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Most common movements preceding goal scoring situations in female professional soccer

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ABSTRACT

This study aimed to assess movements occurring during goal scoring situations in a female professional league.

Data from all the goals on the Women's Super League 2018/2019 were collected through time-motion analysis using a modified version of the Bloomfield Movement Classification with differences analysed through chi-square. Analysis was performed on players (assistant, scorer [attackers], defender of assistant and defender of scorer [defenders]), movements, intensities and directions.

Linear advancing motion (walking, jogging, running or sprint) (total percentage [95% CI] 37% attackers and 32.7% defenders) was the most common action preceding a goal, followed by deceleration (21.5% attackers; 18.4% defenders) and turn (19.2% attackers; 17.6% defenders). Other movements involved but with lower percentages were change in angle run (cut and arc run), ball blocking, lateral advancing motion (crossover and shuffle) and jumps. Players displayed similar tendencies but presented variations based on the role, with attackers performing more linear actions, subtle turns and cuts and defenders more ball blocking actions, lateral movements and high intensity linear actions and decelerations. Assistant performed the less percentage of involvements with at least 1 high intensity action (67.4%), scorer and defender of assistant showed similar values (86.3% and 87.1%), while defender of scorer had the highest percentage (97.3%).

This study shows the importance of linear actions with other movements also being of high significance but with differentiated characteristics based on the role. This study could help practitioners design drills for the enhancement of physical capabilities related to movements occurring in goal scoring situations.

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KEYWORDS
Women's Soccer; sprint; change of direction; Goal scoring actions; position specific

Introduction

Women's soccer has shown considerable growth over recent years (Bradley and Scott 2020) with FIFA projecting participation of 60 million worldwide by 2026 (FIFA 2018). Furthermore, there shows to be an increase in the demands of women's soccer, especially regarding intense running, which has increased around 16–32% from Canada 2015 to France 2019 World cup (Bradley and Scott 2020).

Female players cover around 10,000 m during matches, with sprint efforts ranging from 300 to 600 m (most of these being less than 10 m) (Taylor et al. 2017; Griffin et al. 2020). In addition, decelerations have also been tracked in female soccer, with a study showing female players performing an average of 430 decelerations at >-2 ms^{-2} per match (Mara et al. 2017). Match demands vary depending on playing position, outcome of the match as well as score-line (Andersson et al. 2010; DeWitt et al. 2018; Trewin et al. 2018), highlighting the importance of tactical characteristics on physical demands. However, there is a lack of emphasis on the connection between physical and tactical aspects, such as goal scoring situations, especially in women's soccer.

From a tactical perspective, different studies have emphasised the complexity of effective creation and conversion of goal scoring opportunities (Wright et al. 2011). In this sense, it is essential to consider contextual factors and tactical concepts and how they interrelate with each other, with evidence suggesting that enhancement of attacking players physical output is fundamental for perturbing defensive tactical organisation, creating space for goal chances (Schulze et al. 2022). Therefore, physical characteristics could have an impact in goal scoring actions while a clear understanding of these movements and how these combine could lead to further understanding.

In this regard, only 2 studies have examined the movements occurring before a goal during male football. Faude et al. (2012) found straight line sprint to be the most common action in goal scoring situations, with 83% of the goals being preceded by at least 1 powerful movement of the scoring or the assisting player. Moreover, Martínez Hernández et al. (2022) found linear advancing motion actions to be the most common movement in goal scoring situations followed by deceleration and turn for both attackers and defender. In addition, attackers performed higher ratio of linear action, subtle turns and cuts compared to defenders, while the latter performed more ball blockings,

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lateral movements and cuts. While these studies bring insight into the most common movements occurring in goal scoring situations in male professional soccer, as well as differences between attacking and defending players, there is still very small amount of research performed in this area. More so, there is no such analysis performed in a female professional soccer league, and so, there is a lack of understanding to whether trends found in male soccer are comparable to female soccer in regards to movements performed, intensities and directions. Furthermore, the understanding of movements occurring in goals scoring situations in female soccer would help practitioners in the selection of drills with both injury prevention and performance implications.

Therefore, the aim of this study was to assess movements occurring in goal scoring situations in a female professional league. To achieve this aim, the study had the following objectives: 1. Identify the most common actions preceding a goal and the percentage of involvements that were present. 2. Acknowledge resemblances and differences between players with different roles. 3. Assess movement intensity, direction and interaction with the ball. Based on previous research, we hypothesised that linear advancing motion would be the most common movement performed and players would follow a similar movement frequency trend, but with some role specific differences.

Methods

Procedures

All the goals from Women's Super League 2018/2019 season were analysed through broadcast footage using the same provider. Researchers had access to all goals, which could be seen in slow motion. Analysis was performed in the same manner as the study by Martínez Hernández et al. (2022), using a modified version of the Bloomfield Movement Classification (BMC) (Bloomfield et al. 2004) with coding performed by the lead author using a computerised notation system within a customised excel spreadsheet (Office 365 ProPlus). In the same manner as the study by Martínez Hernández et al. (2022), motion analysis evaluated scorer, player who assisted the goal (assistant), closest defender to the scorer (defender of scorer) and closest defender to the assistant (defender of assistant). Analysis was limited to the last 6 movements of each player, with this sequence of movements being named as 'involvement'. For further analysis, assistant and scorer were named as 'attackers' while defender of assistant and defender of scorer were named as 'defenders'. Goals not selected for analysis were as follows: corners, penalties, direct throw-ins, direct free-kicks, indirect free-kicks, own goals, non-intended goals and rebounds. Regardless, there were certain circumstances where actions coming from indirect free kicks, corners and throw-ins were selected for analysis: 1. When an indirect free kick or short corner was taken and the player receiving the ball was in possession for more than 7´´ or more than 2 passes were performed this sequence. 2. When a corner was taken and the ball went in out of the box (i.e., rebound, clearance, etc.). More so, goals which were preceded by a throw in were not considered for analysis when the ball went straight to the box or straight into the scorer but were included when the delivery was to the assistant out of the box.

Definition and Interpretation of Movements

A modified version of BMC (Bloomfield et al. 2004) was used for data collection. Definition and interpretation of these can be found in Table 1.

Data expressed as frequency (percentage ±95% confidence intervals).

Horizontal axis, difference between players: $^{\beta}$ significant difference from the rest of the players, $^{\&}$ significant difference from scorer, $^{¥}$ significant difference from defender of assistant, ^{x} significant difference from defender of scorer, $^{\#}$ significant difference from defenders.

Vertical axis, difference only between movement totals (includes change in angle run totals, lateral advancing motion totals and ball blocking totals):* significant difference from the rest of the movements, ** significant difference from linear advancing motion, change in angle run, lateral advancing motion, ball blocking, jump.

Vertical axis, differences between movements in the same group (arc run and cut or dive and slide): $^{\Omega}$significant difference from cut, $^{€}$ significant difference from slide.

Statistics

Data are presented as absolute frequencies and percentages alongside 95% confidence intervals [95% CI]. More so, data were treated as ordinal. Data analysis was performed through SPSS for Windows software version 22.0 (SPSS, Inc., Chicago, IL). Normal distribution of the data was analysed though Kolmogorov-Smirnov test and significance level was set at $p < 0.05$. Data were not normally distributed. Chi-square (x^2) was utilised for analysis of pooled and individual differences between movements (individual and group of movements), players (individual and group of players) and movement modifiers (intensities, directions and ball).

Reliability was obtained through pilot data from 10 matches, including 72 players involvement from 22 goals, with a total of 239 movements analysed which included the 3 types of modifiers. This was analysed through intraclass correlation coefficient (ICC) (two-way mixed model, single rater, consistency) obtaining values of 0.87 which is considered a good level of agreement (Koo and Li 2016).

Results

Total frequency and percentages of movements

A total of 336 goals were scored in 110 matches, with 256 being selected for analysis. A total of 2985 movements were recorded, 2548 without the inclusion of pass and shot (Figure 1). When analysing the overall frequency of each of the movement (scorer, assistant, defender of scorer and defender of assistant pooled), differences between these were found ($x^2_{(7)} = 2131$, $p < 0.01$).

The most common movement preceding a goal was a linear advancing motion with 34.9% (±1.9%) of the total.

Table 1. Interpretation and definitions of movement group and movements.

Movement Group	Definition
Linear advancing motion	Actions were a player accelerates or maintains speed in a sagittal plane.
Lateral advancing motion	Actions were a player accelerates or maintains speed in a frontal plane.
Change in angle run	Actions were a player advancing on a linear direction maneuvers without or with very little loss in speed.
Ball blocking	Drive purposefully the lower limb or head in a certain manner to stop a ball or an attacker with
Ball striking	Contact made with the ball with the objective of passing or scoring a goal.
Movement	**Definition**
Walk	Moving slowing by stepping.*
Jog	Moving at a slow monotonous pace (slower than running, quicker than walking).*
Run	Manifest purpose and effort, usually when gaining distance.*
Sprint	Maximal effort, rapid motion.*
Shuffle	Sideways advancing movement in which head, shoulders and hips face forward while legs and feet do not cross.
Crossover	Sideways advancing movement in which head, shoulders and hips face forward while legs and feet cross.
Deceleration	To slow down or brake suddenly.**
Turn	To rotate while standing, decelerating or accelerating/sprinting.
Cut	Path change of less than 45º with this involving little or non-previous deceleration to accomplish the task.
Arc Run	Player (often leaning to one side) moving in a semicircular direction.*
Skip	Moving with small bound-like movements.*
Impact	Any intense contact made with another player.*
Stand Still	More or less stationary or staying in one spot.*
Jump	Spring free from the ground or other base by the muscular action of feet and legs.*
Land	Entered after jump when contact with ground is made.*
Dive	To purposefully and controllably propel the body rapidly through the air either feet or head first.*
Slide	To purposefully and controllably drive the body along the floor with feet leading the movement.
Fall	Descending to the ground.*
Get up	Ascending from the ground.*
Pass	Any attempt to give the ball to a team-mate. Entered as contact made with the ball along with how*.
Shoot	Any attempt on goal. Entered as contact made with the ball along with how.*

*Definition from Bloomfield et al. (2004).
**Modified definition from Bloomfield et al. (2004).

This was followed by deceleration (20% ±1.6%) and turn (18.4% ±1.5%) with both movements showing similar percentages ($p = 0.16$). The fourth most frequent movement was change in angle run (cut and arc run) followed by ball blocking activities (Slide and Dive) while lateral advancing motion (crossover and shuffle) and jump showed to be the sixth and seventh most frequent movements, respectively. Other movements which were analysed but showed very low frequencies (<1%) were skip, impact, stand still, fall, land and get up. Attackers performed higher percentages of linear actions compared to defenders ($x^2_{(1)} = 5$, $p = 0.02$) as well as cuts ($x^2_{(1)} = 32$, $p < 0.01$), while defenders performed higher percentages of lateral movements ($x^2_{(1)} = 10$, $p < 0.01$) and ball blocking actions ($x^2_{(1)} = 132$, $p < 0.01$) (Table 2).

When looking at how often (on percentage) each of the movements analysed were performed on the total number of involvements, chi-square analysis showed differences between movements ($x^2_{(6)} = 1419$, $p < 0.01$). Linear advancing motion showed the highest proportions, being performed on 82.8% ±2.6%) of the involvements, followed by deceleration (53.9% ±3.4%), with turn showing the third highest percentage (47% ±3.4%) and change in angle run the fourth (26.7% ±3%) (Figure 2).

Intensity modifier

When looking at how often (on percentage) each of the movements analysed were performed at least once at high intensity

Table 2. Frequencies and percentages of movements in WSL overall, for individual players and groups of players.

Group of Movements	Movements	Assistant (%)	Scorer (%)	Defender of Assistant (%)	Defender of Scorer (%)	Attackers (%)	Defenders (%)	Movement Total
Linear Advancing Motion		35.1% ±4.3%	38.2% ±3.4%	34.3% ±4.3%	31.7% ±3.3%	37% ±2.6%	32.7% ±2.6%	34.9% ±1.9%
Deceleration		23.4% ±3.8%	20.3% ±2.8%	21.8% ±3.7%	16.4% ±2.6%	21.5% ±2.2%	18.4% ±2.1%	20% ±1.6%
Turn		22.4% ±3.7%	18% ±2.7%	15.7% ±3.3%	18.2% ±2.7%	19.6% ±2.2%	17.2% ±2.1%	18.4% ±1.5%
Change in Angle Run	Arc Run	4.5% ±1.8%	5% ±1.5%	6.9% ±2.3%	5.7% ±1.6%	4.8% ±1.2%	6.1% ±1.3%	5.5% ±0.9%
	Cut	6.6% ±2.2%	6.8% ±1.7%	1.7% ±1.2%	2.3% ±1.1%	6.7% ±1.4%	2.1% ±0.8%	4.4% ±0.8%
	Totals	11.1% ±2.8%	11.8% ±2.2%	8.6% ±2.5%	8% ±1.8%	11.5% ±1.7%	8.2% ±1.5%	9.9% ±1.2%
Lateral Advancing Motion	Crossover	1.2% ±1%	2% ±1%	3.1% ±1.6%	3.6% ±1.3%	1.7% ±0.7%	3.4% ±1%	2.6% ±0.6%
	Shuffle	1% ±0.9%	2.1% ±1%	2.9% ±1.5%	2.4% ±1.1%	1.7% ±0.7%	2.6% ±0.9%	2.2% ±0.6%
	Totals	2.3% ±1.3%	4.1% ±1.4%	6.1% ±2.2%	6.1% ±1.7%	3.4% ±1%	6.1% ±1.3%	4.7% ±0.8%
Ball Blocking	Dive	0.4% ±0.6%	0.6% ±0.5%	8.6% ±2.5%	8.2% ±1.9%	0.5% ±0.4%	8.4% ±1.5%	4.4% ±1.1%
	Slide	0.2% ±0.4%	1% ±0.7%	1.9% ±1.2%	6.1% ±1.7%	0.7% ±0.5%	4.5% ±1.5%	2.6% ±0.6%
	Totals	3 (0.6% ±0.7%)	13 (1.6% ±0.9%)	10.5% ±2.8%	14.3% ±2.5%	1.2% ±0.6%	12.8% ±1.9%	6.9% ±1%
Jump		6 (1.2% ±1%)	27 (3.3% ±1.2%)	0.4% ±0.6%	2.8% ±1.2%	2.6% ±0.9%	1.9% ±0,8%	2.2% ±0.6%
Other (skip, impact, stand still, land, fall, get up)		19 (3.9% ±1.7%)	22 (2.7% ±1.1%)	2.7% ±1.5%	2.6% ±1.1%	3.2% ±1%	2.6% ±0.9%	2.9% ±0.6%

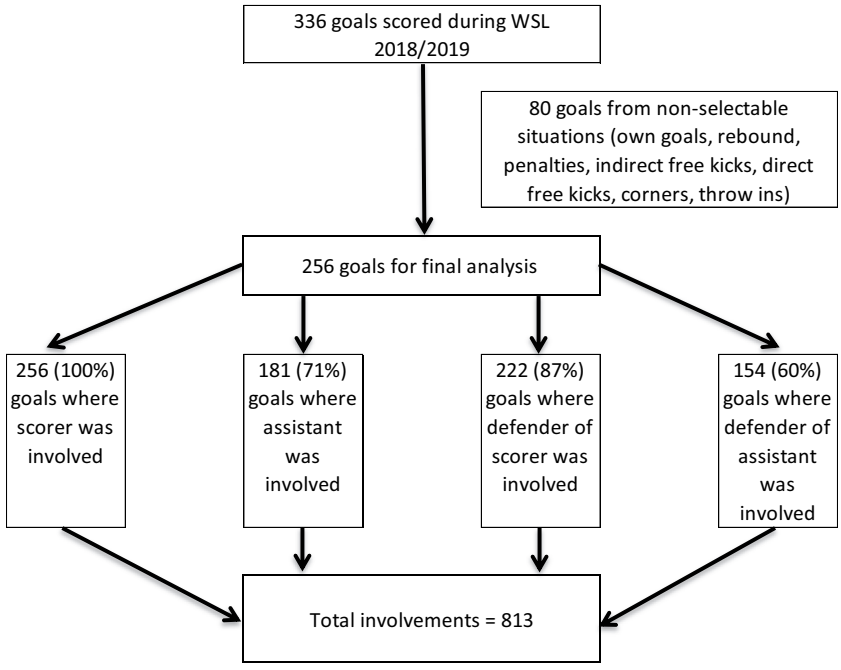

Figure 1. Flow chart of goals selected for analysis as well as total involvements.

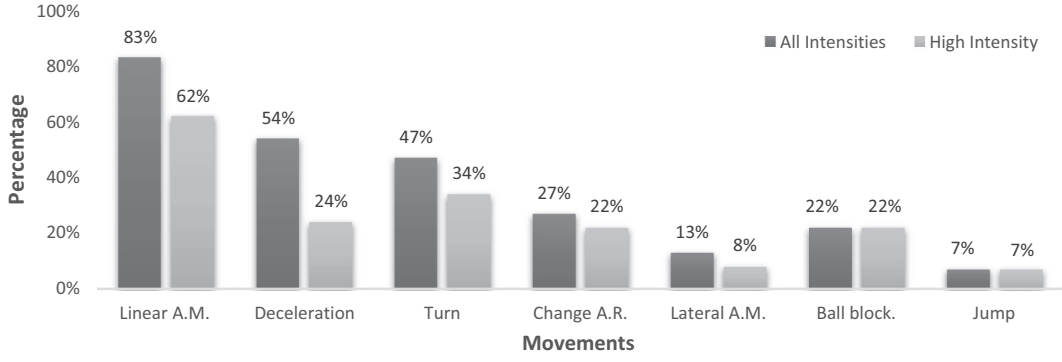

Figure 2. Percentage of involvements were movements were performed at least once. Jump and ball blocking actions are considered always as HI movements for analysis. *Significant difference from the rest of the movements of same group (all intensities or high intensity). #Significant different from linear advancing motion, change in angle run lateral advancing motion, ball blocking and jump. Linear A.M.: linear advancing motion; Change A.R.: change in angle run; Lateral A.M.: lateral advancing motion; Ball Block: ball blocking.

for the total number of involvements analysis performed by chi-square found difference for percentage of involvements where movement was performed at least once at high intensity ($x^2_{(6)} = 899$, $p < 0.01$), with linear advancing motion showing the highest proportions (62.1% ±3.4%), followed by turn (33.8% ±3.3%). This was followed, with similar percentages, by deceleration (23.5% ±3%), change in angle run (22.3% ±2.9%) and ball blocking activities (21.7% ±2.9%) ($x^2_{(2)} = 612$, $p = 0.736$) (Figure 2).

Chi-square analysis showed differences for frequency of involvements were individual players performed at least 1 high intensity action ($x^2_{(3)} = 72$, $p < 0.01$), with assistant showing the lowest percentages (67.4% ±3.2%) and defender of scorer the highest (97.3% ±1.1%) (Table 3). Moreover, when frequencies from the 4 different players (assistant, scorer, defender of assistant, defender of scorer) was pooled together, in 85.4% (±2.4%) of the involvements there was a high intensity action.

Table 3. Frequency and percentage of involvements were players performed at least 1 HI action.

Player	Frequency (percentage)
Assistant	122 (67.4% ±3.2%)
Scorer	221 (86.3% ±2.4%)
Defender of assistant	135 (87.1% ±2.3%)
Defender of scorer	216 (97.3% ±1.1%)
Total Sum	694 (85.4% ±2.4%)

Data expressed as frequency (percentage ±95% confidence intervals). Jump, ball blocking actions and impact are considered as HI movements for analysis. *Significant difference from the rest of the players, ^significant difference from assistant and defender of scorer.

When movements were separated and analysed based on the intensity (low, medium and high), differences were found between intensities in all movements when players were pooled together (assistant, scorer, defender of assistant,

defender of scorer) ($p < 0.01$) (Figure 3). In this sense, all movements showed greater amounts of actions at high intensity except for deceleration and shuffle, where similar percentages were found between high intensity and medium intensity ($p = 0.6101$ and $p = 0.84$, respectively). Moreover, when comparing between attackers and defenders (Figure 3), the latter showed greater amount of actions at high intensity in linear advancing motion ($p < 0.01$) and decelerations ($p < 0.01$).

Direction modifier

Chi-square analysis showed differences when analysing direction for linear advancing motion ($x^2_{(2)} = 1732$, $p < 0.01$). In this sense, linear actions were mostly performed in a forward direction (86.8% ± 2.2%), with forward diagonal direction and backward direction showing low percentages (10.7% ±2% and 2.3% ±1%, respectively).

The direction of the deceleration also showed differences ($x^2_{(3)} = 351$, $p < 0.01$), being forward direction (54.2% ±3.9%) the most common deceleration, followed by sideways (21.6% ±3.6%) and forward diagonal deceleration (19.1% ±3.4%) (Table 5). The turning degrees also showed difference ($x^2_{(4)} = 499$, $p < 0.01$). The most common turning degree ranges were 0º-60º (44.3% ±4.5%) and 60º-120º (39.8% ±4.4%), with no significance difference found while turns of 120º-180º (12.1% ±3%) were the third most common. This showed to differ between positions as attackers showed higher percentage of turns of 0º-60º ($p < 0.01$) and defenders from 60º −120º ($p < 0.01$) (Table 4).

Ball modifier

Assistant performed higher percentage of actions with the ball than without the ball in all movements except for deceleration, arc run, crossover and shuffle, where no differences were found. In contrast, scorers performed actions more commonly without the ball except for turn and cut, which showed no differences. Additional data can be found in online Supplementary Table 1.

Discussion

The aim of this study was to assess movements occurring in goal scoring situations in a female professional league. The results highlight that the most common movement occurring before goal scoring situations in Women's Super League are linear advancing movements, followed by deceleration and turn. Players showed similar trends, with attackers performing higher proportions of linear advancing motion, cuts, subtle turns (0–60º), while defenders performed higher percentages of sharper turns (60º-120º and 120º-180º), lateral movements, sideways decelerations, and ball blocking actions. Moreover, defenders performed higher percentages of high intensity decelerations and high intensity linear advancing movements (sprints). In 85.4% of players' involvements, there was at least 1 high intensity action, with defender of scorer showing the highest and assistant the lowest percentages.

As observed in previous studies in male professional soccer (Faude et al. 2012; Martínez Hernández et al. 2022), linear advancing motion was the most common action prior to a goal, showing similar percentages to those from Martínez Hernández et al. (2022) (English Premier League = 32.4% ±1%, Women's Super League = 34.9% ±1.9%). Moreover, linear advancing motion was present in more involvements than any other movements, at all intensities and when only high intensity were analysed. Interestingly, Women's Super League compared to English Premier League in the study by Martínez Hernández et al. (2022) showed slightly higher percentage of involvements where linear advancing motion was present overall (Women's Super League = 82.8% ±2.6%; English Premier League = 78.5% ±1.6%) and when only sprints (Women's Super League = 62.1% ±3.4%; English Premier League = 54.1% ±2%) were analysed. These differences could be related to Women's Super League, potentially having a more direct style

Table 4. Direction modifier during turning.

	Assistant (%)	Scorer (%)	Defender of Assistant (%)	Defender of Scorer (%)	Attackers (%)	Defenders (%)	Total
0º-60º	46 (42.2% ±9.3%)	90 (62.1% ±7.9%)	30 (40% ±11.1%)	42 (29.8% ±7.6%)	136 (53.5% ±6.1%)	72 (33.3% ±6.3%)	208 (44.3% ±4.5%)
60º-120º	44 (40.4% ±9.2%)	41 (28.3% ±7.3%)	36 (48% ±11.3%)	66 (46.8% ±8.2%)	85 (33.5% ±5.8%)	102 (47.2% ±6.7%)	187 (39.8% ±4.4%)
120º-180º	12 (11% ±5.9%)	13 (9% ±4.7%)	7 (9.3% ±6.7%)	25 (17,7% ±6.3%)	25 (9.8% ±3.7%)	32 (14.8% ±4.7%)	57 (12.1% ±3%)
180º-270º	6 (5.5% ±4.5%)	1 (0.7% ±1.4%)	2 (2.7% ±3.7%)	8 (5.7% ±3.8%)	7 (2.8% ±2%)	10 (4.6% ±2,8%)	17 (3.6% ±1.7%)

Table 5. Direction modifier during deceleration.

	Assistant (%)	Scorer (%)	Defender of Assistant (%)	Defender of Scorer (%)	Attackers (%)	Defenders (%)	Total
Forward	67(58.8% ±8.9%)	89 (54.3% ±7.5%)	62 (59.6% ±9.3%)	58 (45.7% ±8.5%)	156 (56.1% ±5.7%)	120 (51.9% ±6.4%)	276 (54.2% ±3.9%)
Diagonal Forward	19 (16.7% ±6.8%)	38 (23.2% ±6.4%)	16 (15.4% ±6.9%)	24 (18.9% ±6.8%)	57 (20.5% ±4.7%)	40 (17.3% ±4.9%)	97 (19.1% ±3.4%)
Sideways	21 (18.4% ±7.1%)	30 (18.3% ±5.9%)	20 (19.2% ±7.5%)	39 (30.7% ±7.9%)	51 (18.3% ±4.5%)	59 (25.5% ±5.6%)	110 (21.6% ±3.6%)
Backwards	7 (6.1% ±4.7%)	7 (0.9% ±3.2%)	6 (5.8% ±4.7%)	6 (3.8% ±3.9%)	14 (5% ±2.6)	12 (5.2% ±2.6%)	26 (5.1% ±1.9%)

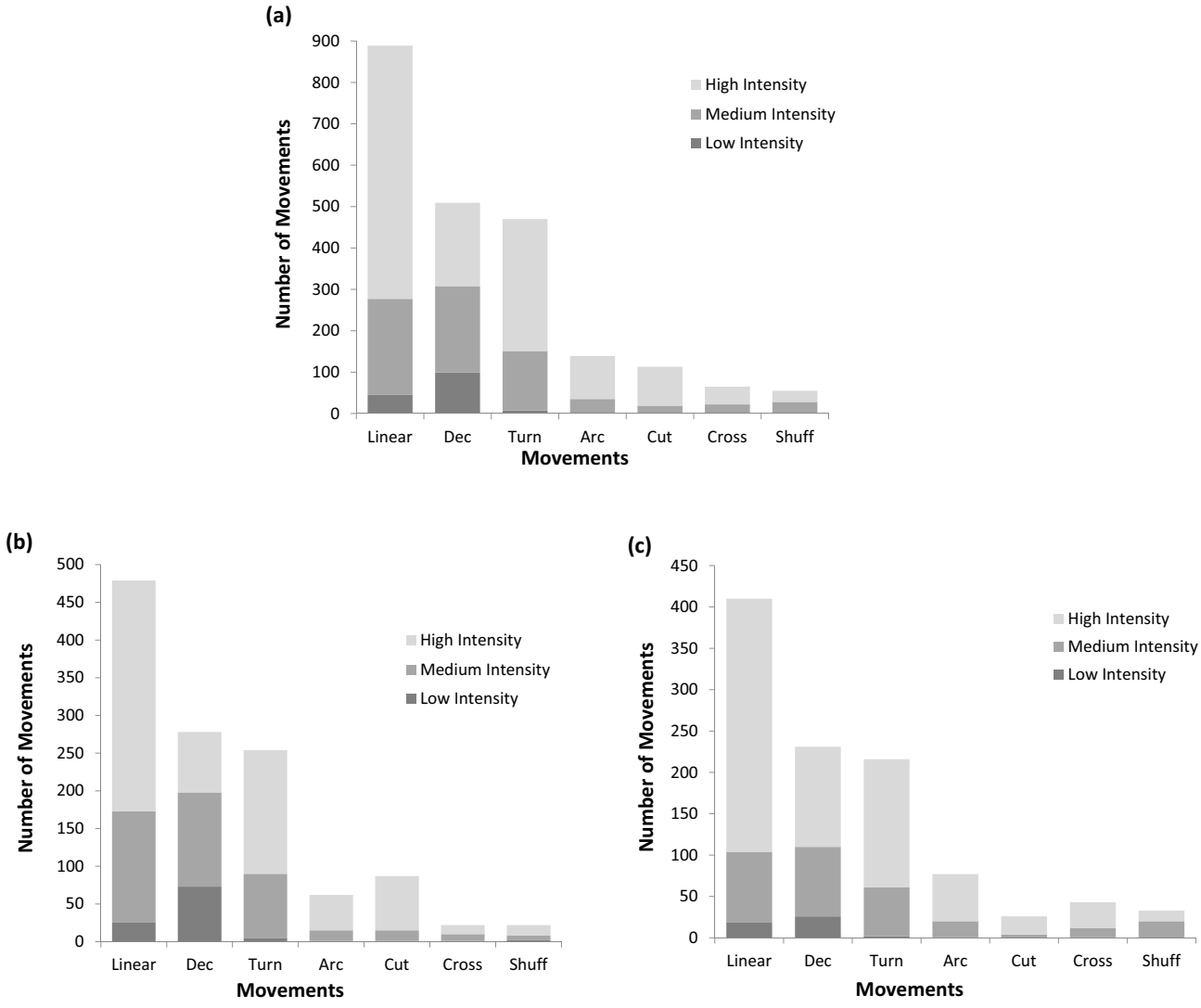

Figure 3. Movement intensity percentages for all players pooled (panel a), attackers (panel b) and defenders (panel c). [#]Significant difference from Medium Intensity. [†]Significant difference from Low Intensity. Linear: linear advancing motion; Dec.: deceleration; Arc R.: arc run; Cross.: crossover.

of play due to possibly recovering possession further up the field, as previously found in female football when compared with male (Espada et al. 2018).

Moreover, when comparing between different intensities (walk, jog, run and sprint), sprint showed the highest proportions, which highlights the importance of fast acceleration and/or not in goal scoring actions. The importance of fast acceleration and or/speed has already been highlighted in female soccer players by Haugen et al. (2012), who found national-team players to be 1 metre ahead of second division players over both 0 to 20 metres and 20 to 40 metres, with these differences being big enough to be decisive in 1 vs 1 duels.

When examining different roles, defenders showed lower percentages of linear activities compared to attackers. As discussed by previous research (Martínez Hernández et al. 2022), this difference could be due to the orientation of the players. While attackers would commonly face the goal, as this would be their ultimate target, defenders would be protecting this by standing between the attacker and goal. In this scenario, while the objective of attackers is set to advance in a straight direction towards the goal; a defender naturally would start with their back to goal and could be more biased towards defensive type movements. Finally, as in the study by Faude et al. (2012) and Martínez Hernández et al. (2022), assistant performed linear actions commonly with the ball and scorer without the ball, having to sprint to get into an advantageable position before receiving and shooting.

Therefore, fast acceleration and speed can be considered as the most important movement in goal scoring situations, and teams would benefit from incorporating training drills and exercises looking to enhance these qualities as these could have a big impact in the result of a match. Notwithstanding the high relevance of technical-tactical player's ability within a specific match scenario, which would be highly variable, having the ability to sprint or accelerate fast would imply having a substantial advantage.

Deceleration was shown to be the second most common action along with turn and showed to be present in half of the involvements, and one fourth when only considering involvements with high intensity decelerations, which was also

observed in the study by Martínez Hernández et al. (2022) in male soccer players. This study shows similar results to the latter mentioned study, where the greater amount of high intensity decelerations for defenders could be related to higher turning degrees (60° – 120°), while attackers commonly performed turns of less than 60º. This is of special interest as it has been reported that during deceleration phases of 45° and 90° Cuts, greater frontal plane loading at the knee occurs (Havens and Sigward 2015).

Turn showed to be the second most common movement along with deceleration and was performed in almost half of the involvements and on one-third when only counting turns at high intensity, which is similar to findings in male professional soccer (Martínez Hernández et al. 2022), while Faude et al. (2012) found lower frequencies despite this movement being the second and third most common action for scoring and assisting players. While 0º-60º turns showed higher percentages compared to turns of 60º to 120º (44.3% ±4.5% and 39.8% ±4.4%, respectively), this did not reach statistical significance, showing similar percentages when compared to the study by Martínez Hernández et al. (2022). Anyhow, differences between positions were found, with attackers performing higher rate, more 0º-60º turns compared to defenders, while defenders performed higher percentage of turns from 60º to 120º and 120º to 180º when compared to attackers. This again could be related to where attackers and defenders would be initially and end up facing, where defenders would have their backs to goal but would have to turn to goal as soon as the ball or opposition goes past them.

Change in angle run was the 4th most common movement and was present in almost one fourth of the involvements when only high intensity actions were analysed. In agreement with Martínez Hernández et al. (2022), attackers showed to perform higher percentages of cuts vs arc runs, while the opposite happened in defenders. Indeed, players performing change in angle run type actions would perform these to beat a player or create advantage situations (attackers) and to regain position (defenders), which would usually need a maximum effort. Interestingly, assistant performed cuts most commonly with the ball; scorers showed similar percentages with and without the ball, which would mean that cut would not only be performed to gain advantage with the ball but also to get into favourable positions to receive the ball. Based on this, it would be recommended for defending players to include arc type runs as part of training drills, while attacking players should include cut type movements with and without the inclusion of the ball.

Lateral advancing motion was performed in a higher rate in defenders compared to attackers, which is in the same line as seen whole match (Bloomfield et al. 2007) and goal scoring situations (Martínez Hernández et al. 2022) in male players. English Premier League also showed higher proportions when percentage of involvements with at least one lateral movement were analyzed (English Premier League = 17.3% ±1% and Women's Super League = 12.8 ± 2.3%). This could be due to Women's Super League players recovering the ball further up the field or having a more direct style of play when compared with English Premier League, as lateral movements would possibly be more habitual in goals coming from possession type attacks rather than fast attack or counterattacks. Finally, similar to the study from Martínez Hernández et al. (2022), within lateral movements, crossover showed to be the preferred strategy for both attackers and defender to advance laterally in a faster manner.

Jump was shown to be the 7th most common action which is in agreement with Martínez Hernández et al. (2022) but in contrast to Faude et al. (2012), who found this action to be the second and third most common for scorer and assistant, respectively. This could be due to our study analyzing more movements as well as including defenders and the fact that 80 goals were excluded from analysis.

As an average, in 85.4% ±2.4% of the players involvements, there was at least 1 high intensity action which is similar to findings by Martínez Hernández et al. (2022) (82.9% ±1.5%). Defenders performed superior percentages of movements at high intensity compared to their attacker counterparts with defender of scorer performing high intensity action in almost every goal. This could be related to defenders commonly being in a disadvantageous position at some point during each involvement, where this would have to perform high intensity actions (i.e. sprint, fast turn) to try to regain a stable defending state. Furthermore, the fact that defender of scorer had superior percentages of at least 1 high intensity action compared to defender of assistant would suggest that this unstable situation is more evident when the scorer comes into play. This could be partially explained by the fact that the movements analyzed in this study were unsuccessful defending actions, and so, it would be more likely that this analysis would bias defending players in an unfavorable position due to different physical or technical-tactical reason.

For most variables, this study showed slightly greater percentages at high intensity compared to Martínez Hernández et al. (2022) which could be due to differences in where possession of the ball is regained and the position where the final pass and shot takes place. In this sense, female vs male tend to recover the ball in offensive areas in a higher percentage (Espada et al. 2018; Mitrotasios et al. 2022), perform less combinative attacks (Mitrotasios et al. 2022) and score and assist closer to the goal (Althoff et al. 2010; Espada et al. 2018) which could explain this trend.

This study not only has implications on the importance of specific physical actions on key instance of the game but also the understanding of these physical requirements during goal scoring situations could help coaches decide which tactical strategy could be more advantageous for their team depending on the players attributes as well as the opposition physical characteristics.

This study supports similar findings found in male professional soccer (Faude et al. 2012; Martínez Hernández et al. 2022) and highlights the key role of high intensity actions in goal scoring situations. Therefore, training strategies to enhance players efficacy in these types of actions should prioritize the development of explosive attributes of female football players in a multidirectional environment.

A limitation of this study is that investigation was performed on goal scoring situations only, which would represent only 1% of the attacks (Pollard and Reep 1997) and 10% of the shots (Hughes and Franks 2005) and so analysis would be biased

towards successful actions of scorers and unsuccessful actions of defenders (specially defender of scorer) while also not taking into consideration successful actions of assistant not leading to goal.

Another limitation was the fact that analysis was performed on the last 6 movements of each player and so in certain involvements, some movements were not analysed.

A further limitation was the fact that 80 out of 336 goals were not included for analysis due to the characteristics of these (own goals, rebounds, penalties, indirect free kicks, free kicks, corners, throw ins).

Finally, while this is the first study to analyse through video motion actions occurring in goal situations in female professional soccer players, analysis was performed on Women's Super League and so caution should be taken when generalising to other female leagues.

Conclusions

These study support previous findings in male's soccer where linear advancing actions have shown to be the most common movements in goal scoring situations. Moreover, it increases the knowledge and understanding on why and how physical capabilities are important in key instance of the game. This study emphasizes the importance of linear as well as multidirectional explosive actions prior to a goal and highlights the different demands of attacking and defending players during goal scoring actions in female soccer. Anyhow, it should be taken into consideration that analysis performed could be biased towards successful actions of scorers and unsuccessful actions of defenders.

Practical Applications

When individualising training, both attackers and defenders would benefit from specific acceleration and speed training. In this sense, speed training should be a priority in soccer players, with focus on the specific development of this attribute based on individual characteristics (Morin and Samozino 2016; Hicks et al. 2020) and through context specific training. In the latter, defenders would benefit from reacting to different stimulus prior to a maximal effort sprint while players usually involved in assisting and scoring would benefit from a maximal effort incorporating the ball.

Moreover, defending players should prioritise specific drills with sharp turns and fast approaching velocities which would allow high speed decelerations. Defenders would be more commonly exposed to longer ground contact times and higher eccentric forces when changing direction. Therefore, plyometric training with long stretch shortening cycle (SSC) as well as eccentric strength development, especially for quadriceps muscles (Jones et al. 2017; Zhang et al. 2021) to enhance the absorption of greater kinetic energy to decelerate (Zhang et al. 2021) would be recommended. On the other hand, attackers would benefit from shallow turns and cut drills where lower intensity decelerations are required as well as short SSC plyometric drills (Dos'Santos et al. 2018) performed in a multidirectional manner and/or other exercises that replicate repeated rapid braking and propulsive actions.

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