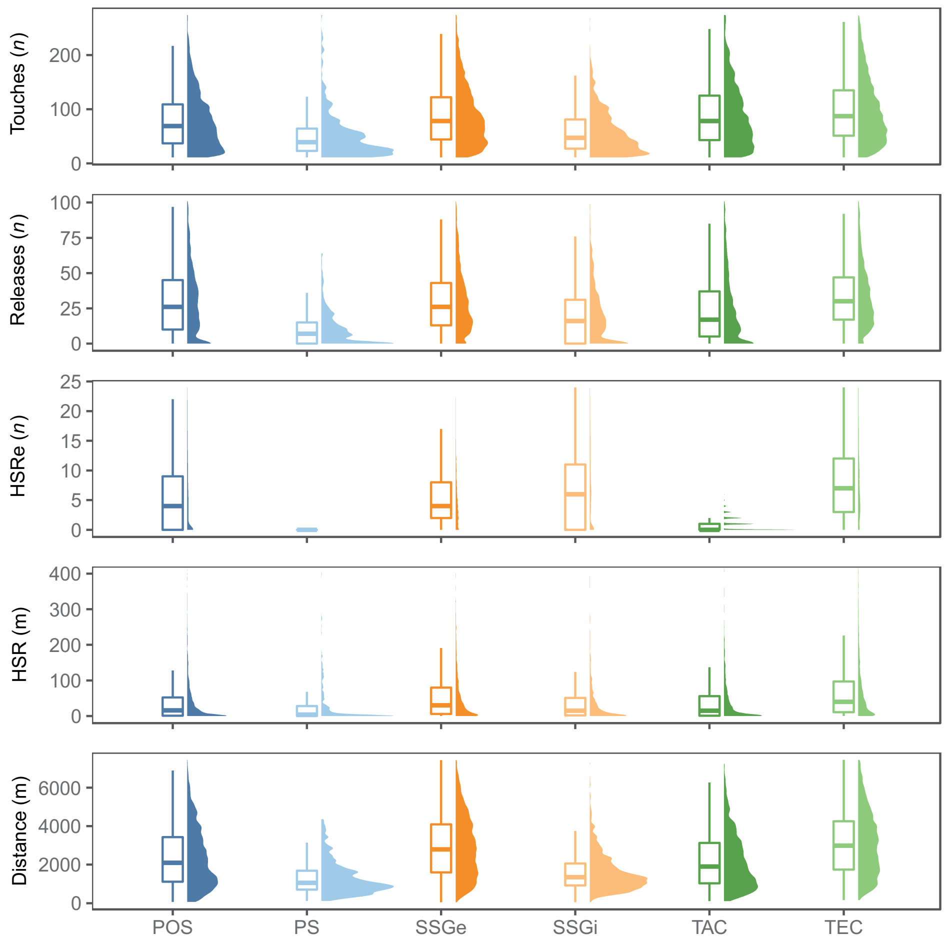

Figure 1. Distributions of each technical and locomotor variable across each drill category, including box plots with kernel density estimations.

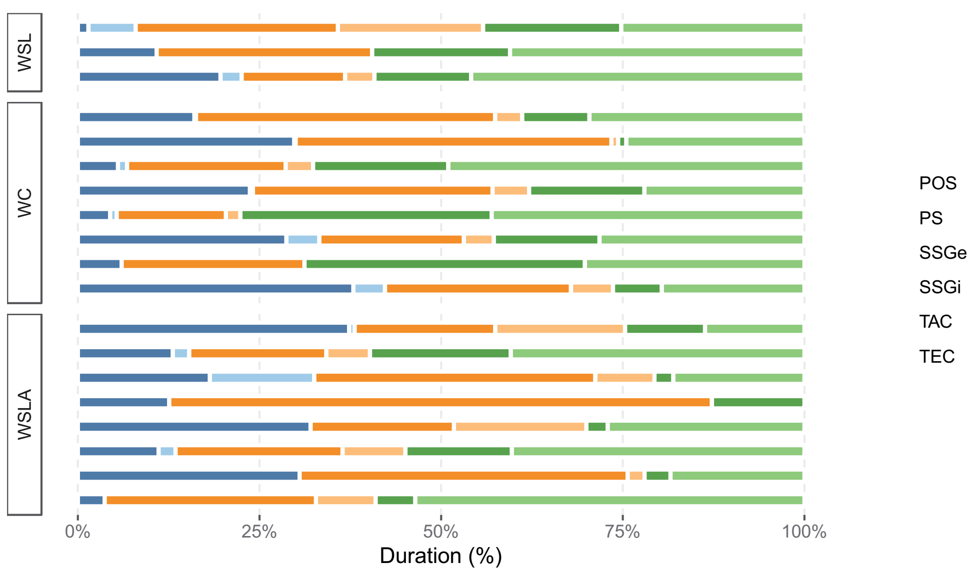

Figure 2. Proportional stacked bar graph, showing the distribution of duration (%) across each drill category for each individual team, stratified by level of competition.

Table 2. Overall distribution of duration (%) across each drill category and level of competition.

Drill category	WSLA	WC	WSL
POS	22%	21%	12%
PS	2%	1%	4%
SSGe	30%	31%	20%
SSGi	9%	3%	10%
TAC	8%	15%	16%
TEC	29%	28%	38%

Figure 2 displays a proportional stacked bar graph, showing the distribution of duration (%) across each drill category and level of competition, stratified by individual teams. The overall distributions of duration for WSLA, WC, and WSL are displayed in Table 2.

POS = , possession drills; PS, position-specific drills; SSGe, small-sided games (extensive); SSGi, small-sided games (intensive); TAC , t actical drills; TEC, technical drills.

The adjusted means, which were estimated from the generalised linear mixed models, for all variables are displayed in Table 3. The pairwise comparisons between each drill category, also extracted from the models, are presented as forest plots in Figure 3A and 3B for technical and locomotor variables, respectively.

For the duration of drills, all comparisons were substantial (RR descriptor = *small* to *moderate*) apart from TEC vs POS. For number of touches, the only substantial comparisons found were for SSGe vs POS, SSGi vs SSGe, TAC vs SSGe, and TEC vs TAC (RR descriptors = *small*). For number of releases, all comparisons were substantial aside from PS vs POS and SSGe vs POS. The largest effects found were for TAC vs POS, TAC vs PS, TEC vs POS, TEC vs PS, TEC vs SSGi (RR descriptor = very *large*).

POS, possession drills; PS, position-specific drills; SSGe, small-sided games (extensive); SSGi, small-sided games (intensive); TAC, tactical drills; TEC, technical drills

For TD, all comparisons were found to be trivial. Many of the comparisons were unclear for HSR as their confidence limits span both the increase and decrease thresholds (Figure 3B). However, small effects were found for PS vs POS, SSGe vs POS, SSGi vs POS, TAC vs SSGe, TAC vs SSGi, TEC vs POS, and TEC vs TAC. For a full list of pairwise comparisons stratified by competition standard, including rate ratios (±90% confidence limits) and back transformed means, see Supplementary Data 2.

Discussion

The purpose of this study was to determine the differences in the locomotor and technical characteristics of training drills used within female soccer and explore their distribution across a training programme.

The main findings were that the duration of the drills and number of releases per min provided the highest frequency of substantial differences between drill categories, with locomotor (total distance and high-speed distance per min) variables and the number of touches per min possessing limited differences. Overall, this suggests a strategy by practitioners to manipulate the duration, rather than the intensity, of technical and locomotor actions within drills. Additionally, across all levels of competition, the largest proportion of training drill time was spent in TEC (WSL = 38%, WC = 28%, WLSA = 29%) and SSGe (WSL = 20%, WC = 31%, WLSA = 30%) drills. WSL completed more TEC and TAC training whilst WC and WSLA players completed more SSGe- and TEC-based drills and completed very little PS drills. Overall, findings can be used by coaching teams to facilitate the design and implementation of different drill formats as part of a structured training program to maximise training time, efficiency and potentially reduce the risk of injury through more controlled variance of training.

To the authors' knowledge, this is the first study to provide insights into the technical characteristics of female soccer training. For the number of touches, TAC drills provided the highest number of touches per minute (2.93 $n\cdot min^{-1}$) although this was only greater than TEC (2.43 $n\cdot min^{-1}$) and SSGe (2.15 $n\cdot min^{-1}$) drills to a *small* extent, with all other comparisons non-substantial. Additionally, SSGe was substantially lower than POS (2.56 $n\cdot min^{-1}$) and SSGi (2.5 $n\cdot min^{-1}$) to a *small* extent. This suggests only some small differences between drills in terms of the intensity of touches. One explanation for this could relate to the area sizes of the drill, although this data were not available and should be considered in future research. For the number of releases, a greater frequency and magnitude of difference were observed between drills with TEC providing the highest per minute (1.65 $n\cdot min^{-1}$) followed by TAC (1.27 $n\cdot min^{-1}$) with all drills demonstrating substantial differences between each other. There is a lack of comparative data within the female game although the number touches (Marris et al. 2022) and releases (Lewis et al. 2022) have been reported in male professional soccer players during different drill types using the same technology. Female players completed a similar number of

Table 3. Least-squares means (±90% CI) extracted from generalised linear mixed models for each variable and drill type.

Variable	POS	PS	SSGe	SSGi	TAC	TEC
Duration (min)	30.8 (3.6)	27.8 (3.4)	42.6 (4.8)	21.4 (2.5)	34.0 (3.9)	31.5 (3.7)
Touches ($n\cdot min^{-1}$)	2.56 (0.11)	2.5 (0.14)	2.15 (0.09)	2.5 (0.11)	2.93 (0.13)	2.43 (0.1)
Releases ($n\cdot min^{-1}$)	0.31 (0.05)	0.24 (0.04)	0.38 (0.05)	0.53 (0.07)	1.27 (0.19)	1.65 (0.26)
Distance ($m\cdot min^{-1}$)	57.3 (1.9)	64.4 (2.3)	67.4 (2.1)	66.5 (2.1)	61.8 (2.1)	69.2 (2.4)
HSR ($m\cdot min^{-1}$)	0.6 (0.1)	0.8 (0.1)	0.8 (0.1)	0.9 (0.1)	0.6 (0.1)	0.9 (0.1)
Touches (n)[a]	77 (3)	75 (4)	65 (3)	75 (3)	88 (4)	73 (3)
Releases (n)[a]	9 (1)	7 (1)	11 (2)	16 (2)	38 (6)	49 (8)
Distance (m)[a]	1720 (57)	1932 (69)	2022 (62)	1994 (64)	1853 (61)	2075 (71)
HSR (m)[a]	17 (2)	24 (4)	25 (3)	26 (3)	19 (2)	28 (3)

[a]Offset to 30 min, which represents the mean duration across all drill types. For example, 2.56 $touches\cdot min^{-1} \times 30$ min = 77 touches.

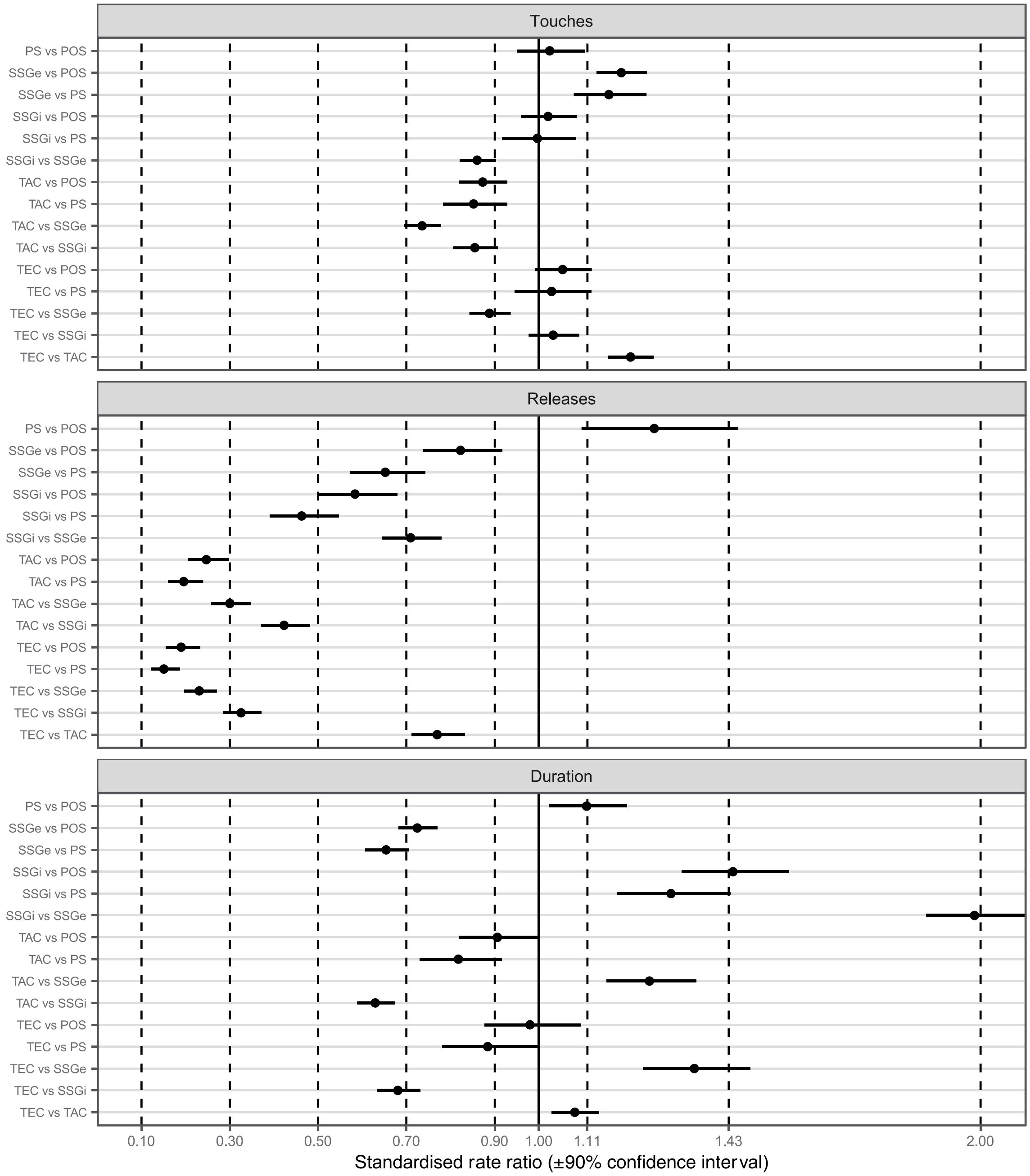

Figure 3. (Continued).

touches per minute during POS (female = 2.6 vs. male = 2.5 n·min^{-1}), PS (female = 2.5 vs. male = 2.4 n·min^{-1}) and SSG drills (female = 2.2 to 2.5 vs. male = 2.2 n·min^{-1}). However, they completed more touches than males during TAC drills (females: 2.9 n·min^{-1} vs. males 1.2 n·min^{-1}) yet less during TEC drills (females: 2.4 n·min^{-1} vs. males 6.2 n·min^{-1}). Noteworthy, female players completed less ball releases than males for all drills apart from TAC (females = 1.27 vs. males = 0.5 n·min^{-1}) despite this providing the greatest frequency of substantial differences between drills within the female game. While the author group acknowledges comparisons between male and female players are not advised (Emmonds et al., 2020), within the current available literature, it is difficult to provide context for comparisons of technical data for discussions.

From a locomotor perspective, when controlling for duration in the model there were trivial differences in total distance and only some small differences in HSR between drill categories suggesting that the locomotor intensity of training drills are similar regardless of standard

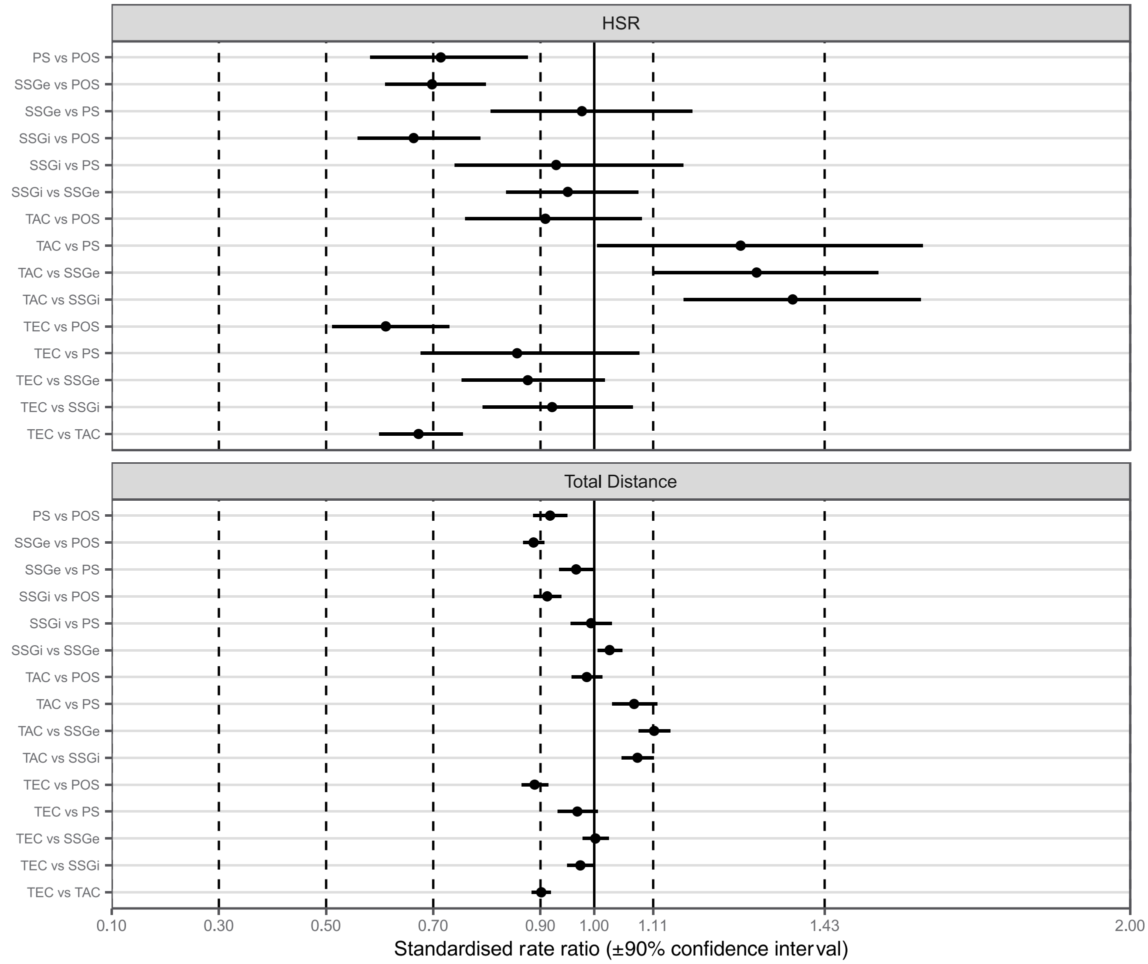

Figure 3. Forest plots including pairwise comparisons by drill category for technical variables. Direction of effect is in relation to first drill category (i.e., positive rate ratio = first named drill greater).

of competition. Although, it must be stated that a lot of high-speed comparisons were deemed unclear. Given the higher frequency of differences in duration between studies, locomotor differences between drills are likely to be due to manipulations of duration, rather than the locomotor intensity of drills. In addition, when accounting for duration within the models via an offset term, the additional variability provided by the teams was null. This suggests a lack of variability between teams in regard to locomotor intensity and technical actions. Collectively, this suggests a greater emphasis on the manipulation of duration, rather than intensity between different teams. This is consistent with previous findings in male soccer, with Barrett et al. (2020) reporting large standard deviations in the duration of drills (e.g., SSG = 14.74 ± 8.53 min, TEC = 12.51 ± 8.61 min) used by different teams. Consequently, teams should consider the manipulation of different constraints (e.g., rules, area size), rather than just duration, to elicit increased physical and tactical intensities per minute within a drill. Increasing intensity would be aimed at promoting increased stresses to a player, allowing them to adapt to the increased stimulus and increase outputs accordingly (Jaspers et al. 2017). However, it is not possible to quantify technical actions not performed with the foot (e.g., thigh, head) (Bloomfield et al. 2007) using the technology implemented in the current study. Given that underreporting the frequency of technical actions performed may have implications for skill acquisition periodisation (Farrow and Robertson 2017), practitioners should account for the disparity between the frequency of technical actions measured by foot-mounted IMUs and those performed with alternative body parts when programming players' technical actions during training.

Regardless of standard of competition, the greatest proportion of training time was spent completing TEC drills. This agrees with previous findings in male soccer where technical and tactical skill development was considered the primary focus of in-season training (Malone et al. 2015; Barrett et al. 2020). Barrett et al. (2020) reported that the overall proportion of training drills from each category for elite male players was PS: 4%, POS: 27%, SSG: 33%, TAC: 11% and TEC: 15%. Current findings suggest that female soccer players complete comparable proportion of TAC work in training (8–16%) but substantially more TEC work (28–38%). Between competitions in female soccer, current study findings suggest a greater focus on TEC and TAC drills within WSL (54%) than WSLA teams

(37%), while WSLA have a greater focus on SSGe (30%) and POS-based drills (22%; Total – 52% of training time). Furthermore, WSL prescribe slightly more PS drills (4%) in comparison to both WSLA (2%) and WC (1%), which may be reflective of the training constraints of WC and WSLA training time (Myhill et al. under review). Unlike WSL teams who are full time and likely train 4–5 times per week, WC and WSLA teams are semi-professional or part time and often train 3–4 times per week (Myhill et al., under review). Although potentially beneficial from a physical, technical or tactical perspective (Barrett et al. 2020), the decision whether or not to include PS drills within a preparation program must be taken with reference to factors such as the time and resources (e.g., coaching expertise) that are available as well as considering the training priorities in the context of the broader preparation program. Therefore, coaches working in WC and WSLA may look to optimise this time by focusing more on team-based drills such as SSGe and POS versus PS drills, as reflected in the current study.

While findings of this study are novel, study limitations must be acknowledged, such as the lack of further details on the drill design (e.g., area size and constraints). From a modelling perspective, we did not analyse the differences in HSRe (>15 km·h^{-1}) as they displayed near zero variance properties in the observed data set of female soccer players. Given HSRe have been recorded during drills within the male game (Lewis et al. 2022) this suggests that that the velocity threshold used within male soccer is not valid to represent HSRe technical actions within female players. Further research is therefore required to determine the appropriate ball release velocity threshold for female soccer players prior to describing these technical actions across training and match play. This could have important implications not only for training drill design but injury reduction strategies. However, the aim of this study was to provide practitioners insights into the technical and physical outputs of different training drills. To the authors knowledge, this is the first study that assesses the technical and locomotor characteristics of different training drill categories in female soccer. Furthermore, a strength of the study is the use of a multi-club analysis at each standard of competition. The methods provided in this study can be used by practitioners to analyse their own data and provide the insights required to account for the use of different training drill types and the associated technical and locomotor output, allowing practitioners to account for training prescription for teams and individual players.

Practical Applications

The current study provides baseline data for practitioners working within female soccer in relation to the locomotor and technical outcomes of different drills. Different drill categories will elicit different outcomes and can be used as a tool for practitioners to plan their training sessions. These findings could have potential implications for practitioners when designing/prescribing optimal weekly training loads for elite female soccer players during the competitive season. Based on the methods used in this study, practitioners may also find it beneficial to create their own drill data sets to help support their own team and individual specific training prescriptions, using the findings of this study as comparative data.

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Disclosure statement

The fourth author of this study is employed by the company who provided the foot-mounted IMUs used to collect players' technical performance data. However, throughout the data collection and statistical analysis periods, the fourth author was not involved with this process to avoid any perceived bias.

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