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Benchmarking successful performances in elite Ladies Gaelic football

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ABSTRACT

The lack of sport science research conducted on female sport, makes it challenging for coaches and sport science practitioners to develop an evidence-based approach. Ladies Gaelic football (LGF) is the most popular female sport in Ireland with over 200,000 members, however there has been no research to benchmark performance. The current study investigates the game characteristics of LGF by developing analysis system which could provide benchmark profiles of successful performance at elite level and evaluate the transferability of the game intelligence available within LGF's brother sport, Gaelic football (GF). Thirty-one games (62 performances) were analysed from the 2019 and 2020 TG4 All-Ireland Senior Ladies Football Championship using NacSport Scout+. Statistical differences between winning and losing performances were identified using paired sample *t*-tests ($p \leq 0.05$) and Wilcoxon signed ranked tests ($p \leq 0.05$). Winning teams were found to be significantly superior to losing teams, demonstrating superior ability to gain and use possession. LGF and men's GF teams adopt different strategic approaches to the game. The current study provides a first insight into the nature of LGF with benchmark data, facilitating a better understanding of the game demands of LGF and the key points of difference between male and LGF.

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Ladies Gaelic football; performance analysis; benchmark profiles; gender differences

1. Introduction

The rise in the professionalism and profile of female sports has resulted in teams and athletes incorporating professional coaching, sport science and sports medicine to help preparations and practice (Balagué et al., 2017; Cowley et al., 2021). The historical lack of sport science research conducted on elite female sport, makes it challenging for coaches and sport science practitioners to develop an evidence-based approach to preparations and practice and in turn, may be failing to maximise the performance potential of the female athlete (Emmonds et al., 2019). Ladies Gaelic football (LGF), governed by the Ladies Gaelic Football Association (LGFA) is a clear example of this. LGF is the most

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popular female sport in Ireland, with over 200,000 registered members (LGFA, L, 2020), 40% more than women's soccer in England (120,557 members; FIFA, 2019). In 2019, the Ladies All Ireland Football final was one of the largest female spectator events in the world (56,114 viewers; RTE.ie, 2019; TAM Ireland Ltd, 2019). While we have witnessed significant growth in the participant and spectator appeal of the sport, there has been no research to quantify the match-play demands nor provide a benchmark profile of successful performance. Consequently, coaches and applied practitioners of LGF must access knowledge and resources from the men's Gaelic football (GF), governed by the Gaelic Athletic Association (GAA). The GAA have dedicated considerable resources to growing coaches' knowledge and understanding of their game, demonstrated by the outlay of €11.1 million on coaching and games development in 2018, nearly 50% greater than the total expenditure by the LGFA in 2019 (€5.5 million). It is not currently known how valid this "borrowing" of resources is and how much of the guidance suggested for development of young male players is applicable to females. Establishing the points of commonality could help focus resources in LGF on developing coaching materials to cater for the points of difference.

Despite some differences between the playing rules, the concept of GF is the same for both male and female codes, to retain possession and outscore the opponent (Reilly & Collins, 2008). LGF games are shorter, consisting of two 30-min halves, signalled by a countdown timer. No bodily contact is permitted in LGF and players cannot be legally dispossessed while holding the ball into their body. Kickouts can be taken from the hand or the ground at 13 m when a wide occurs and at 21 m after a score. Unlike the men's game, LGF do not have attacking or kickout marks. Since 2020, 2 points are awarded on the scoreboard when a 45 m free kick is kicked over the bar, without deflecting from an attacking player (LGFA, L, 2020). The other key difference to the men's game is that the ball can be picked up directly from the ground.

Performance profiling is a key aspect of performance analysis (PA) practice, as it allows coaches to interpret and evaluate their progress against the indicators of a profiled winning performance (Nicholls et al., 2018). There is an evolving body of research emerging from the men's game, profiling and benchmarking performance, facilitating an understanding of the game demands and what it takes to win (Gamble et al., 2019, 2020; Mangan, Mangan, et al., 2017; McGuckin et al., 2020; McGuigan et al., 2018). However, it is not yet known if the profiles and benchmark PA data emerging from the men's game is transferable to LGF due to the physiological differences between the genders and rule variations within the sports. There is strong evidence to suggest that the genders adopt distinct playing styles, resulting in the variables associated with success being gender specific in Rugby, Soccer, and Australian Rules Football. It has been reported that women's soccer is a "less controlled team game" with more turnovers and less attacking opportunities created in comparison to the men's game (Casal et al., 2020). Additionally, female players were found to have a greater shot-to-score ratio and a shooting-range closer to the goal (Althoff et al., 2010). A. Hughes et al. (2017) investigated the characteristics of performances in women's rugby, concluding that men's and women's rugby teams adopt different tactical approaches to play resulting in the variables that were associated with success being gender specific. It was reported that winning men's teams are far more direct with their attacking strategies and adopt a riskier style of play to achieve territorial gains (kicked a greater percentage of their

possessions in the opposition 22–50 m). In comparison, women's teams adopt a safer possession driven attacking approach, executing wider carries in the outside channels, resulting in the women's game being more expansive (A. Hughes et al., 2017). In women's Australian football (AFLW), a sport with similar characteristics of play to LGF, researchers found that winning teams performed with greater disposal efficiency, had more marks and uncontested possessions than losing teams, with the greatest discriminant factor being winning teams converting significantly more of their "Inside 50's" (an attack) into goals (Black et al., 2019). The authors reported many differences between the men and women's Australian football performance, such as time in possession, and attack and shot efficiencies, which contributes to a different style of play being adopted between the genders. AFLW teams are more likely to lose possession of the football in the attacking zone as they had to complete a greater number of hand passes or kick passes to allow a closer shot on goal suggesting that there is a different shooting range amongst the genders (Black et al., 2019; Sullivan et al., 2014). The research in soccer, rugby and Australian football emphasises that the styles of play, tactical approaches, and the indicators of successful performance differentiate amongst the genders. This suggests that the current body of research into men's Gaelic football may not be representative of the LGF performance.

The body of research in the men's game is evolving, contributing to an increased understanding of the game demands and what it takes to win (McGuigan et al., 2018) and at elite level (Allister et al., 2018; Carroll, 2013; Gamble et al., 2019; Mangan et al., 2017; McGuckin et al., 2020). Research to date indicates that winning teams are more efficient with their possessions in comparison to losing teams, with significant differences being found in turnover rates, shot-to-score ratios and productivity. Notably, there has been a technical improvement in men's GF with average shot efficiencies increasing from 48% in 2011 (Carroll, 2013) to the current reported values of 53% and 53.5% (Allister et al., 2018; McGuckin et al., 2020). With almost half of possessions in GF coming from kickouts, there has been a tactical evolution in recent years (McGuckin et al., 2020). The style has now developed to optimise the return from the kickout to gain possession with many teams favouring the short kickout due to the higher retention rates (Daly & Donnelly, 2018; Mangan et al., 2017; McGuckin et al., 2020). However, the longer kickout was found to have a greater possession to score conversion (McGuckin et al., 2020), presenting a risk-reward dilemma to be taken into consideration when developing team strategies. Overall, the research in the men's game has contributed to an understanding of the technical and tactical proficiency, allowing men's Gaelic football teams can set realistic targets to gain successful match outcomes.

The aim of the current study was to establish a benchmark profile for successful performance in LGF and to identify the key points of difference between LGF and the men's game using games from the 2019 and 2020 Senior Ladies Intercounty All-Ireland Championship. We hypothesised that there are significant differences between the performances of winning and losing teams in LGF and there are differences in how LGF and men's GF is played. Given the dearth of research into this subject area, it is envisaged that this study will provide valuable information to coaches, performance analysts, and administrators of LGF, and facilitate a better understanding on the key points of difference between the LGF and the men's game.

2. Materials and methods

The performance indicators (PI's) and operational definitions for this study were developed in five stages. A review of the Gaelic Football literature was conducted, where a draft list of PI's and operational definitions were compiled. The draft operational definitions were then circulated amongst an expert panel of coaches and past players (N = 4), who later partook in a focus group (validation panel; Francis et al., 2019). Guided by the expert panel, adaptations were made to the existing operational definitions. These adaptations were tested on randomly selected match footage to test the reliability of the definitions. During the pilot study, all variables collected were deemed acceptable (<5%), except for classifying whether a turnover was "Forced" or "Unforced' which could not be replicated in the inter-operator agreement tests below the acceptable level of 5% error (O'Donoghue & Holmes, 2014). Kickouts in this study were coded as "starter plays" and the possession began when the ball was secured after the kickout (Clear et al., 2017; McGuckin et al., 2020; McGuigan et al., 2018). Finally, video clips of the variables which were most susceptible to subjectivity were created with overlaying text and voiceover. These were circulated amongst the participants of the validation panel to ensure that the typology definition was an accurate representation of the actual action. The operational definitions used can be found in Appendix.

Analysis was carried out on 31 games (62 Performances) from the 2019 and 2020 All-Ireland Senior Ladies Football Championship. The 2019 match sample included one final, two semi-finals, four quarter finals, and 12 group stage games and the 2020 match sample included one final, two semi-finals, and 12 group stage games. Three group games from 2019 were excluded from the sample as footage was unattainable. Match recordings were sourced from the Ladies Gaelic Football Association (LGFA) and participating teams and stored on a Dell Intel Core i7 laptop computer. The analysis was carried out on NacSport Scout Plus (Version 6.0). Data were then checked and exported to Microsoft Excel, where a specific extraction system was created to extract, filter and categorise all relevant match information. An inter and intra-rater reliability assessment was carried out, and Interclass Correlation Coefficient (ICC) estimates and their 95% confident intervals calculated on 2 randomly selected matches over a 4-week period (Table 2). The average measure ICC was 1.000 with a 95% confidence interval from .999 to 1.000 demonstrating excellent reliability (Koo & Li, 2016).

A total of 25 dependent variables were used to compare winning and losing performances. Using a Shapiro–Wilk test ($p > 0.05$), 23 variables were normally distributed and 2 variables were not normally distributed (Cumulative Score & Goal Productivity). Thus, statistical differences between winning and losing performances were identified using paired sample *t*-tests ($p \leq 0.05$) for 23 variables and Wilcoxon signed ranked tests ($p \leq 0.05$) for the remaining 2 variables. Data analysis was completed using Microsoft Excel, SPSS, and R Studio (Table 1).

3. Results

Of the chosen 25 performance variables analysed, winning teams were found to be significantly superior to losers in 22 (Table 2). Winning teams demonstrated superiority in their ability to gain possession (turnovers and kickouts) and the use of those possessions (attack creation, shot count, productivity, and shooting efficiency).

Table 1. Inter-rater reliability assessment for percentage error in variables where agreement was less than 100% for action, description, and temporal variables (Interclass correlation coefficient).

	Observer 1	Observer 2	%Error
Team B Inside 45	41	40	0.03%
Attack Retained	36	37	0.03%
Team B Shot	23	22	0.04%
Shot Short	2	1	0.67%
Team B Foul	14	15	0.07%
Foul Midfield	5	6	0.18%

Table 2. Mean and STD for performance indicators of winning (n = 31) versus losing (n-31) performances (n = 62) across two Senior Ladies football championship seasons (2019–2020).

	Senior Performances		
Outcome	Winning Teams	Losing Teams	
Performance Variable	Mean ± Std.Dev	Mean ± Std.Dev	*P* Value
Total Possession Count	47 ± 7	44 ± 6	**0.010^**
Possession Share %	52 ± 3	48 ± 3	**0.009^**
Inside 45's	40 ± 8	33 ± 6	**0.001^**
Attacks (Retaining Ball Inside 45)	36 ± 7	29 ± 5	**0.001^**
Inside 45 Creation %	84 ± 7	75 ± 8	**0.001^**
Attack Creation %	66 ± 9	46 ± 10	**0.001^**
Territorial Effectiveness % (Attack to Score)	46 ± 10	37 ± 11	**0.000^**
Shot Count	29 ± 7	23 ± 7	**0.002^**
Scores	17 ± 5	11 ± 4	**0.000^**
Points	14 ± 4	9 ± 4	**0.000^**
Goals	3 ± 2	2 ± 1	**0.001^**
Cumulative Score	23 ± 8	15 ± 5	**0.000***
Productivity	3.51 ± 0.86	2.49 ± 0.83	**0.000^**
Goal Productivity	4.72 ± 1.29	3.21 ± 1.08	**0.000***
Shot: Score %	58 ± 9	48 ± 12	**0.000^**
Shot: Score from Play %	55 ± 8	41 ± 12	**0.000^**
Shot: Score from Placed Ball %	75 ± 22	66 ± 26	0.164^
Total Own Kickouts	17 ± 5	23 ± 6	**0.000^**
Own Kickouts Won	13 ± 4	16 ± 4	**0.001^**
Own Kickout Won %	77 ± 13	72 ± 14	0.150^
Opposition Kickouts Won	7 ± 5	4 ± 3	**0.005^**
Opposition Kickout Won %	28 ± 14	23 ± 14	0.145^
Turnovers	23 ± 5	26 ± 7	**0.001^**
Turnover Rate %	48 ± 8	58 ± 11	**0.000^**
Total Fouls Committed	21 ± 6	19 ± 5	**0.039^**

^Paired T-test used, * Wilcoxon signed ranked test used.
Bold where significance found ($p \leq 0.05$)

A detailed breakdown of kickout outcomes for winning and losing teams was investigated, considering the distance kicked and the final outcome of the possession (Table 3). The findings indicate that losing teams are required to take more kickouts per game than winning teams with similar retention rates. Although the retention rates for winning and losing teams are similar, losing teams having to distribute more kickouts, thus, are losing more kickouts. Winning teams have a greater possession to score conversion when retaining their own kickout and winning the opposition kickout, irrespective of the distance.

The pitch map allows the identification of a distinct shooting and scoring area from play for LGF (Figure 1).

Table 3. Kickout outcome for winning (n = 31), losing (n = 31) and all performances (n = 32) across two Senior Ladies football championship seasons* (2019–2020).

	Total	Retention Rate %	Possession Retained	Possession to Shot Conversion %	Shots	Scores	Goals	Points	Possession to Score Conversion %	Net Point per Kickout Retained
All Performances										
Own Kickout	1253	73%	913	54%	490	276	40	236	30%	0.39
Short Kickout	792 (63%)	82%	652	51%	330	187	23	164	29%	0.36
Long Kickout	461 (37%)	57%	261	61%	160	89	17	72	34%	0.47
Opp Kickout	1253	27%	341	79%	269	152	32	120	45%	0.63
Short Kickout	792	18%	142	87%	123	75	16	59	53%	0.75
Long Kickout	461	43%	199	73%	146	77	16	61	39%	0.55
Winning Performances										
Own Kickout	527	76%	402	60%	240	149	23	126	37%	0.49
Short Kickout	354 (67%)	84%	297	55%	164	100	11	89	34%	0.41
Long Kickout	173 (33%)	61%	105	72%	76	49	12	37	47%	0.70
Opp Kickout	726	30%	216	82%	177	106	26	80	49%	0.73
Short Kickout	438	19%	84	90%	76	50	13	37	60%	0.90
Long Kickout	288	46%	132	77%	101	56	13	43	42%	0.62
Losing Performances										
Own Kickout	726	70%	511	49%	250	127	17	110	25%	0.32
Short Kickout	438 (60%)	81%	355	47%	166	87	12	75	25%	0.31

(*Continued*)

Table 3. (Continued).

	Total	Retention Rate %	Possession Retained	Possession to Shot Conversion %	Shots	Scores	Goals	Points	Possession to Score Conversion %	Net Point per Kickout Retained
Long Kickout	288 (40%)	54%	156	54%	84	40	5	35	26%	0.32
Opp Kickout	527	24%	125	74%	92	46	6	40	37%	0.46
Short Kickout	354	16%	58	81%	47	25	3	22	43%	0.53
Long Kickout	173	39%	67	67%	45	21	3	18	31%	0.40

4. Discussion

The aim of the current study was to establish a benchmark profile for successful performance in LGF and to identify the key points of difference between LGF and the men's game using games from the 2019 and 2020 Senior Ladies Intercounty All-Ireland Championship. The findings revealed that a successful performance in LGF can be characterised by a superior ability to gain possession through kickouts and turnovers, ultimately having more possession of the ball, and using that possession more efficiently, creating more attacks and shooting opportunities. The findings also uncovered that LGF and men's GF teams utilise their possessions differently, confirming the original hypothesis that there are key differences between how LGF and the men's game is played.

The current findings indicate that a winning teams performance in LGF will score an average of 17 times per game, six times more than a losing performance. The scoring frequency of winning teams in LGF is comparable to that of the men's game, also scoring an average of 17 times per game (McGuckin et al., 2020). An average winning performance in LGF was found to score 3–14 per game, with losing performances scoring an average of 2–9. McGuckin et al. (2020) reported that to win the 2016 GF Championship, winning teams scored an average of 1–17, highlighting that there are more goals in LGF. Around 1 in 5 scores in senior LGF is a goal, compared to 1 in 10 in the men's game. It is important to note the time differential between these two sports, as LGF match lasts for a total of 60 minutes, whereas a men's GF match will last for 70 minutes. Thus, LGF has more goals and a greater scoring frequency per minute, agreeing with the popular narrative that LGF is an attractive and exciting game to watch. These data concurs with the higher reported frequency of scoring in women's rugby and soccer compared to their male counterparts; suggesting there is a trend of higher scoring frequencies in female invasion-based team sports compared to male invasion-based team sports (Althoff et al., 2010; Casal et al., 2020; A. Hughes et al., 2017). A possible explanation for the prevalence of goals is the goal post dimensions which are common to both genders, which have dimensions of 6.5 m in width by 2.5 m in height. The fact that women are considerably smaller and slighter than male players (Pedersen et al., 2019), makes it more challenging for LGF players to defend the entirety of their goals potentially resulting in more goal scoring opportunities in the women's game. While it can be difficult to compare LGF to soccer due to the difference in volume of scores, women's soccer teams have more shot attempts at goal resulting in more goals per game than men and a similar argument is posited for this as the female goal keepers defend a relatively much larger goal (Pedersen et al., 2019). The score difference between losing teams is larger in LGF than in the men's game with losing teams scoring an average of 11 times per game compared to male losing teams (13 scores), suggesting that the men's game may be more competitive (McGuckin et al., 2020).

It is well established in the men's game that winning teams demonstrate superiority in their utilisation of their possessions by creating more attacking opportunities and being more efficient in shooting (Allister et al., 2018; Carroll, 2013; Gamble et al., 2019, 2020; McGahan et al., 2021; McGuckin et al., 2020). The current findings indicate that winning teams in LGF have a similar profile. Winning teams create an attack with 66% of their possessions whereas losing teams are creating attacks with only 46% of their possessions and winning teams converting 58% of their shots to a score with losing teams converting

48%. Attacking play has been established as a key performance indicator in the Gaelic sports and other female invasion-based team games (Allister et al., 2018; Althoff et al., 2010; Black et al., 2019; Carroll, 2013; Casal et al., 2020; Gamble et al., 2019, 2020; A. Hughes et al., 2017; McGahan et al., 2021; McGuckin et al., 2020; O'Brien et al., 2021). In the current study, a new metric of "Inside 45" was used derived from Australian football (Black et al., 2019), providing more clarity on attacking build-up play in LGF. The metric "Inside 45" facilitates the identification of how many times a team plays the ball into the attacking zone ("Inside 45"), with an "Attack" being used to identify the retention of that ball, highlighting the importance of developing tactical strategies in LGF to infiltrate the oppositions defensive lines.

When an attacking opportunity is cultivated, both winning and losing teams are getting a shot off around 80% of the time, with winning teams shooting 29 times per game and losing teams 23 times, consistent with that of men's GF. Despite the growing volume of papers in men's GF considering shooting metrics, none have explored the difference in shooting accuracy between shots in open play and those from "placed balls" which include free kicks, 45's and penalties. The current data demonstrates that in LGF, both winning and losing teams have a greater shot-to-score ratio from placed balls than from play. It was observed that 48% of shots from play result in a score and 70% from placed balls result in a score. These findings are consistent with variation between open play and placed ball success reported in hurling (Clear et al., 2017; O'Brien et al., 2021). The observation highlights how difficult it is to score from open play in both games. The ability to score in open play was a key differentiator between winning and losing performance with winning teams in LGF significantly more efficient than losing teams when shooting in play. The difference was not observed in the placed balls success, possibly explained by the fact that most teams have a reliable free taker.

The current findings indicate that possession dominance impacts match outcome with winners securing more than losers. This is consistent with that of men's GF and other female invasion team sports, such as rugby and soccer (Gamble et al., 2019; M. Hughes et al., 2019; Kubayi & Larkin, 2020; McGuckin et al., 2020). Winning teams dominate possession allowing them to create more shots and scores while also preventing the opposition from creating opportunities to gain an advantage. The current study observed that winning teams are gaining more possession due to their ability to force opposition turnovers and win more opposition kickouts, both of which were found to be significantly different between winning and losing performances. Consequently, it seems that game control through possession dominance in LGF is crucial to success and can be achieved through forcing the opposition to turnover the ball and winning more opposition kickouts.

Winning teams demonstrate superior utilisation of possession, having a greater productivity than losing teams, scoring 3.51 times per 10 possessions versus the losing teams' 2.49 times per 10 possessions. These findings are consistent and comparable with that of the men's game where productivity was found to be significantly higher for winning teams (4 scores per 10 possessions; McGuckin et al., 2020). However, the sample revealed that having a greater productivity in LGF does not always result in a successful outcome. In three of the 31 games, losing teams were found to have a greater productivity. An explanation for this is that the productivity metric uses scoring frequency as opposed to cumulative score. As goals are worth 3 points and are twice as common in LGF, this

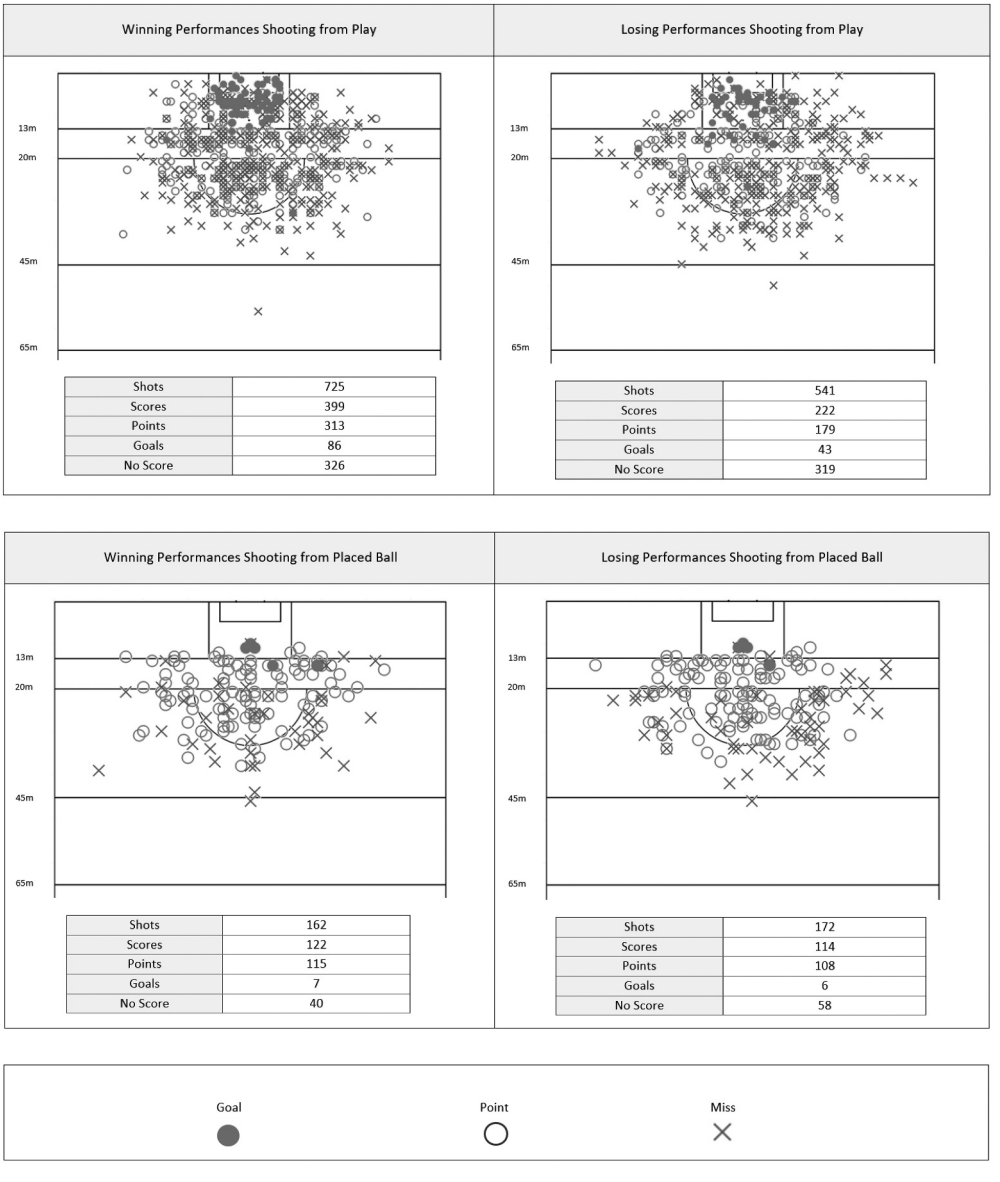

Figure 1. Shot and scoring location for winning (n = 31), losing (n = 31) and all performances (n = 32) across two Senior Ladies football championship seasons* (2019–2020).

borrowed metric potentially does not accurately reflect the nature of the game. To address this anomaly, we developed a new metric of goal productivity which incorporates the cumulative score. Application of this metric uncovered that all winning teams from the sample have higher goal productivity and score significantly more cumulative points per 10 possessions than losing teams. It seems that being more productive with your possessions in terms of frequency of scores does not always result in a successful outcome and attention should be placed upon shot selection and coaching strategies to facilitate and optimise goal scoring opportunities.

The kickout is not a key influencer of match outcome in LGF, with no statistical difference being found between winning and losing teams retaining their own kickout (77% and 72% respectively) or winning their oppositions kickout (28% and 23% respectively). These findings contradict previous research in the men's game, where winning kickouts has evolved into a significant contributor to achieve a winning advantage (Carroll, 2013; Gamble et al., 2019, 2020). While the retention and winning rates of kickouts are not a significant indicator of performance, winning teams are gaining more possession through kickouts as losing teams are required to have an average of six more kickouts per game. Our analysis indicates that an average performance will see teams opting for a shorter kickout 63% of the time, and a longer kickout 37%. The prevalence of short kickouts in LGF mirrors the trend which has been observed in men's GF over the last ten years (Daly & Donnelly, 2018; McGuckin et al., 2020). The adoption of the short kickout tactic drastically reduces teams' risk of losing the ball from a kickout, however it means they are considerably further from the attack zone when securing possession resulting in more build-up play being required. Data show that LGF teams opt for short kickouts much more often than GF teams despite poorer retention rates (LGF: 63% short, retaining 82%; GF: 47% short, retaining 93.4%; McGuckin et al., 2020). Although, shorter kickouts were found to have a higher retention rate for both winning and losing performances (67% and 60% respectively); the longer kickout was found to have a greater possession to shot, and possession to score conversion for both winning (47%) and losing teams (26%). Thus, teams may be taking a risk kicking longer with their kickouts, but if they do retain the possession, they have a greater chance of creating a shooting and scoring opportunity. The nature of LGF as an invasion-based team sport requires moving the ball up the field to infiltrate the opposition's goal and a longer kickout reduces the risk of losing the ball during build up play. Given that the kickout is a critical and potentially controllable factor in gaining possession, further analysis is needed with a bigger sample size, considering additional variables and to investigate the differences amongst the grades in LGF.

Based upon this two-season sample, six key points seem to differentiate the technical and tactical behaviours between LGF and the men's game. The following summary is a based on the comparison with the current study to those published by McGuckin et al. (2020) as this was the only study to analyse a full elite GF season. The key points of difference are as follows; 1) goals are a key influencer in LGF with double the amount scored than the men's game, (LGF = 1/5 scores are a goal men's GF = 1 in 10 scores are a goal). 2) LGF players have a distinct shooting range, opting to shoot closer to the goal (See, Figure 1). 3) The kickout in LGF is not a significant influencer of success, whereas it is in the men's game. 4) LGF teams use shorter kickouts more often, (LGF = 63%, men's GF = 47%). 5) LGF teams have a considerably lower retention rate from short kickouts (LGF = 82%, men's GF = 93%). 6) There is a greater winning margin between LGF teams, suggesting games are less competitive, (LGF = average winning margin of 8 points, men's GF = average winning margin of 6 points). Further investigation is needed to verify these key points of differences with a larger sample size over a number of championship seasons.

5. Conclusion

The current study was the first to establish a benchmark profile for successful performance in LGF and consider the transferability of knowledge available in the men's game. Given the dearth of research into this subject area, special attention was placed upon developing a valid and reliable analysis system which can be replicated in future research. We identified that in addition to scoring measures, winning teams in LGF demonstrate possession dominance with superior ability to gain possession (turnovers and kickouts) and the utilisation of those possessions (attack creation, shot count, productivity, and shooting efficiency). We uncovered six key differences between LGF and the men's game, confirming our hypothesis that there are implications to coaches in LGF borrowing resources developed in the men's game.

It is envisaged that this study will facilitate a better understanding of the game demands of LGF, providing valuable information to coaches, performance analysts, and administrators of LGF, particularly around the potential transferability of coaching resources from the men's game.

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Disclosure statement

No potential conflict of interest was reported by the author(s).

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Appendix. Operational definitions used

Action Variable	Definition
Shot (Play)	An action that sends the ball directly towards the opposing teams' goal in an attempt to score a point or goal from free play.
Shot (Placed Ball)	An action that sends the ball directly towards the opposing teams' goal in an attempt to score a point or goal from free, 45, or penalty.
Goal	The whole ball crossing over the goal line when kicked, flicked on in flight by any part of the body, or played by either team, between the goalposts and under the crossbar. This score is valued at three points.
Point (Play)	When the ball is kicked, fisted, palmed or flicked on in flight by any part of the body, by either team, between the goalposts and over the cross bar from open play. This score is valued at one point.
Point (Free)	When the ball is kicked over the crossbar and between the two posts, as a result of the referee awarding the attacking team a free kick. This score is valued at one point.

(*Continued*)

Action Variable	Definition
Point (45)	When the ball is kicked over the crossbar and between the two posts from the ground on the opposition teams 45 m line. A '45 is awarded when the defending team play the whole ball over their own end line. If the ball is touched or deflected, one point will be awarded. If the ball is not touched or deflected, two points will be awarded.
Score	When a point or goal is achieved.
Cumulative Score	Combined total score from points and goals. ((Total goals x3) + Total Points)
Net Points per Kickout Retained	Total points ((Total goals x3) + Total Points)/Total Possession retained from Kickout.
Productivity	Number of scores per 10 possessions. (Scores/Possessions) × 10 (Point = 1, Goal = 1)
Goal Productivity	Cumulative score per 10 possessions. (Cumulative Score/Possessions) × 10 (Point = 1, Goal = 3)
Score: Score %	Number of scores expressed as a percentage of the total team shots.
Possession count	Each time a team is in control (held in hand or foot) of the ball. One possession will persist until the team loses control of the ball. Does not include the goalkeeper holding kickout. (Multiple "plays" can occur within a single possession).
Possession Share %	Number of one teams possessions/total possessions in the game expressed as a percentage.
Possession to Shot Conversion%	Shots/Possessions expressed as a percentage.
Possession to Score Conversion %	Scores/Possessions expressed as a percentage.
Inside 45	An "Inside 45" is an action of moving the ball from outfield to the attacking third, over the 45 m line.
Attack	An "Attack" occurs when a team plays the ball over the 45 m line into their attacking third of the field and retain possession of the ball. A foul committed on the team who played the ball inside the 45 also constitutes an attack retained, as they are still in possession of the ball.
Inside 45 Creation %	Number of Inside 45's/Total possessions expressed as a percentage.
Attack Creation %	Number of Attacks/Total possessions expressed as a percentage.
Territorial Effectiveness %	Number of scores/Number of attacks expressed as a percentage.
Opposition Kickout Won	When a player from the attacking team gains possession from the oppositions kickout in the attacking third, inside the 45 m line.
Turnover	When a player in possession surrenders possession to the opposition.
Turnover Rate	Number of turnovers expressed as a percentage of the total number of team possessions
Kickout	Any time the kicker kicks the ball from the ground or the hands as a result of the ball travelling over the end line having been touched last by a player on the opposing team or from conceding a goal. The kickout will be taken from the 13 m line when a wide occurs and from the 20 m line when a score occurs.
Kickout Won	When the team who take the kickout gain possession of the ball. A foul committed by the opposing team constitutes a kickout won.
Kickout Lost	When the team who take the kickout do not gain possession of the ball. A foul committed by the team who take the kickout constitutes a kickout lost. A kickout which goes directly out of play without a team gaining possession constitutes a kickout lost.
Kickout Won %	Kickouts won/Total kickouts expressed as a percentage.
Short Kickout	When the kickout from the goalkeeper is received inside the 45 m line.
Long Kickout	When the kickout from the goalkeeper is received outside the 45 m line.
Foul committed	Any action that is considered by the referee, to be an infringement on the rules regarding the ball or another player.