



Waterford Institute *of* Technology

INSTITIÚID TEICNEOLAÍOCHTA PHORT LÁIRGE

To identify statistical differences in performance  
variables in professional football

A project submitted in part fulfilment of the requirement for the BSc (Hons) in  
Sports Coaching and Performance

The Department of Sport & Exercise Science

Student: Tom Doyle (W20067277)

Supervisor: Gerry Fitzpatrick

Submitted: April 2018

Statement of Originality & Ownership of Work

**Department of Health, Sport and Exercise and Science  
BSc in Sports Coaching and Performance**

Name.....

I confirm that all the work submitted in this project is my own work, not copied from any other person's work (published or unpublished) and that it has not previously been submitted for assessment on any other course, in any other institution.

Signed.....

Date.....

Student Number.....

Address.....

.....

.....

.....

Word Processor Word Count.....

## Acknowledgements

Firstly, my thanks and appreciation must go to the staff of Waterford Institute of Technology, the lecturers on the BSc in Sports Coaching & Performance and in particular the course leader Dr. Jean McArdle and my supervisor for this study Gerry Fitzpatrick. The knowledge and experiences shared to me over the last four years have been something that will only be a positive to me in my future endeavours and something that I will keep with me for many years to come.

I would also like to thank the Scottish football club with whom I completed my third-year internship with. The opportunity to work in such a professional footballing setup is something I could only have dreamed of before starting the course. The year gave me a deep insight into the world of performance analysis and offered me invaluable experience for the future and is the reason I have chosen such a topic for this study.

Finally, I would like to extend a huge thank you to my family and close friends and specifically my parents who not only from a financial side have helped me through the last four years but have been there for me every day to encourage and motivate me to better myself in every sense. I would also like to thank and wish the best for the future to my classmates who I have shared this experience with.

## Abstract

The aim of the present study was to identify statistical differences in performance variables between winning, losing and drawing performances in a professional football team. A total of 38 games played in the Scottish Premiership season of 2016/17 were analysed. The performance variables collected were: total shots, shots on target, goals, short passes, successful short passes, long passes, successful long passes, crosses, successful crosses, dribbles, successful dribbles, tackles, successful tackles, headers, successful headers, clearances, successful clearances, fouls gained, fouls committed, losses of possession, yellow cards and red cards. Video footage of the matches were tagged and linked to one of five positional areas for the player who executed it (external defenders, central defenders, external midfielders, central midfielders and forwards) using 'Longomatch PRO' software. The data was then analysed by performing a one-way analysis of variance (ANOVA) to check for statistical differences between winning, losing and drawing performances.

The results showed significant differences ( $p < 0.05$ ) were found either for the team as a total or for one of the five positional areas in performance variables relating to goals scored (shots, shots on target and goals), offensive variables (successful short passes, long passes, successful long passes, dribbles and successful dribbles), defensive variables (headers and successful headers) and other variables (losses of possession and yellow cards).

Losses of possession was the variable that was found to be the most common for the total team and three of the five positional areas (central defenders, external defenders and central midfielders) with losing performances showing significantly higher values when compared to winning performances. This may suggest that losing the football cheaply especially in defensive and central positions in matches may result in opportunities for the opposition which in turn may lead to goals being conceded and matches lost.

# Table of Contents

<b>Statement of Originality &amp; Ownership of Work .....</b>	<b>ii</b>
<b>Acknowledgements .....</b>	<b>iii</b>
<b>Abstract.....</b>	<b>iv</b>
<b>List of Figures.....</b>	<b>vii</b>
<b>List of Tables .....</b>	<b>ix</b>
<b>Chapter 1 - Literature Review .....</b>	<b>1</b>
1.1 Introduction to Performance Analysis .....	2
1.2 Performance Indicators.....	3
1.3 Winning & Losing in Sport .....	5
1.4 Winning & Losing in Professional Football .....	7
<b>Chapter 2 - Methodology.....</b>	<b>10</b>
<b>Introduction .....</b>	<b>11</b>
2.1 Purpose of the Study .....	11
2.2 Research Questions .....	11
2.3 Conceptual Framework.....	11
2.4 Data Sources .....	12
2.5 Variables .....	12
2.6 Data Collection .....	14
2.7 Reliability .....	16
2.8 Data Analysis .....	17
2.9 Ethical Considerations .....	17
<b>Chapter 3 - Results .....</b>	<b>18</b>
<b>Introduction .....</b>	<b>19</b>
3.1 Differences between Winning & Losing Performances.....	20
3.1.1 Total Team .....	20
3.1.2 External Defenders .....	20
3.1.3 Central Defenders .....	20
3.1.4 External Midfielders.....	20
3.1.5 Central Midfielders .....	20
3.1.6 Forwards .....	20
3.2 Differences between Winning & Drawing Performances .....	21
3.2.1 Total Team .....	21

3.2.2	External Defenders .....	21
3.2.3	Central Defenders .....	21
3.2.4	External Midfielders.....	21
3.2.5	Central Midfielders .....	21
3.2.6	Forwards .....	21
3.3	Differences between Drawing & Losing Performances .....	22
3.3.1	Total Team .....	22
3.3.2	External Defenders .....	22
3.3.3	Central Defenders .....	22
3.3.4	External Midfielders.....	22
3.3.5	Central Midfielders .....	22
3.3.6	Forwards .....	22
	<b>Discussion .....</b>	<b>39</b>
	Winning & Losing Performances .....	39
	Winning & Drawing Performances.....	40
	Drawing & Losing Performances .....	41
	<b>Conclusion.....</b>	<b>42</b>
	<b>Limitations &amp; Future Research .....</b>	<b>42</b>
	<b>Reference List .....</b>	<b>44</b>

## List of Figures

Figure 1. Example of the 'Longomatch PRO' Tagging Panel .....	15
Figure 2. Positional Areas.....	15
Figure 3. Statistical Differences in Total Shots ( $p<0.05$ ), Shots on Target & Goals ( $p<0.01$ ) for the Total Team .....	29
Figure 4. Statistical Differences in Headers, Successful Headers, Losses of Possession ( $p<0.01$ ) & Successful Dribbles ( $p<0.05$ ) for the Total Team. ....	29
Figure 5. Statistical Differences for Long Passes, Crosses & Tackles ( $p<0.05$ ) for the Total Team .....	30
Figure 6. Statistical Differences in Goals ( $p<0.05$ ) for the Total Team .....	30
Figure 7. Statistical Differences in Shots on Target ( $p<0.05$ ) for the Total Team .....	30
Figure 8. Statistical Differences in Losses of Possession ( $p<0.05$ ) for External Defenders .....	31
Figure 9. Statistical Differences in Long Passes & Successful Long Passes ( $p<0.05$ ) for External Defenders .....	31
Figure 10. Statistical Differences in Long Clearances ( $p<0.05$ ) for External Defenders .....	31
Figure 11. Statistical Differences in Headers & Successful Headers ( $p<0.05$ ) for Central Defenders .....	32
Figure 12. Statistical Differences in Successful Long Passes & Losses of Possession ( $p<0.05$ ) for Central Defenders .....	32
Figure 13. Statistical Differences in Clearances ( $p<0.05$ ) for Central Defenders .....	32
Figure 14. Statistical Differences in Long Passes & Clearances ( $p<0.05$ ) for Central Defenders .....	33
Figure 15. Statistical Differences in Shots on Target ( $p<0.05$ ) for Central Defenders .....	33
Figure 16. Statistical Differences in Long Passes, Successful Dribbles ( $p<0.01$ ) & Dribbles ( $p<0.05$ ) for External Midfielders.....	34
Figure 17. Statistical Differences in Dribbles ( $p<0.05$ ) for External Midfielders	34
Figure 18. Statistical Differences in Successful Tackles ( $p<0.05$ ) for External Midfielders .....	34

Figure 19. Statistical Differences in Successful Long Passes, Headers, Successful Headers ( $p < 0.01$ ) & Long Passes ( $p < 0.05$ ) for Central Midfielders .....	35
Figure 20. Statistical Differences in Goals, Losses of Possession ( $p < 0.05$ ) & Yellow Cards ( $p < 0.01$ ) for Central Midfielders .....	35
Figure 21. Statistical Differences in Headers & Successful Headers ( $p < 0.05$ ) for Central Midfielders.....	36
Figure 22. Statistical Differences in Successful Long Passes ( $p < 0.05$ ) for Central Midfielders.....	36
Figure 23. Statistical Differences in Total Shots, Dribbles, Successful Dribbles ( $p < 0.01$ ) & Shots on Target ( $p < 0.05$ ) for Forwards .....	37
Figure 24. Statistical Differences in Successful Short Passes ( $p < 0.05$ ) for Forwards.....	37
Figure 25. Statistical Differences in Clearances & Successful Clearances ( $p < 0.05$ ) for Forwards .....	38
Figure 26. Statistical Differences in Total Shots, Shots on Target, Dribbles, Successful Dribbles, Crosses, Tackles & Fouls Committed ( $p < 0.05$ ) for Forwards.....	38

## List of Tables

Table 1. Reliability Testing Results.....	16
Table 2. Variables Studied.....	19
Table 3. Differences between winning, losing and drawing games in performance indicators for total team .....	23
Table 4. Differences between winning, losing and drawing games in performance indicators for external defenders .....	24
Table 5. Differences between winning, losing and drawing games in performance indicators for central defenders .....	25
Table 6. Differences between winning, losing and drawing games in performance indicators for external midfielders.....	26
Table 7. Differences between winning, losing and drawing games in performance indicators for central midfielders.....	27
Table 8. Differences between winning, losing and drawing games in performance indicators for forwards .....	28

# Chapter 1 - Literature Review

## 1.1 Introduction to Performance Analysis

Performance analysis of sport is the video based investigation of actual sports performance or performance in training and has now become an accepted sub-discipline of sports and exercise science which combines aspects of motor control, biomechanics and notational analysis (O'Donoghue, 2010; 2015). It has become an essential tool for coaches, athletes and sports organisations in recent times which has allowed for the improvement of training programmes, better tactical decisions and management of teams (O'Donoghue, 2015). Performance analysis can ultimately be defined as a four-stage process; collecting, collating, interpreting and delivering objective data to enhance the feedback process (Robins and Hughes, 2015). The use of performance analysis can be used in a number of ways with one being in the coaching process. Coaches using performance analysis can look back on different aspects of the game and can receive an objective view which removes any subjective thoughts by a coach or other team members (Hughes & Bartlett, 2008), (Groom & Cushion, 2004). Performance analysis can also give coaches a reminder of post-match events which they may not have remembered sufficiently in order to make a decision, a study by Laird and Waters (2008) found that the probability of qualified, experienced coaches recalling critical events accurately is 59.2%. The use of performance analysis can insure that all critical events are of use to a coach in a particular way and avoid any of these critical events being forgotten about or not remembered clearly enough to be of support.

Aside from the use of performance analysis in the coaching process it has also been used heavily in sports such as rugby, American football, cricket and tennis to aid officials in decision making. The use of 'Hawkeye' in particular has been implemented in these sports to remove human error by providing objective information which can then be used by match officials to insure the correct decision is made in a certain situation (Williams, 2015).

In relation to research in the area of performance analysis there is a lack of continuity in research, which makes it difficult for performance to be understood as each research paper is utilising completely contrasting analysis methods which may give different results (MacKenzie & Cushion, 2013).

## 1.2 Performance Indicators

Over the last few years, research has suggested that the development and use of performance indicators should be utilised by athletes, coaches and sports organisations (Carling et al, 2009; 2005). With this recommendation in mind, the use of performance indicators has become increasingly popular as a determinant of successful sports performance. A performance indicator is defined as a selection, or combination, of action variables that aims to define some or all aspects of a performance and should relate to successful performance or outcome (Hughes & Bartlett, 2002). These indicators establish a profile of ideal performance that should be present to achieve a certain performance and can be useful as a tool to predict the future behaviour of sporting activity (Jones et al., 2004). Key performance indicators can be studied from an individual or team perspective (Carling et al., 2009) and can provide the coach with a quantification of performance that can be compared against previously collected data (Carling & Court, 2013). In recent years, research has been directed towards patterns of play and build up play to goals in football (Armatas & Yiannakos, 2010), (Johnson & Murphy, 2010), (Sajadi & Rahnama, 2007), (Acar et al., 2006) (Hughes et al., 2005), (Ensum et al., 2002), (Grant et al., 1999) & (Yamanaka et al., 1993). This research aims to seek out particular patterns of play and build-up of play which may lead to goal scoring chances being created but lacks a focus on performance indicators in the sport.

In terms of performance indicators, research in the area of developing specific performance indicators per position has also been looked at (Hughes et al., 2012) & (Di Salvo et al., 2007) which has aimed to develop specific performance indicators based on positions in football. Hughes et al. (2012) aimed to use the unique opportunity of a large number of performance analysts coming together to discuss and define sets of performance indicators for each position in soccer. The study gathered twelve experts in performance analysis who were also supplemented by three more experts from different commercial performance analysis software companies. The twelve experts had over two hundred years combined work in the field of analysis and were also helped by fifty-one level three sports science students. The key performance indicators for the outfield players were very similar, differing only in their order of importance. No performance analysis software was used in the study unlike research from Di

Salvo et al. (2007) who used extremely high-tech equipment in their study of performance characteristics according to playing position. The paper provided a large-scale study into the motion characteristics of elite soccer players during match play and according to playing position. The study analysed 300 players over 20 Spanish Premier League matches and ten Champions League games in the 2002/2003 and 2003/ 2004 seasons. Using a multiple-camera match analysis system (Amisco Pro) which captures whole game footage using eight cameras situated on the stadium roof differences were found in relation to total distance covered per position with central midfielders covering significantly more ground than any other position. Noteworthy differences were also found in the distance covered in the first half compared to the second half in medium intensity running (11.1km/h-19km/h).

These research papers purely identified the performance indicators and characteristics for specific positions which can be then used to influence specific training based on the requirements for each position in a football team. In recent years, a number of studies have attempted to specify performance indicators of team performance through the comparison of winning, losing and drawing (Cintia et al., 2015), (Araya & Larkin, 2013) (Castellano et al., 2012), (Lago-Peñas et al., 2011; 2010), (Armatas et al., 2009), (Szwarc, 2004) which is going to be the aim of this research project with the addition of identifying differences in performance indicators based on position.

### 1.3 Winning & Losing in Sport

Performance analysis is used in a wide variety of sports and with that comes the use of performance indicators. The idea of identifying performance indicators in relation to winning and losing teams has been used in several studies in rugby union (Hughes et al., 2017), (Ortega et al., 2009) & (Jones et al., 2004). Research published by Ortega et al. (2009) aimed to analyse differences in rugby game statistics in relation to winning and losing performances. 58 “Six Nations” games were analysed with the software “SPSS” with numerous attacking and defensive variables considered. The research concluded that winning teams scored more points and also used the kicking game more with significantly more kicks to touch than losing teams. No actual video analysis software was used in the study which was different to the two other studies by Hughes et al. (2017) & Jones et al. (2004) who both used video analysis in their research studies.

Jones et al. (2004) aimed to examine predictors of success in rugby union through the comparison of winning and losing performances which was a similar aim to Hughes et al. (2017) who aimed to compare key performance indicators in elite men’s and women’s rugby union and identify those that discriminated winning from losing. Jones et al. (2004) analysed 20 games from a professional team using the ‘Noldus Observer Pro’ software. 22 variables relating to attack and defence were analysed with only two being significantly different between winning and losing teams. Hughes et al. (2017) looked at a total of 16 games (eight from the men’s world cup and eight from the women’s world cup) using ‘Sportscode’ software. A total of fourteen variables relating to attack and defence were analysed with two main variables being considerably different between winning and losing teams. Both studies concluded that the percentage of lineouts won on opposition throws and the number of tries scored were two highly important factors when it came to distinguishing winning performances from losing ones.

Research in the area of performance indicators that distinguish winning and losing teams has also been conducted in basketball (Csataljay et al., 2009) and in field hockey (Vinson & Peters, 2015). Csataljay et al. (2009) examined the statistics of 54 games from the European Men’s Basketball League with the aim to identify critical performance indicators that most distinguish winning teams

from losing teams. 18 main variables relating to both attack and defence were input to SPSS to obtain results with no video analysis being performed. Three main variables were found to distinguish winning teams from losing teams (percentage of three point attempts made, number of free-throws made & number of defensive rebounds). Research conducted by Vinson & Peters (2015) aimed to establish performance profiles specific to position and also identify differences in these profiles for qualifying teams, mid-table teams and relegated teams. The study looked at 36 games from the Women's English Hockey Premier League. Nine main variables also relating to attack and defence were analysed using 'Dartfish' software. The study concluded that winning teams had much higher successful passes whereas losing teams had significantly more unsuccessful passes and unsuccessful interceptions. Although these studies all relate to different sports much of the findings are similar which shows the wide variety of sports in which performance indicators can be used to distinguish winning teams from those who lose.

#### 1.4 Winning & Losing in Professional Football

Football has received the most attention in terms of performance analysis research to this recent day (Mackenzie & Cushion, 2013). According to Lago-Peñas et al. (2011), football's continuously interactive nature together with relatively low scoring and limited set plays does not facilitate breakdown, record and measurement via analysis. The majority of research in team sports such as rugby union, basketball & field hockey is largely explained by the sport's nature involving "plays" which can be easily identifiable and categorized with individual performances easily isolated.

Armatas et al. (2009) studied the Greek Premier Division over a total of ten seasons (from 1998/99 to 2007/08). The study only looked at attacking variables as indicators of success (shots on target, assists & goals). The study aimed to discover the differences in these variables between the top two teams in the league versus the bottom two teams in the league for each season. The study furthermore looked to uncover whether there were any changes in the number of variables from season to season between the top and bottom teams. It was concluded that the top two teams had more goals and shots which was a predictable finding. The amount of goals scored reduced significantly for the top teams over the ten years whereas goals scored for the bottom two teams remained much the same. In terms of shots from inside and outside the penalty area the numbers for the top two and the bottom two teams both increased. This conclusion supports a widely agreed on argument in the soccer world that concerns the strong margin reduction between strong and weak teams over the last decade. Szwarc (2004) came to the same conclusion that there were minor differences in the total effectiveness of attack and defence between the winners (Germany & Brazil) and the losers (rest of the teams).

The study by Szwarc (2004) looked at Germany and Brazil in the 2002 World Cup, both teams who made it to the final. Means of 15 variables relating to attack and defence were analysed over twenty-four games during the tournament with their frequency per game being calculated separately for the finalists (Brazil and Germany) and the remaining teams defeated by them in direct competition. Of the fifteen variables analysed Germany and Brazil fared better in ten of them. The two successful teams were more proficient in goals scored and also in the

effectiveness of their shots but Szwarc (2004) concluded that the successful teams showed a much higher effectiveness in only a few game elements. Noteworthy also, these very elements point to Germany and Brazil's technical and tactical maturity and the highest competence in individual actions. This includes the passing of the ball in pressurised situations, frequency and accuracy of shots towards the goal, ball winning in direct actions with the opponent and most importantly, effective defence of their own goal.

Araya & Larkin (2013) published research similar to that of Armatas et al. (2009) and Szwarc (2004) in terms of looking at performance indicators of teams who finished in a particular place at the end of a season or in a tournament. Araya & Larkin (2013) analysed 380 games from the 2012/2013 English Premier League season to look at variables that differentiated the top ten teams from the bottom ten teams come the end of the season. Variables collected included both attacking (team possession, successful passes, dribbles, fouls, offside, crosses, through balls, long balls, short passes of less than 10 metres and shots on target) and defensive (aerial duels, shots conceded, tackles, interceptions, fouls) indicators. Results showed that teams in the top ten had increased numbers in the attacking variables with teams in the bottom ten showing greater numbers in the defensive variables. Significant differences were found in possession, successful short passes and shots per game. Variables such as crosses, dribbles, offsides and tackles were very similar in both sets of teams, a conclusion that teams should focus on retaining possession of the ball through short passes, with the aim to have shots from inside the 18-yard box was made.

Leading author in the area of distinguishing winning and losing teams using performance indicators Carlos Lago-Peñas published two research papers in 2010 and 2011 and was a co-author on a paper with Castellano (2012) which all aimed to identify the game-related statistics that discriminate between winning and losing teams in Spanish soccer (2010), identify performance indicators that discriminate winning teams from drawing and losing teams in the UEFA Champions League (2011) and identifying the match statistics which best discriminated between winning, drawing and losing teams (2012).

The three research papers published by Lago-Peñas et al. (2011 & 2010) and Castellano et al. (2012), examined the same variables relating to attack and

defense in football. Total shots, shots on goal, effectiveness, assists, crosses, offside committed and received, corners, ball possession, crosses against, fouls committed and received, corners against, yellow and red cards, and venue were collected from 'GecaSport' for the Lago-Peñas et al. (2011 & 2010) (a private company dedicated to the performance assessment of teams in the Spanish Soccer League). Castellano et al. (2012) analysed three World Cup tournaments: Korea/Japan 2002, Germany 2006 and South Africa 2010. The research found results to suggest that winning, drawing and losing national teams may be discriminated from one another on the basis of variables such as ball possession and the effectiveness of their attacking play. The study from Lago-Peñas et al. (2010) included statistics from 380 games from the 2008-2009 season of the Spanish Premier Division. The results from the study indicated that winning teams made more shots and shots on goal than losing and drawing teams. Furthermore, winning teams had a higher effectiveness when it came to converting these shots to goals than losing and drawing teams. Interestingly possession was about the same for teams who won, drew and lost which is a result that differs in the research from Araya & Larkin (2013) who concluded that possession was main predictor of successful teams. In comparison, Lago-Peñas et al. (2011) looked at the statistics of 288 UEFA Champions League matches and compiled them in similar fashion to the study in 2010. The research concluded that winning teams were most proficient in attacking areas (shots, shots on target, effectiveness, successful passes and ball possession). Losing teams had significantly higher numbers of yellow and red cards compared to the winning teams. Both sets of research from Lago-Peñas et al. (2011;2010) concluded with similar results which gives an indication of the types of results that may be expected in this research.

# Chapter 2 - Methodology

## Introduction

### 2.1 Purpose of the Study

To examine whether certain performance indicators in football are statistically different when a team wins, loses or draws. Similar research has been conducted by key author Lago-Peñas et al. (2011 & 2010) who studied only the teams as a whole and failed to look at specific positional areas, something which this study aims to do.

### 2.2 Research Questions

#### Null Hypothesis

There would be no significant differences between performance indicators when the team wins and when the team lose.

There would be no significant differences between performance indicators when the team win and when the team draw.

There would be no significant differences between performance indicators when the team draw and when the team lose.

### 2.3 Conceptual Framework

The following research was a quantitative study of a full seasons worth of games from a professional football club in the Scottish premier division. The current study incorporated a quantitative design which is the main method used in sporting research (Conroy et al. 2008). A quantitative design involves the gathering of measurable numerical quantities (Gratton and Jones, 2010). Quantitative methods are often implemented due to their objectivity in performance analysis (O'Donoghue, 2010). Due to the nature of performance analysis and its' use of numerical values the following study was quantitative in nature.

## 2.4 Data Sources

A total of thirty-eight (n=38) games were analysed as part of the research which is a full seasons' worth of games from the Scottish Premiership season of 2016/2017 which is the top tier of Scottish football. The decision to analyse a full seasons' worth of matches was based on previous research in similar research studies by Jones & Mellalieu (2005), Di Salvo et al. (2007) and Vinson & Peters (2015) who all used a seasons' worth of matches when conducting their research. The video footage was gathered from the clubs Head of Performance Analysis with the permission of the club given to undertake the research on the particular set of matches.

## 2.5 Variables

The following 22 primary aspects based on Hughes et al. (2012) relating to football performance were tagged when analysing each game:

- Short Pass - An attempt to project the ball to another teammate under twenty yards.
- Successful Short Pass - A successful attempt to project the ball to another teammate under twenty yards.
- Long Pass – An attempt to project the ball to another teammate over twenty yards.
- Successful Long Pass - A successful attempt to project the ball to another teammate over twenty yards.
- Shot – An attempt to project the ball towards the opposition goal in an attempt to score.
- Shot on Target - An attempt to project the ball towards the dimensions of the opposition goal that is on target but does not result in a goal.
- Goal - When a player successfully scores in the opposition goal.
- Cross – An attempt to project the ball to a teammate from a wide area.
- Successful Cross - A successful attempt to project the ball to a teammate from a wide area.
- Dribble – Any movement whilst in possession of the ball which is not inherently part of a passing action.

- Successful Dribble - Any movement whilst in possession of the ball which is not inherently part of a passing action that ends in the player not losing possession of the football.
- Tackle – An attempt to gain possession of the ball from the opponent.
- Successful Tackle - A successful attempt to gain possession of the ball from the opponent.
- Header - An attempt to project the ball with the head which may move the ball in any direction.
- Successful Header - A successful attempt to project of the ball with the head which may move the ball in any direction.
- Clearance - An attempt to project the ball away from one's defensive area which is not inherently part of a passing action.
- Successful Clearance - A successful attempt to project the ball away from one's defensive area which is not inherently part of a passing action.
- Foul Gained - Any act committed by an opposition player which is deemed by the referee to be unfair and is subsequently penalised with the awarding of a free-kick.
- Foul Committed - Any act committed by a player which is deemed by the referee to be unfair and is subsequently penalised with the awarding of a free-kick.
- Loss of Possession - Any action which results in possession of the ball being returned to the opposition team.
- Yellow Card - When a player receives a yellow card after committing a foul.
- Red Card - When a player receives a red card after committing a foul.

## 2.6 Data Collection

The analysis was carried out using the 'LongoMatch PRO' (LongoMatch by Fluendo, Barcelona) software where each game was looked at individually and a specific tagging panel was created (see Figure 1) to count numbers of the specific primary technical aspects of the team's performance which are listed above.

Each aspect tagged was then linked to the final performance of the team (win, loss or draw) and also to one of the five certain positional areas (see Figure 2) on the pitch which are explained below.

- Central Defenders: Players playing centrally in the defensive area of the pitch (Centre Backs).
- External Defenders: Players playing wide in the defensive area of the pitch (Left Backs & Right Backs).
- Central Midfielders: Players playing centrally in the middle of the pitch (Centre Midfielders).
- External Midfielders: Players playing wide in the middle of the pitch (Left & Right Midfielders/Wingers)
- Forwards: Players playing in the advanced attacking area of the pitch (Strikers).



Figure 1. Example of the 'Longomatch PRO' Tagging Panel

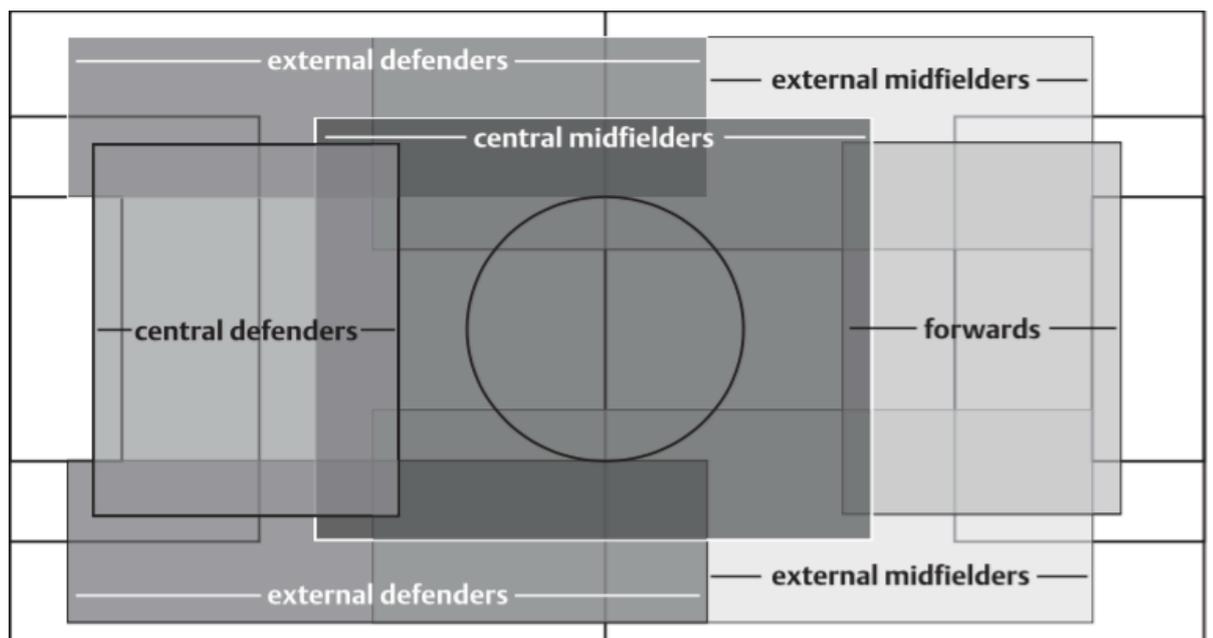


Figure 2. Positional Areas

## 2.7 Reliability

In order to make sure the aspects being tagged are reliable some method of testing must occur to confirm the reliability of the variables being tagged. In a review of performance analysis research Hughes, Cooper and Nevill (2002) found that only 30% of PA papers included reliability measures within their study. According to O'Donoghue (2012), the most commonly used type of reliability testing for performance analysis research is inter-rater reliability which involves the agreement of an event or action by two or more observers. To achieve this one game was sent to a performance analysis professional to tag using the variables above with the data being compared to the data collected already. Intra-reliability which involves the agreement of an event or action by the same observer was assessed by tagging variables from game ten twice with a gap of four weeks between each to avoid any familiarities with the game. Following these tests, a Kappa score was achieved which has a range between -1.0 and +1.0 (O'Donoghue 2008). According to Altman (1995) a Kappa value of over 0.8 is considered a very good score in terms of reliability.

Intra and inter reliability testing was undertaken to assess the objectivity and consistency of data collection. The following table shows the results from the reliability testing:

*Table 1. Reliability Testing Results*

Variables	Absolute (k)	
	Intra	Inter
Short Passes	0.823	0.793
Long Passes	0.771	0.691
Shots	0.868	0.831
Crosses	0.816	0.869
Dribbles	0.896	0.822
Tackles	0.842	0.814
Headers	1.00	0.907
Clearances	0.811	0.772
Fouls Gained	1.00	1.00
Fouls Committed	1.00	1.00
Loss of Possession	0.711	0.657
Yellow Cards	1.00	1.00
Red Cards	1.00	1.00

The reliability results showed a strong agreement in all the variables being analysed. All variables were between either 0.61-0.80 which shows a substantial agreement or 0.81-0.99 which shows a near perfect agreement. A Kappa score of one denotes a perfect agreement, which was seen in variables which would be expected to be perfectly agreed on.

## 2.8 Data Analysis

A descriptive analysis of the performance indicators for the team as a whole followed by the data relating to each of the five positional areas was first compiled (Mean  $\pm$  SD) for each variable when the team won, drew and lost using Microsoft Excel. Following this, a one-way analysis of variance (ANOVA) was carried out with the aim of analysing the statistically significant differences between winning and losing, winning and drawing and drawing and losing performances. The level of significance was set at  $p < 0.05$  with some variables being statistically significant to a level of  $p < 0.01$ .

## 2.9 Ethical Considerations

Due to the fact that the research project involved using analysis software to analyse a number of football matches the amount of data involved had to be obtained, stored and kept secure in a secure fashion. All of the data used and collected was obtained from the football club to be used solely for the purpose of this research project. This information was kept strictly confidential and was stored securely on a personal computer (MacBook Air) under password protection, a personal hard drive (Seagate Expansion Portable Drive) and a second personal computer (Sony Vaio) to avoid any information being leaked to other parties.

# Chapter 3 - Results

## Introduction

Descriptive results of key performance indicators between winning and losing, winning and drawing and drawing and losing performances for the total team are presented below in Table 3. Following this, results of the key performance indicators are presented for external defenders in Table 4, central defenders in Table 5, external midfielders in Table 6, central midfielders in Table 7 and forwards in Table 8. Within these tables, certain symbols indicate significant differences between winning, losing and drawing performances which will test the three null hypothesis that no significant differences would be found in performance indicators when the team wins and loses, wins and draws and draw and loses. Bar charts showing the statistical differences in performance indicators in the total team and the five positional areas are also presented below.

Variables are divided by those relating to goals scored, those relating to offense, those relating to defense and others as shown below in Table 2.

*Table 2. Variables Studied*

<b>Group of Variables</b>	<b>Variables/Performance Indicators</b>
<b>Relating to Goals Scored</b>	Total Shots Shots On Goal Goals
<b>Relating to Offense</b>	Short Passes, Successful Short Passes Long Passes, Successful Long Passes Crosses, Successful Crosses Dribbles, Successful Dribbles
<b>Relating to Defense</b>	Tackles, Successful Tackles Headers, Successful Headers Clearances, Successful Clearances
<b>Other</b>	Fouls Gained Fouls Committed Losses of Possession Yellow Cards Red Cards

### 3.1 Differences between Winning & Losing Performances

#### 3.1.1 Total Team

In relation to performance indicators concerning the total team when the team had a winning performance there were significantly higher values for shots on target, goals, headers and successful headers ( $p < 0.01$ ). Values for total shots and successful dribbles were also significantly higher ( $p < 0.05$ ). During a win, the number of losses of possession were significantly lower ( $p < 0.01$ ) when compared to a loss.

#### 3.1.2 External Defenders

External defenders presented significantly less losses of possession ( $p < 0.05$ ) during a win in comparison to a loss.

#### 3.1.3 Central Defenders

Central defenders displayed more headers and successful headers ( $p < 0.05$ ) during a winning performance with significantly less successful long passes and losses of possession ( $p < 0.05$ ).

#### 3.1.4 External Midfielders

External midfielders presented significantly more long passes and successful dribbles ( $p < 0.01$ ) along with more dribbles ( $p < 0.05$ ) during a win.

#### 3.1.5 Central Midfielders

Central midfielders produced significantly more headers and successful headers ( $p < 0.01$ ) along with more goals ( $p < 0.05$ ) during a win when compared to a loss. They also had significantly less successful long passes and yellow cards ( $p < 0.01$ ) accompanied with less long passes and losses of possession ( $p < 0.05$ ).

#### 3.1.6 Forwards

Forwards displayed significantly more total shots, dribbles and successful dribbles ( $p < 0.01$ ) and also more shots on target and successful short passes ( $p < 0.05$ ) during a winning performance when compared to losing performances.

## 3.2 Differences between Winning & Drawing Performances

### 3.2.1 Total Team

The team as a total produced significantly more goals, long passes ( $p < 0.05$ ) during a winning performance with significantly less crosses and tackles ( $p < 0.05$ ) when compared to drawn games.

### 3.2.2 External Defenders

External defenders completed significantly more long passes and successful long passes ( $p < 0.05$ ) during a win.

### 3.2.3 Central Defenders

Central defenders made significantly less clearances ( $p < 0.05$ ) during a win in comparison to a draw.

### 3.2.4 External Midfielders

External midfielders created significantly more dribbles and successful dribbles ( $p < 0.05$ ) during a winning performance when compared to the drawn performances.

### 3.2.5 Central Midfielders

Central midfielders had significantly more headers and successful headers ( $p < 0.05$ ) during a winning performance.

### 3.2.6 Forwards

Forwards showed significantly more clearances and successful clearances ( $p < 0.05$ ) in a win in comparison to a draw.

### 3.3 Differences between Drawing & Losing Performances

#### 3.3.1 Total Team

During a draw, the team as a total had more shots on target, clearances and successful clearances ( $p < 0.05$ ) when compared to a loss. The team as a total also had significantly less losses of possession ( $p < 0.05$ ) during a drawn game.

#### 3.3.2 External Defenders

External defenders made significantly more successful clearances ( $p < 0.05$ ) during a drawing performance in comparison to a losing performance.

#### 3.3.3 Central Defenders

Central defenders during a drawn performance exhibited significantly more shots on target and clearances ( $p < 0.05$ ) along with significantly less long passes ( $p < 0.05$ ) when compared to a loss.

#### 3.3.4 External Midfielders

External midfielders made significantly more successful tackles ( $p < 0.05$ ) during a draw when compared to a loss.

#### 3.3.5 Central Midfielders

During a draw, central midfielders produced significantly less successful long passes ( $p < 0.05$ ) in comparison to a loss.

#### 3.3.6 Forwards

Forwards displayed significantly more shots, shots on target, crosses, dribbles, successful dribbles, tackles and fouls committed ( $p < 0.05$ ) during a drawn performance when compared to a losing performance.

Table 3. Differences between winning, losing and drawing games in performance indicators for total team

Variables	Winner	Loser	Drawer
<b>Related to Goals Scored</b>			
Total Shots	14.1±4.2 <sup>^</sup>	10.1±4.5	13.9±5.5
Shots On Target	6.0±3.4 <sup>#</sup>	2.9±1.4	5.0±2.1 <sup>^</sup>
Goals	1.8±0.7 <sup>#</sup>	0.9±0.8	0.9±0.7 <sup>*</sup>
<b>Related to Offense</b>			
Short Passes	188.2±47.9	189.0±71.8	186.4±51.5
Successful Short Passes	163.1±45.4	163.6±69.1	161.4±47.2
Long Passes	42.7±13.8 <sup>*</sup>	48.9±16.5	35.4±12.3
Successful Long Passes	13.1±4.5	19.1±10.4	13.0±6.9
Crosses	21.7±7.2 <sup>*</sup>	23.8±11.9	30.1±11.4
Successful Crosses	5.9±2.7	5.7±3.8	7.9±5.5
Dribbles	51.6±12.8	41.6±15.0	45.1±11.1
Successful Dribbles	42.1±11.6 <sup>^</sup>	32.3±13.7	36.0±8.8
<b>Related to Defense</b>			
Tackles	31.0±10.6 <sup>*</sup>	31.9±12.7	41.9±8.3
Successful Tackles	19.6±7.6	18.3±8.7	25.1±5.1
Headers	100.4±10.0 <sup>#</sup>	78.4±24.7	96.6±28.4
Successful Headers	84.4±9.0 <sup>#</sup>	64.6±19.4	77.6±20.3
Clearances	30.8±6.6	27.3±8.3	38.6±12.6 <sup>^</sup>
Successful Clearances	26.1±6.3	22.5±6.7	32.1±11.7 <sup>^</sup>
<b>Other</b>			
Fouls Gained	12.7±3.1	11.6±2.1	11.7±3.5
Fouls Committed	11.3±2.6	10.5±1.6	12.4±3.4
Losses of Possession	21.5±5.4 <sup>#</sup>	31.1±5.8	24.4±5.6 <sup>^</sup>
Yellow Cards	1.6±1.3	2.2±1.1	1.9±0.7
Red Cards	0.0±0.0	0.1±0.5	0.0±0.0

\* Equals Significantly Different from any other group p<0.05

# Equals Significantly Different from Losers p<0.01

<sup>^</sup> Equals Significantly Different from Losers p<0.05

Table 4. Differences between winning, losing and drawing games in performance indicators for external defenders

Variables	Winner	Loser	Drawer
<b>Related to Goals Scored</b>			
Total Shots	0.6±0.9	1.0±1.2	1.0±0.8
Shots On Target	0.1±0.3	0.1±0.4	0.1±0.4
Goals	0.0±0.0	0.1±0.4	0.0±0.0
<b>Related to Offense</b>			
Short Passes	32.8±15.4	34.6±15.6	35.3±12.4
Successful Short Passes	27.8±12.9	29.2±15.5	30.3±12.1
Long Passes	18.5±6.8*	15.1±7.7	12.0±2.3
Successful Long Passes	5.7±2.5*	4.5±3.3	3.3±1.8
Crosses	7.7±4.3	8.1±5.0	9.0±3.4
Successful Crosses	2.2±2.0	1.9±1.7	2.1±2.1
Dribbles	9.6±4.4	8.2±3.4	7.6±1.8
Successful Dribbles	8.5±4.1	6.9±2.9	6.1±1.9
<b>Related to Defense</b>			
Tackles	5.2±2.6	6.5±2.8	6.9±3.6
Successful Tackles	3.4±1.9	3.9±1.9	4.7±3.4
Headers	17.4±5.3	15.3±5.7	18.4±9.0
Successful Headers	15.0±4.5	13.2±5.3	15.9±7.4
Clearances	6.7±2.1	5.4±3.2	8.9±4.5
Successful Clearances	5.5±1.8	4.1±2.8	7.4±4.2 <sup>^</sup>
<b>Other</b>			
Fouls Gained	1.4±1.2	1.2±1.1	1.3±1.1
Fouls Committed	1.6±1.1	1.4±0.9	1.4±0.8
Losses of Possession	4.3±2.3 <sup>^</sup>	6.8±3.1	4.7±1.9
Yellow Cards	0.1±0.3	0.1±0.3	0.4±0.5
Red Cards	0.0±0.0	0.1±0.3	0.0±0.0

\* Equals Significantly Different from any other group p<0.05

# Equals Significantly Different from Losers p<0.01

<sup>^</sup> Equals Significantly Different from Losers p<0.05

Table 5. Differences between winning, losing and drawing games in performance indicators for central defenders

Variables	Winner	Loser	Drawer
<b>Related to Goals Scored</b>			
Total Shots	1.1±0.8	1.1±1.1	1.1±0.9
Shots On Target	0.5±0.6	0.2±0.4	0.9±0.7 <sup>^</sup>
Goals	0.2±0.4	0.1±0.3	0.0±0.0
<b>Related to Offense</b>			
Short Passes	19.4±8.2	25.7±17.0	19.3±13.1
Successful Short Passes	17.8±8.3	23.8±16.4	17.4±13.0
Long Passes	8.8±3.9	12.6±6.4	6.6±4.7 <sup>^</sup>
Successful Long Passes	2.1±1.4 <sup>^</sup>	4.1±3.2	2.6±3.5
Crosses	0.3±0.5	0.9±1.6	0.6±1.0
Successful Crosses	0.1±0.3	0.1±0.4	0.4±0.8
Dribbles	3.2±2.9	5.7±5.2	4.4±6.6
Successful Dribbles	3.0±2.7	5.3±4.8	4.3±6.7
<b>Related to Defense</b>			
Tackles	4.8±2.7	6.2±3.2	6.9±2.2
Successful Tackles	3.3±2.5	4.4±2.2	4.4±1.7
Headers	34.4±5.9 <sup>^</sup>	25.3±12.4	31.9±12.4
Successful Headers	29.2±5.1 <sup>^</sup>	21.6±10.8	25.4±9.6
Clearances	15.7±4.8 <sup>*</sup>	14.6±4.9	21.9±7.2 <sup>^</sup>
Successful Clearances	13.6±4.5	12.6±4.7	17.6±6.7
<b>Other</b>			
Fouls Gained	1.2±1.3	1.8±1.6	0.6±0.8
Fouls Committed	1.6±1.1	1.4±1.0	1.7±1.0
Losses of Possession	2.1±1.8 <sup>^</sup>	3.8±2.5	2.7±1.1
Yellow Cards	0.2±0.5	0.3±0.5	0.0±0.0
Red Cards	0.0±0.0	0.0±0.0	0.0±0.0

\* Equals Significantly Different from any other group p<0.05

# Equals Significantly Different from Losers p<0.01

<sup>^</sup> Equals Significantly Different from Losers p<0.05

Table 6. Differences between winning, losing and drawing games in performance indicators for external midfielders

Variables	Winner	Loser	Drawer
<b>Related to Goals Scored</b>			
Total Shots	4.2±2.3	2.9±2.3	3.7±2.1
Shots On Target	1.8±1.8	1.0±1.0	1.1±0.9
Goals	0.4±0.5	0.3±0.5	0.1±0.4
<b>Related to Offense</b>			
Short Passes	43.8±14.2	40.1±20.6	38.6±8.1
Successful Short Passes	37.8±12.7	33.9±18.8	32.1±5.7
Long Passes	6.7±3.7#	3.3±2.8	4.7±2.8
Successful Long Passes	1.8±1.4	1.3±1.6	2.3±2.1
Crosses	6.4±2.8	7.2±4.6	9.9±6.9
Successful Crosses	1.7±1.0	1.6±1.4	2.3±2.7
Dribbles	21.4±5.6^	15.1±8.5	14.9±5.9*
Successful Dribbles	16.1±5.3#	10.1±6.2	11.4±3.7*
<b>Related to Defense</b>			
Tackles	6.2±3.7	5.5±4.3	9.6±4.7
Successful Tackles	3.9±2.9	2.9±2.4	5.7±3.3^
Headers	9.3±5.8	7.8±5.1	11.9±4.1
Successful Headers	7.4±4.5	5.6±3.9	8.6±4.4
Clearances	2.5±2.1	1.6±2.1	2.4±1.5
Successful Clearances	2.1±2.0	1.4±2.2	2.3±1.5
<b>Other</b>			
Fouls Gained	2.8±1.7	2.0±1.4	3.3±2.2
Fouls Committed	2.3±1.6	1.8±1.4	1.9±0.9
Losses of Possession	6.1±3.4	8.3±4.4	6.3±3.3
Yellow Cards	0.6±0.6	0.4±0.6	0.3±0.5
Red Cards	0.0±0.0	0.1±0.3	0.0±0.0

\* Equals Significantly Different from any other group p<0.05

# Equals Significantly Different from Losers p<0.01

^ Equals Significantly Different from Losers p<0.05

Table 7. Differences between winning, losing and drawing games in performance indicators for central midfielders

Variables	Winner	Loser	Drawer
<b>Related to Goals Scored</b>			
Total Shots	2.8±1.6	2.5±1.8	3.3±2.9
Shots On Target	1.4±1.5	0.5±0.7	0.6±1.1
Goals	0.5±0.7 <sup>^</sup>	0.0±0.0	0.1±0.4
<b>Related to Offense</b>			
Short Passes	47.2±14.5	53.1±21.6	49.6±14.9
Successful Short Passes	41.6±13.3	47.7±21.1	44.3±12.9
Long Passes	10.8±3.3 <sup>^</sup>	15.3±7.3	9.0±5.8
Successful Long Passes	3.6±1.7 <sup>#</sup>	7.4±5.1	3.0±1.8 <sup>^</sup>
Crosses	3.9±3.0	5.4±5.1	6.3±2.4
Successful Crosses	1.2±1.2	1.7±2.5	1.6±1.0
Dribbles	7.1±5.6	7.0±6.0	7.9±4.3
Successful Dribbles	6.4±5.1	5.6±4.8	6.9±4.0
<b>Related to Defense</b>			
Tackles	11.8±3.9	11.3±5.1	14.1±4.1
Successful Tackles	7.6±3.0	6.0±4.4	8.6±3.1
Headers	21.2±5.2 <sup>#</sup>	14.9±7.2	15.9±2.5 <sup>*</sup>
Successful Headers	19.5±5.1 <sup>#</sup>	13.4±6.1	14.6±2.4 <sup>*</sup>
Clearances	4.2±1.6	4.3±2.4	4.7±2.2
Successful Clearances	3.4±1.8	3.4±1.8	4.3±2.2
<b>Other</b>			
Fouls Gained	2.8±1.8	2.7±1.5	2.4±0.8
Fouls Committed	2.8±1.8	3.1±1.3	3.0±1.8
Losses of Possession	4.4±1.7 <sup>^</sup>	6.7±3.2	4.6±2.4
Yellow Cards	0.4±0.5 <sup>#</sup>	1.0±0.7	0.6±0.5
Red Cards	0.0±0.0	0.0±0.0	0.0±0.0

\* Equals Significantly Different from any other group p<0.05

# Equals Significantly Different from Losers p<0.01

<sup>^</sup> Equals Significantly Different from Losers p<0.05

Table 8. Differences between winning, losing and drawing games in performance indicators for forwards

Variables	Winner	Loser	Drawer
<b>Related to Goals Scored</b>			
Total Shots	5.4±2.3#	2.6±1.6	4.7±1.6^
Shots On Target	2.2±1.4^	1.1±0.9	2.3±1.0^
Goals	0.7±0.7	0.4±0.5	0.6±0.8
<b>Related to Offense</b>			
Short Passes	45.0±10.8	35.4±15.7	43.7±9.9
Successful Short Passes	38.0±9.5^	29.0±13.2	37.3±8.0
Long Passes	2.2±1.8	2.6±1.5	3.1±1.8
Successful Long Passes	1.2±1.4	1.9±1.6	1.9±1.2
Crosses	3.4±2.3	2.2±2.2	4.4±2.4^
Successful Crosses	0.7±0.8	0.4±0.8	1.4±1.5
Dribbles	10.4±5.3#	5.6±3.8	10.4±3.6^
Successful Dribbles	8.1±4.1#	4.4±2.7	7.3±2.6^
<b>Related to Defense</b>			
Tackles	3.0±2.6	2.4±1.8	4.4±1.8^
Successful Tackles	1.4±1.4	1.1±1.2	1.7±1.3
Headers	18.2±6.0	15.2±7.7	18.6±6.4
Successful Headers	13.4±4.7	10.9±5.9	13.1±4.3
Clearances	1.7±1.1*	1.4±1.2	0.7±0.8
Successful Clearances	1.5±1.1*	1.1±0.9	0.6±0.5
<b>Other</b>			
Fouls Gained	4.6±2.5	3.9±2.2	4.1±1.9
Fouls Committed	3.1±2.0	2.8±1.8	4.4±1.4^
Losses of Possession	4.6±2.9	5.5±3.0	6.1±1.8
Yellow Cards	0.4±0.6	0.4±0.5	0.6±0.8
Red Cards	0.0±0.0	0.0±0.0	0.0±0.0

\* Equals Significantly Different from any other group p<0.05

# Equals Significantly Different from Losers p<0.01

^ Equals Significantly Different from Losers p<0.05

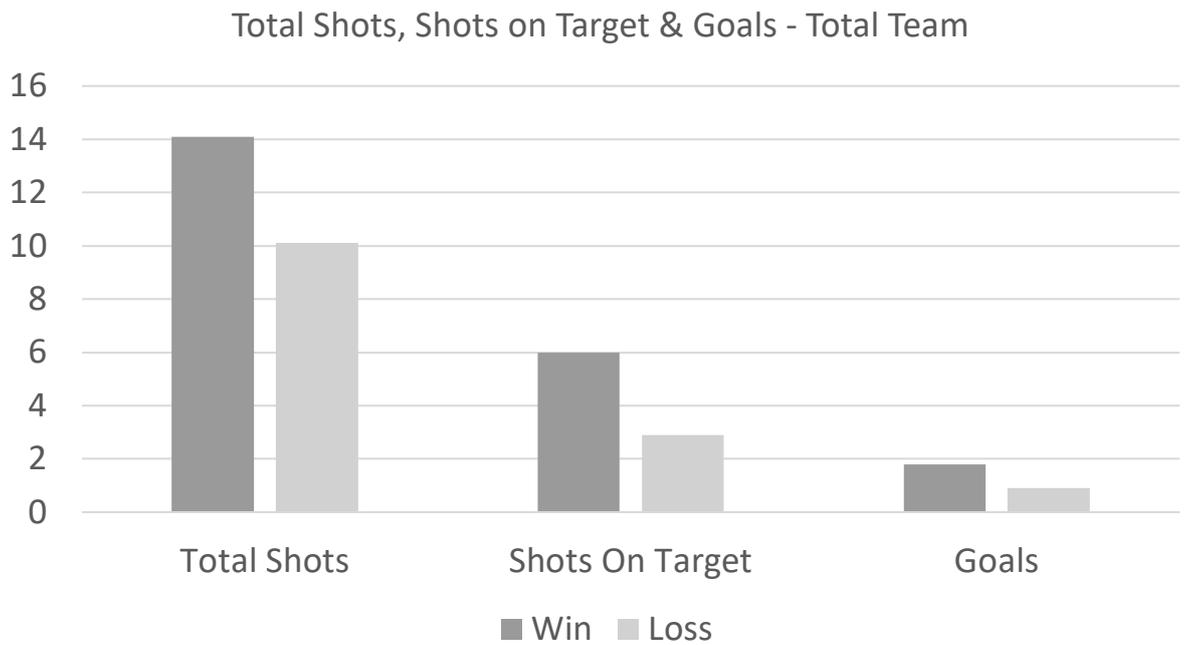


Figure 3. Statistical Differences in Total Shots ( $p < 0.05$ ), Shots on Target & Goals ( $p < 0.01$ ) for the Total Team

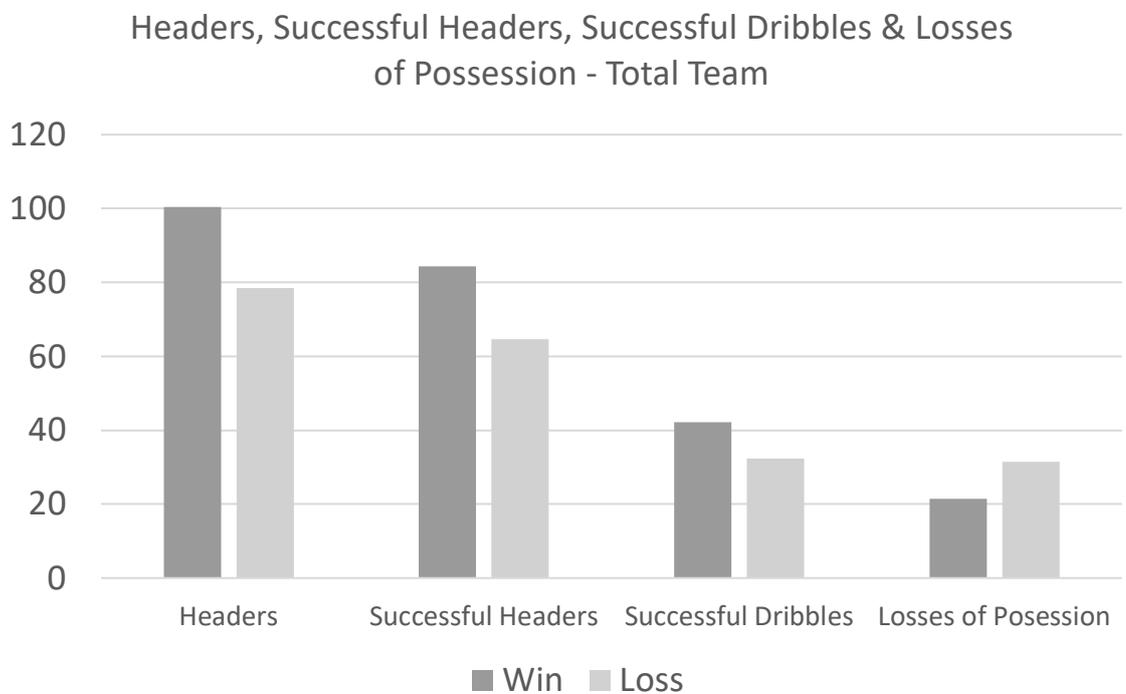


Figure 4. Statistical Differences in Headers, Successful Headers, Losses of Possession ( $p < 0.01$ ) & Successful Dribbles ( $p < 0.05$ ) for the Total Team

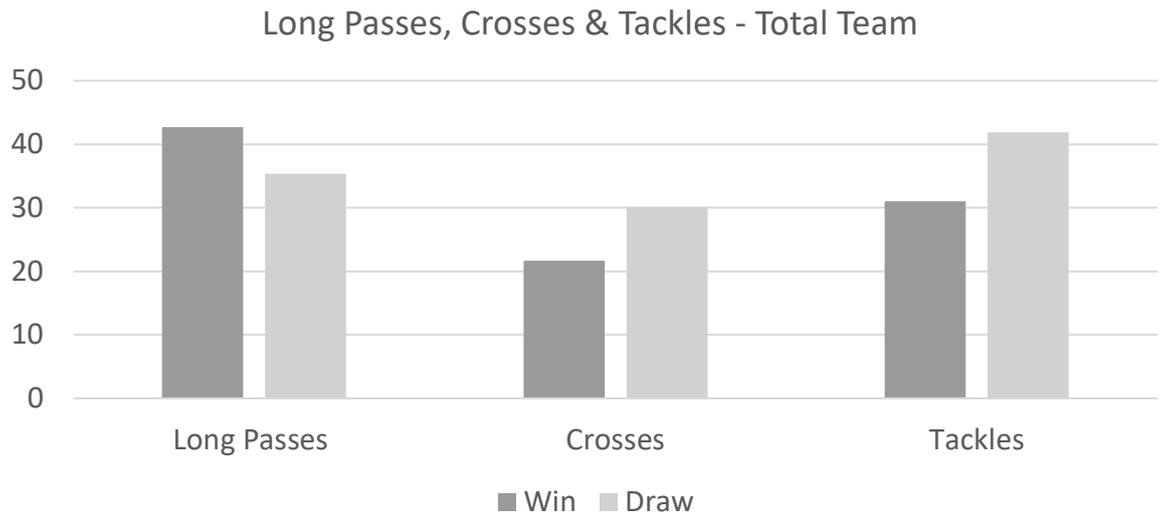


Figure 5. Statistical Differences for Long Passes, Crosses & Tackles ( $p < 0.05$ ) for the Total Team



Figure 6. Statistical Differences in Goals ( $p < 0.05$ ) for the Total Team

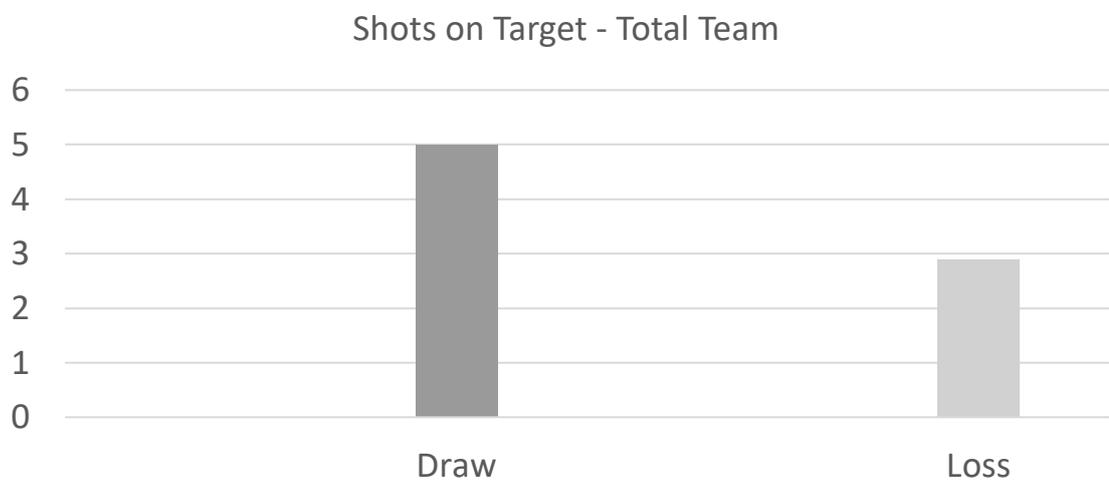


Figure 7. Statistical Differences in Shots on Target ( $p < 0.05$ ) for the Total Team

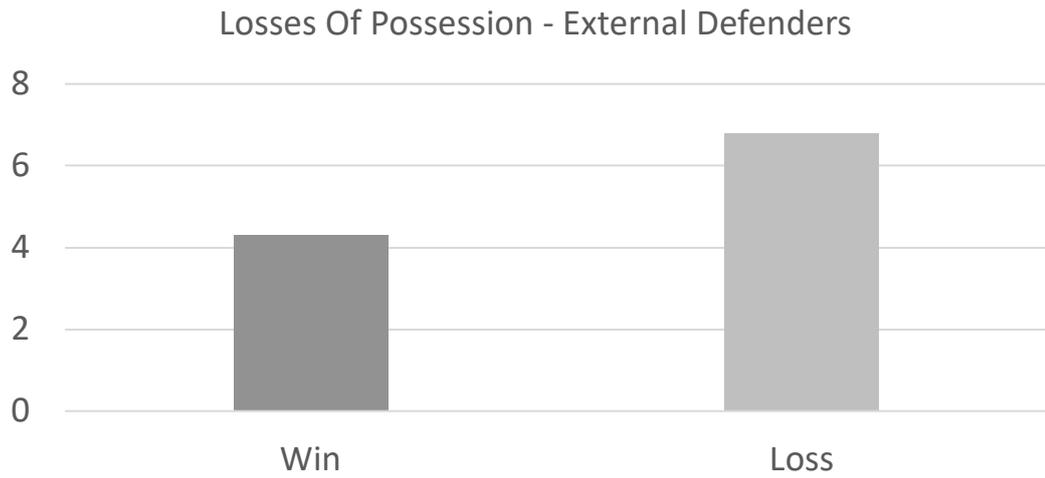


Figure 8. Statistical Differences in Losses of Possession ( $p < 0.05$ ) for External Defenders

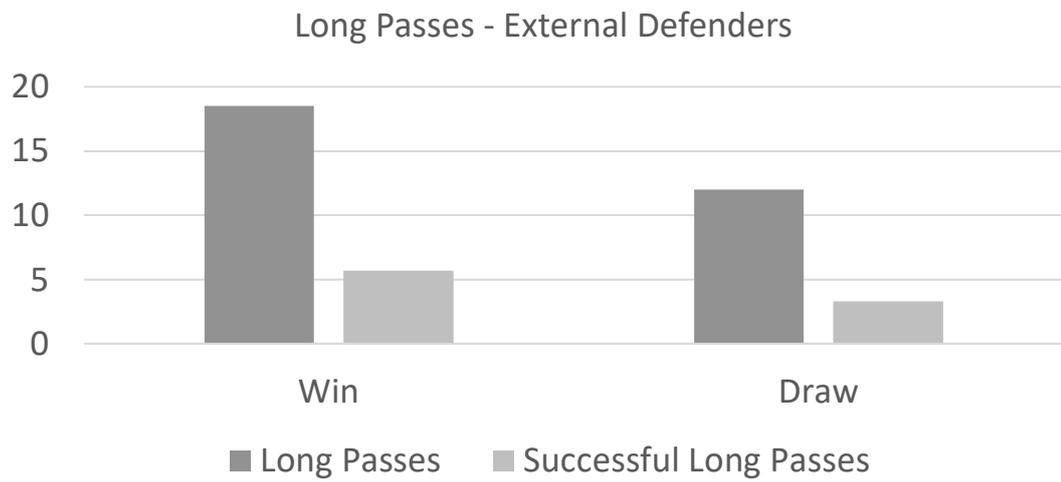


Figure 9. Statistical Differences in Long Passes & Successful Long Passes ( $p < 0.05$ ) for External Defenders

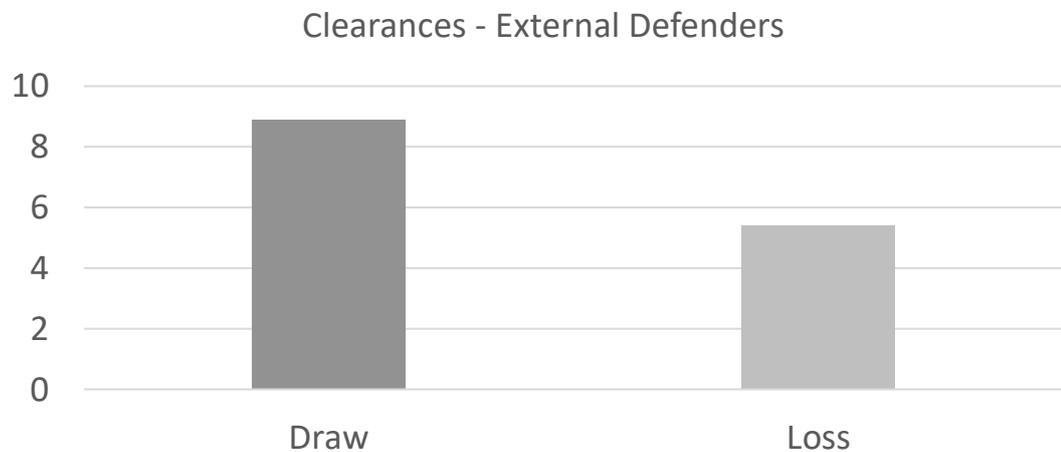


Figure 10. Statistical Differences in Long Clearances ( $p < 0.05$ ) for External Defenders

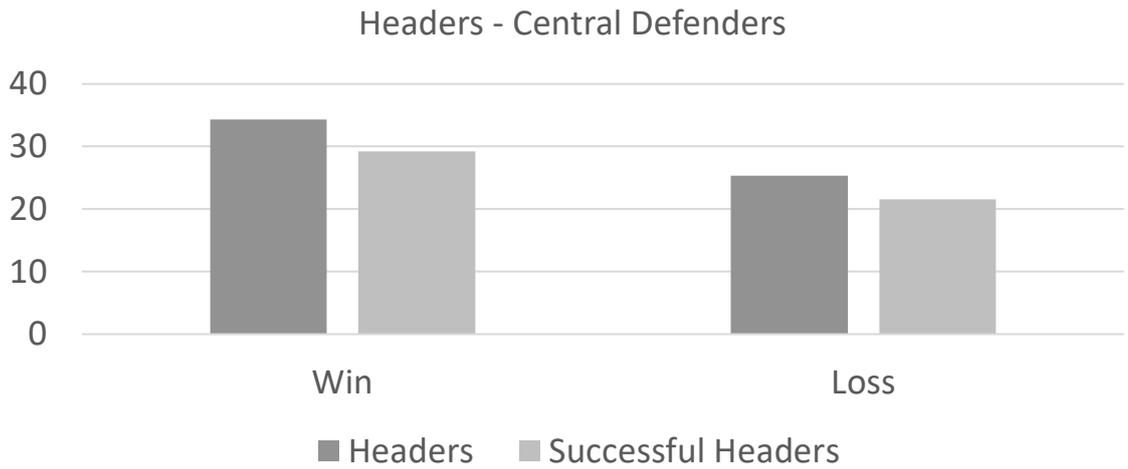


Figure 11. Statistical Differences in Headers & Successful Headers ( $p < 0.05$ ) for Central Defenders

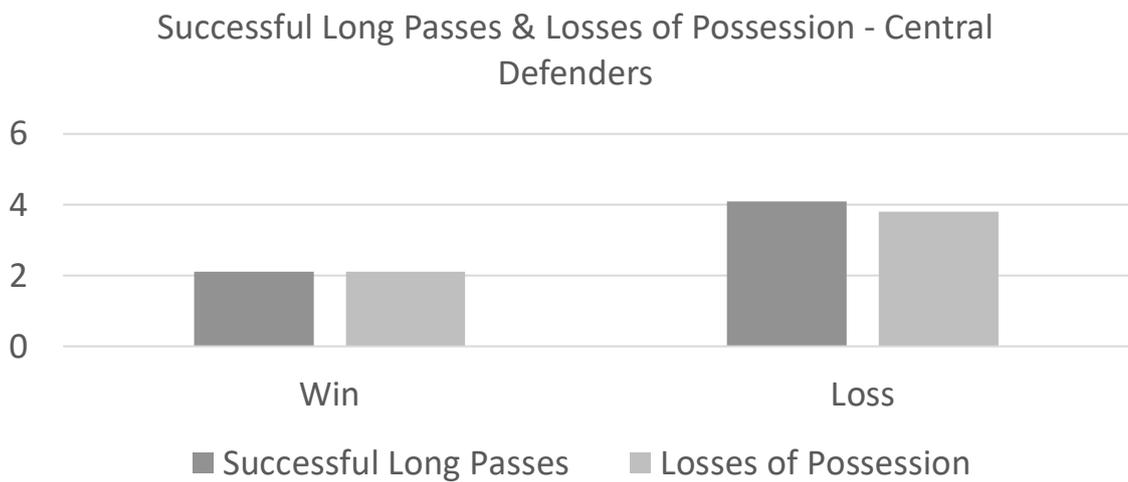


Figure 12. Statistical Differences in Successful Long Passes & Losses of Possession ( $p < 0.05$ ) for Central Defenders

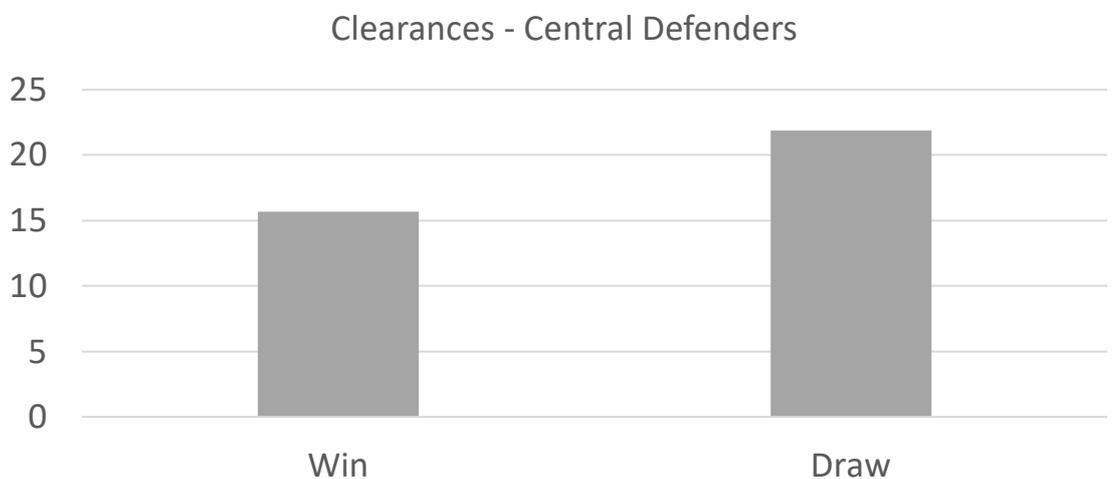


Figure 13. Statistical Differences in Clearances ( $p < 0.05$ ) for Central Defenders

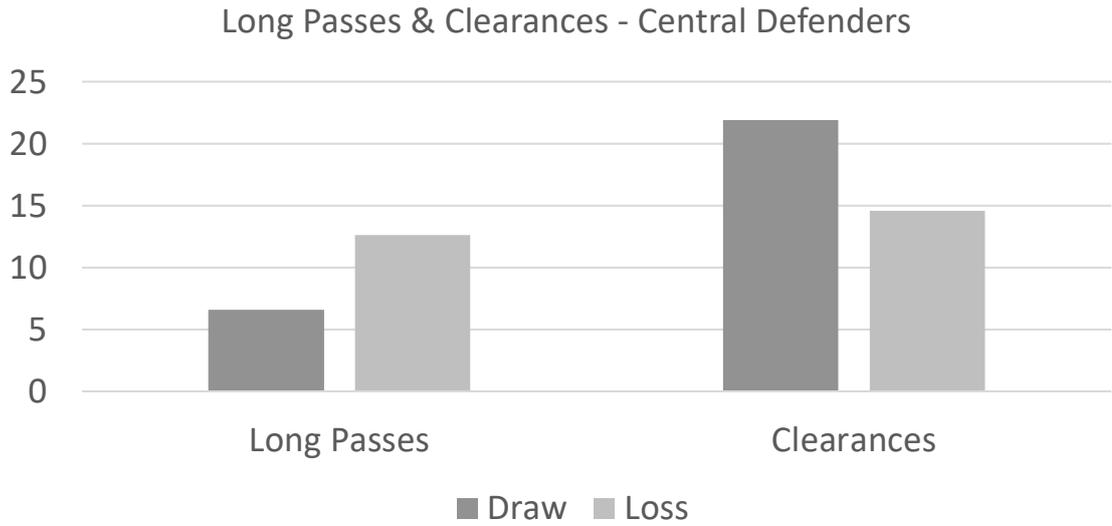


Figure 14. Statistical Differences in Long Passes & Clearances ( $p < 0.05$ ) for Central Defenders

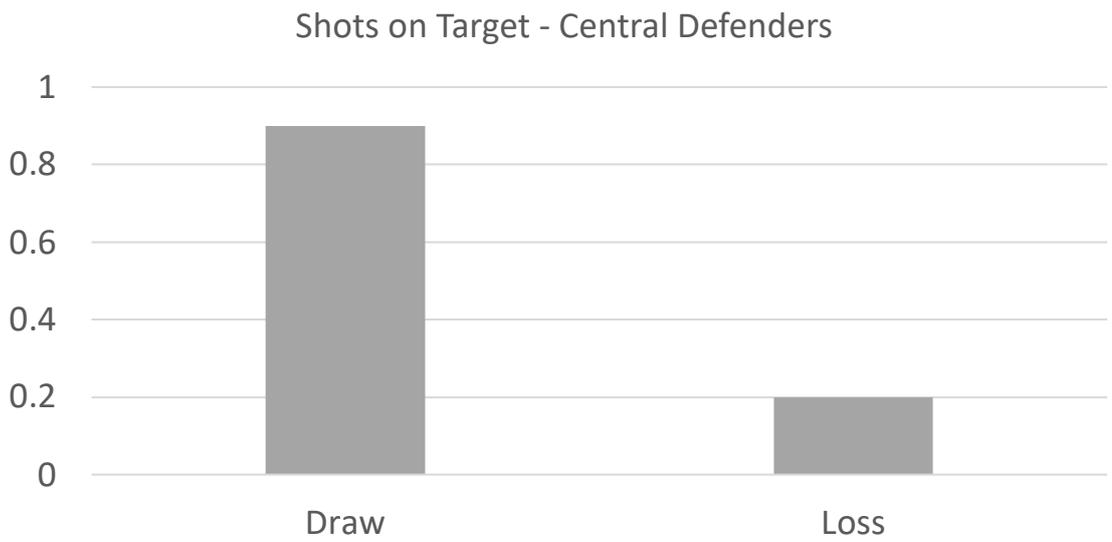


Figure 15. Statistical Differences in Shots on Target ( $p < 0.05$ ) for Central Defenders

### Long Passes, Dribbles & Successful Dribbles - External Midfielders

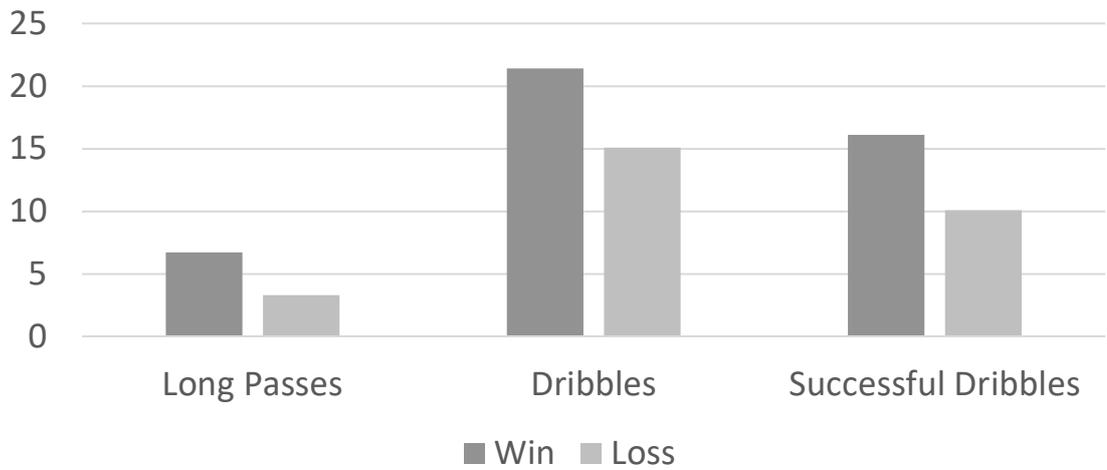


Figure 16. Statistical Differences in Long Passes, Successful Dribbles ( $p < 0.01$ ) & Dribbles ( $p < 0.05$ ) for External Midfielders

### Dribbles - External Midfielders

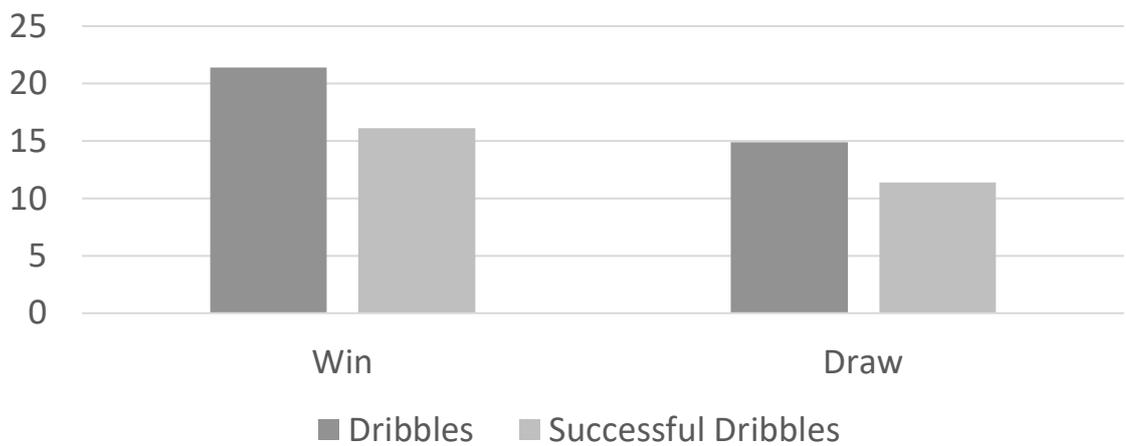


Figure 17. Statistical Differences in Dribbles ( $p < 0.05$ ) for External Midfielders

### Successful Tackles - External Midfielders



Figure 18. Statistical Differences in Successful Tackles ( $p < 0.05$ ) for External Midfielders

### Long Passes, Successful Long Passes, Headers & Successful Headers - Central Midfielders

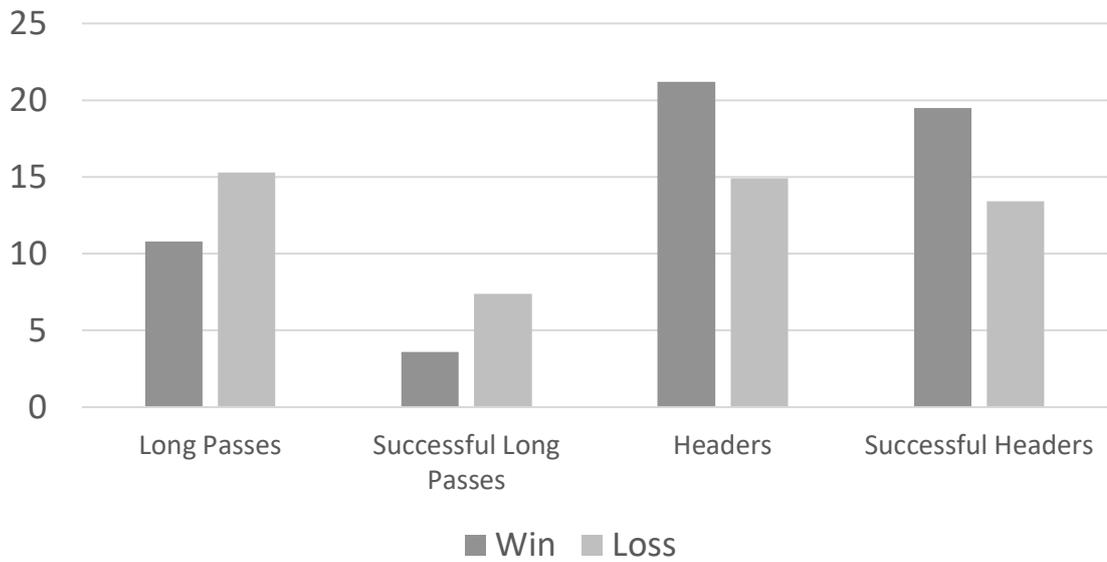


Figure 19. Statistical Differences in Successful Long Passes, Headers, Successful Headers ( $p < 0.01$ ) & Long Passes ( $p < 0.05$ ) for Central Midfielders

### Goals, Losses of Possession & Yellow Cards - Central Midfielders

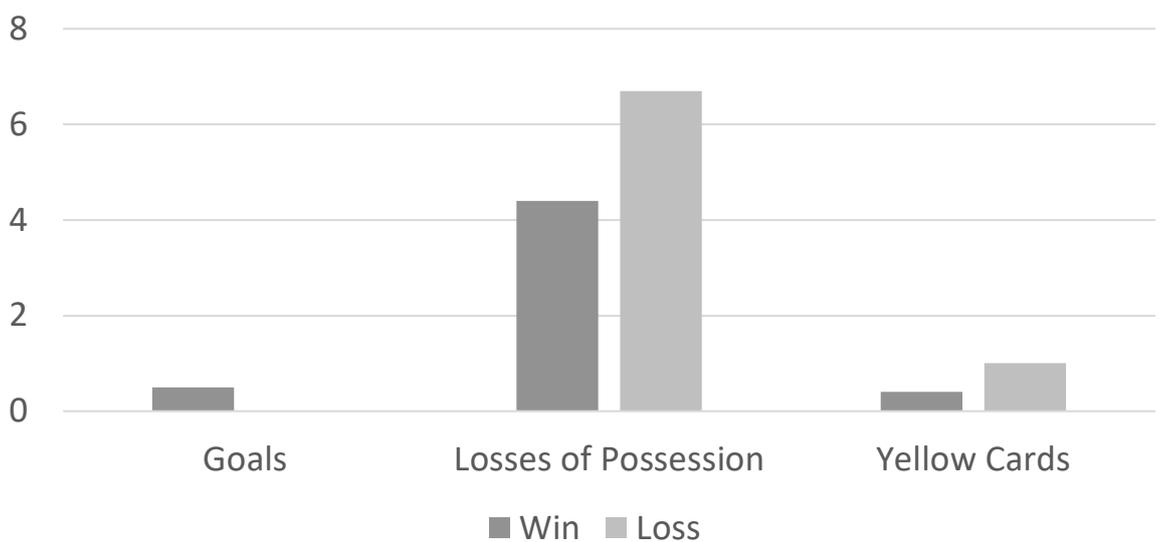


Figure 20. Statistical Differences in Goals, Losses of Possession ( $p < 0.05$ ) & Yellow Cards ( $p < 0.01$ ) for Central Midfielders

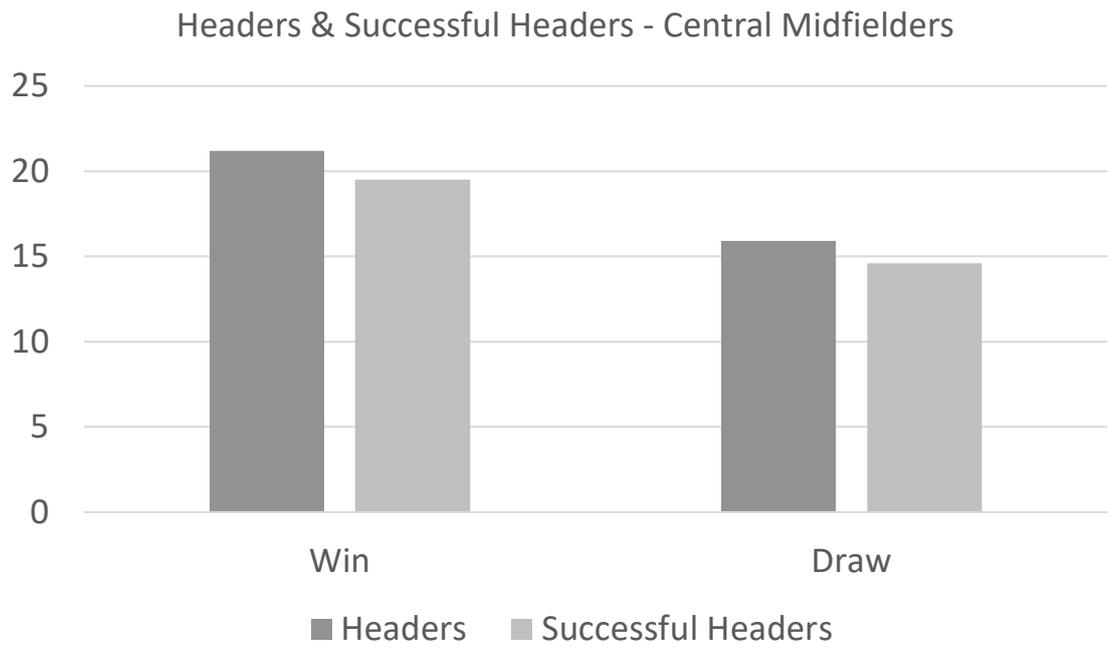


Figure 21. Statistical Differences in Headers & Successful Headers ( $p < 0.05$ ) for Central Midfielders

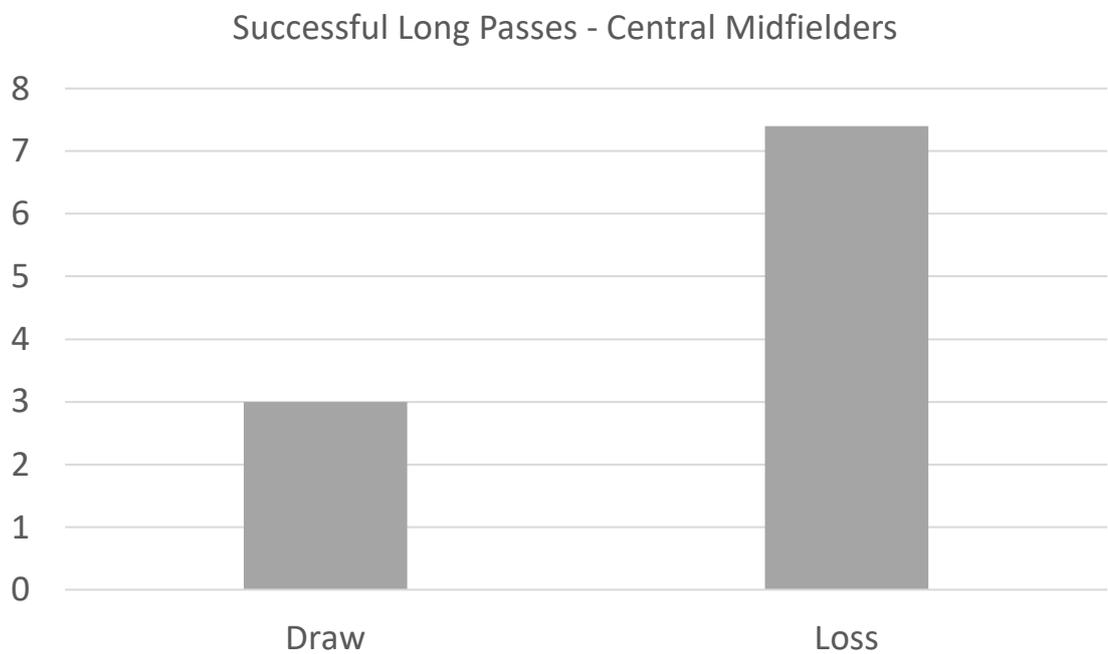


Figure 22. Statistical Differences in Successful Long Passes ( $p < 0.05$ ) for Central Midfielders

### Total Shots, Shots on Target, Dribbles & Successful Dribbles - Forwards

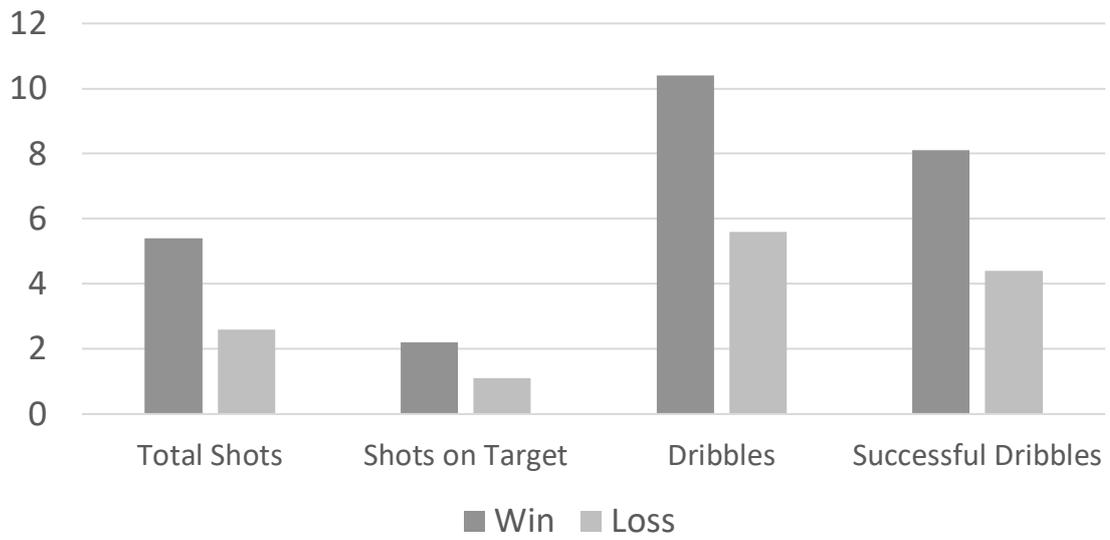


Figure 23. Statistical Differences in Total Shots, Dribbles, Successful Dribbles ( $p < 0.01$ ) & Shots on Target ( $p < 0.05$ ) for Forwards

### Successful Short Passes - Forwards

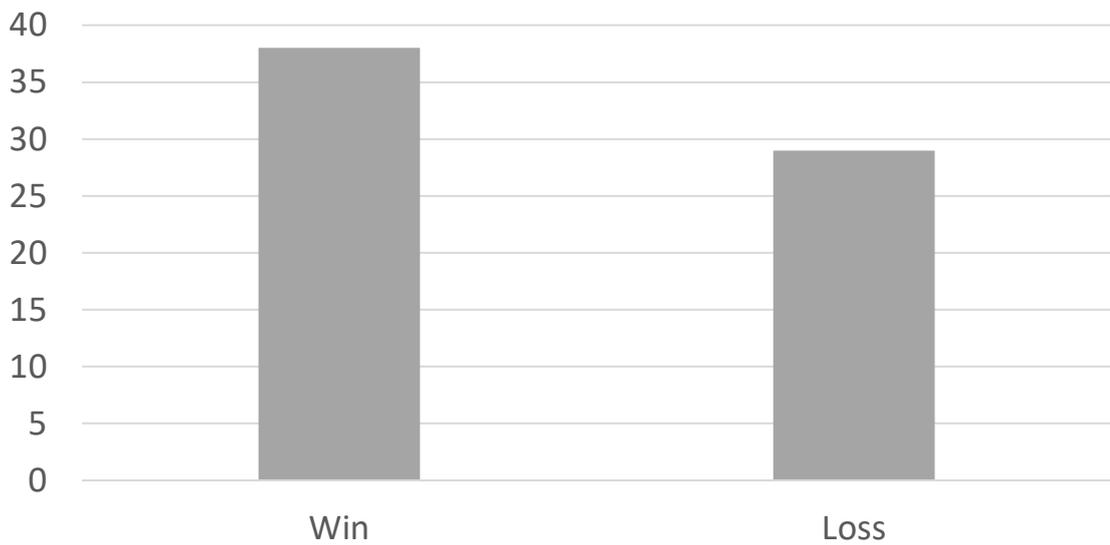


Figure 24. Statistical Differences in Successful Short Passes ( $p < 0.05$ ) for Forwards

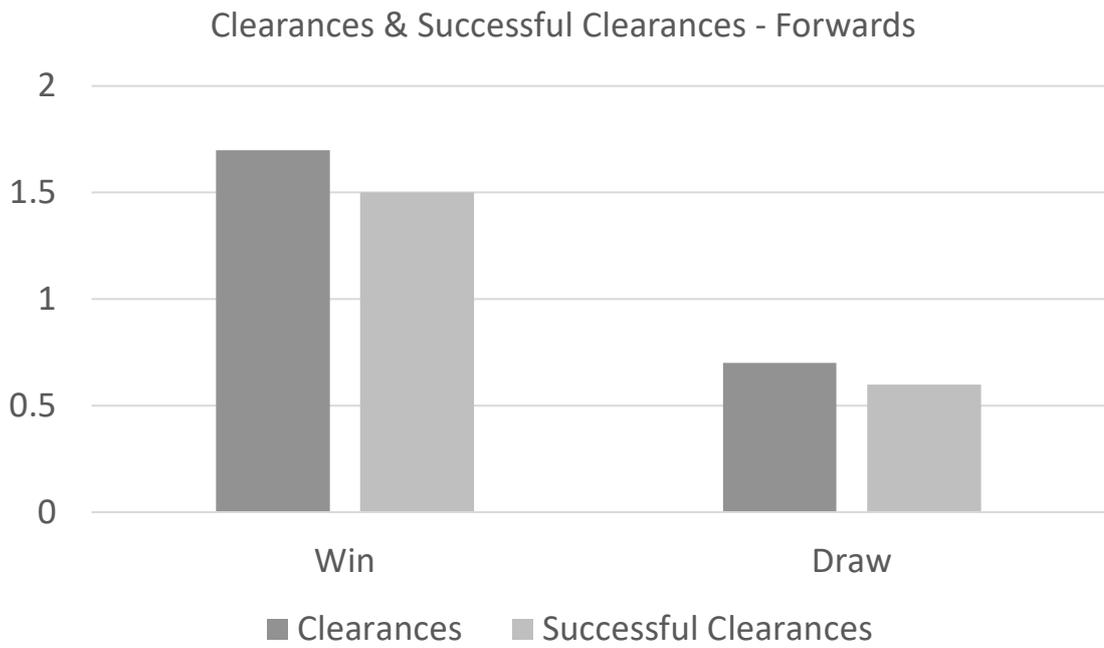


Figure 25. Statistical Differences in Clearances & Successful Clearances ( $p < 0.05$ ) for Forwards

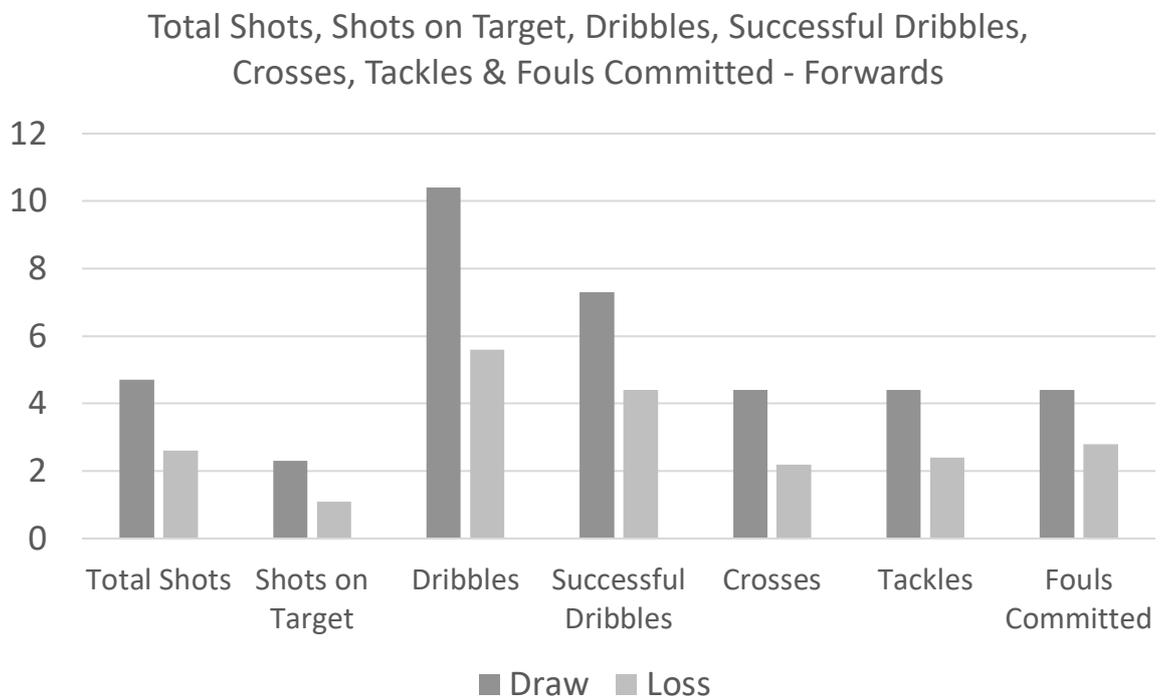


Figure 26. Statistical Differences in Total Shots, Shots on Target, Dribbles, Successful Dribbles, Crosses, Tackles & Fouls Committed ( $p < 0.05$ ) for Forwards

## Discussion

The aim of the present study was to identify statistically different performance indicators between winning, losing and drawing performances in a professional football team in the Scottish premier division.

### Winning & Losing Performances

Null hypothesis - There would be no significant differences between performance indicators when the team win and when the team lose.

In relation to winning and losing performances, significant differences ( $p < 0.05$ ) were found in 12 of the 22 performance indicators. There were significantly higher values for the following eight performance indicators during a win: total shots and shots on target (total team & forwards), goals (total team & central midfielders), successful short passes (forwards), dribbles (external midfielders & forwards), successful dribbles (external midfielders, forwards & total team), headers and successful headers (central defenders, central midfielders & total team). Lago-Peñas et al. (2011;2010) found similar results in terms of winning and losing performances with winning performances showing greater numbers in terms of shots and shots on target which is expected during winning performances and was expected in this study. Armatas et al. (2009) also found higher values in goals and shots when comparing winning with losing as did Araya & Larkin (2013) who moreover concluded that there were no significant differences in variables like crosses and tackles which showed no significant differences similar to this research. The reasoning behind the increased values for goal related indicators (goals, shots, shots on target) were expected as during a winning performance a team is expected to have more of the ball and in turn produce more chances at goal. A surprising finding was the increased values for headers and successful headers during a win which may be caused by opposition teams using a long ball/route one style of play which will cause central defenders and central midfielders (who were found to have significantly more headers/successful headers) have to head the ball more.

There were significantly lower values for the following four performance indicators during a win: long passes, successful long passes and yellow cards (central midfielders), losses of possession (central defenders, external defenders, central midfielders, total team). Araya & Larkin (2013) & Lago-Peñas et al. (2011) found significantly more short passes in winners over losers and although this wasn't

the case in this research it was noted that there were significantly lower values for long passes and successful long passes in winner which may suggest that the team being analysed utilised a short passing game even though short passes were not significantly different. The null hypothesis that no differences would be found can therefore be rejected as differences were found in 12 of the 22 performance indicators analysed.

### Winning & Drawing Performances

Null hypothesis - There would be no significant differences between performance indicators when the team win and when the team draw.

In relation to winning and drawing performances, significant differences ( $p < 0.05$ ) were found in ten of the 22 performance indicators. There were significantly higher values for the following nine performance indicators during a win: goals (total team), long passes (external defenders & total team), successful long passes (external defenders), dribbles and successful dribbles (external midfielders), clearances and successful clearances (forwards), headers and successful headers (central midfielders). Lago-Peñas et al. (2011:2010) and Castellano et al. (2012) concluded that winners made more shots and shots on goal than drawing teams which was a finding that wasn't found in this study. Both Lago-Peñas et al. (2011:2010) & Araya & Larkin (2013) found that winners had significantly more possession than drawing teams. Even though possession wasn't calculated in this study it could be said that significantly more short passes may attribute to more possession. Short passes were not significantly different between winning and drawing performances which may suggest that possession could have been the same between the two which goes against the findings of both studies above.

There were significantly lower values for the following two performance indicators during a win: crosses (total team) and clearances (total team). These findings of lower values in crosses may be down to the fact that during a winning performance the team may not have to attack as much so crosses would be less. For clearances during a draw the team being analysed may have been attacking to try and score a winning goal which would have meant less of the ball in a defensive area which could attribute to less clearances. Again, the null hypothesis that no differences would be found between winning and drawing can

be rejected as differences were found in ten of the 22 performance indicators analysed.

#### Drawing & Losing Performances

Null hypothesis - There would be no significant differences between performance indicators when the team draw and when the team lose.

In relation to drawing and losing performances, significant differences ( $p < 0.05$ ) were found in 13 of the 22 performance indicators. There were significantly higher values for the following ten performance indicators during a draw: total shots, shots on target, crosses, dribbles, successful dribbles, tackles, fouls committed (forwards), clearances (central defenders & total team), successful clearances (external defenders & total team) and successful tackles (external midfielders). Castellano et al. (2012) concluded that drawing performances had significantly higher numbers of goals when compared to losing performances which was not found in this study. Lago-Peñas et al. (2011) found that drawing performances had higher values for total shots with Lago-Peñas et al. (2010) finding that drawing performance had more total shots and shots on target when compared to drawing performances which were both findings found in this study also. All three studies from Castellano et al. (2012) and Lago-Peñas et al. (2011;2010) found no significant differences in indicators such as crosses, tackles and fouls committed which were found to be significantly different in this study. This could be due to the fact that these studies focused on total team performance rather than breaking up the team into positional areas which is where most of the significant differences were found in this research.

There were significantly lower values for the following three performance indicators during a draw: long passes (central defenders), successful long passes (central midfielders) and losses of possession (total team). This could be down to when the team being analysed were behind long passes came into effect more as the team tried to get forward quickly when losing. Once more, the null hypothesis that no differences would be found between drawing and losing performances can be rejected as differences were found in 13 of the 22 performance indicators analysed.

## Conclusion

In conclusion, it was found that there were significant differences ( $p < 0.05$ ) in performance indicators when the team won, lost and drew. Significant differences were found either for the team as a total or for one of the five positional areas in performance indicators relating to goals scored (shots, shots on target and goals), offensive indicators (successful short passes, long passes, successful long passes, dribbles and successful dribbles), defensive indicators (headers and successful headers) and other indicators (losses of possession and yellow cards). Losses of possession was the indicator that was found to be the most common across the five positional areas and the total team with losing performances showing significantly higher values when compared to winning performances. This may suggest that losing the football cheaply in matches may result in opportunities for the opposition which in turn may lead to goals being conceded which ultimately is the winning and losing of football matches. In relation to positions, forwards and external midfielders showed significantly more dribbles and successful dribbles during a win. This may imply that when these players get the ball they should look to take on opposition players as it may lead to an increase in chances for forwards who also had significantly more shots and shots on target during a win. This finding could be down to the fact that more chances were created by either themselves (forwards) dribbling and creating an opportunity or their teammates (external midfielders) creating the chances for them.

## Limitations & Future Research

Some limitation of this study may be in the sample size used. Using a season's worth of games ( $n=38$ ) may be considered a low amount when perhaps a second season worth of games added to this would add to the research. Previous studies by Lago-Peñas et al. (2011;2010) used 288 and 380 games respectively with Armatas et al. (2009) using ten years' worth of games from the Greek premier division although these studies did not use analysis software to tag variables themselves.

Another limitation may include the fact that this study didn't incorporate the quality of opposition faced by the team analysed. This can have a big impact on the style

of play utilised by the team in question and could alter performance indicators depending on how the team set up and played. A final limitation may be the advantage of playing at home. Players may be more inclined to perform at a higher level and intensity when playing at home due to the crowd and familiarity with the stadium and pitch which could also alter the numbers of certain performance indicators.

In terms of future research, the idea of comparing the performance indicators associated with a title winning team with a team who were relegated from the same league would be of interest to try to identify what indicators may be accounting for the success of one team and the failure of another.

Secondly, replicating this research in different leagues around the world with different teams. The styles of play in football varies hugely from country to country and results of significant performance indicators from a team in one country may be completely different from a team in another country.

# Reference List

- Acar, M.F., Yapicioglu, B., Arikan, N., Yalcin, N., Ates, N., Ergun, M. (2009) Analysis of goals scored in the 2006 World Cup. In: Reilly T, Korkusuz AF, editors. Science and Football VI. London: Routledge; pp. 235–242.
- Altman, D. G. (1995). Practical Statistics for Medical Research. London: Chapman and Hall.
- Araya, J. & Larkin, P. (2013). Key performance variables between the top 10 and bottom 10 teams in the English Premier League 2012/13 season. University of Sydney Papers in Human Movement, Health and Coach Education (HMHCE), 2, 17-29.
- Armatas V., Yiannakos A. (2010) Analysis and evaluation of goals scored in 2006 World Cup. Journal of Sport and Health Research, 2, 119–128.
- Armatas, V., Yannakos, A., Zaggelidis, G., Skoufas, D., Papadopoulou, S., Fragkos, N. (2009) Differences in offensive actions between top and last teams in Greek first soccer division. Journal of Physical Education and Sport, 23(2): 1-5.
- Carling, C. & Court, M., (2013). Match and Motion analysis. In M.A. Williams, (Ed.). Science and soccer: Developing elite performers (pp: 173-198). 3<sup>rd</sup> Ed. Oxon: Routledge.
- Carling C., Reilly T., Williams A. (2009). Performance assessment for field sports, London: Routledge.
- Carling C., Williams A., Reilly T. (2005). The handbook of soccer match analysis, London: Routledge.
- Castellano, J., Casamichana, D., & Lago, C. (2012). The Use of Match Statistics that Discriminate Between Successful and Unsuccessful Soccer Teams. Journal of Human Kinetics, 31(-1).
- Cintia, P., Giannotti, F., Pappalardo, L., Pedreschi, D., & Malvaldi, M. (2015). The harsh rule of the goals: Data-driven performance indicators for football teams. 2015 IEEE International Conference on Data Science and Advanced Analytics (DSAA).
- Conroy, D.E., Kay, M.P. and Schantz, L.H. (2008). Quantitative research methodology. In: Horn, T.S., ed. Advances in sport psychology. 3<sup>rd</sup> Ed. Leeds: Human Kinetics, 15-30.

- Csataljay, G., O'Donoghue, P., Hughes, M., & Dancs, H. (2009). Performance indicators that distinguish winning and losing teams in basketball. *International Journal of Performance Analysis in Sport*, 9(1), 60-66.
- Di Salvo, V., Baron, R., Tschan, H., Calderon Montero, F., Bachl, N., & Pigozzi, F. (2007). Performance Characteristics According to Playing Position in Elite Soccer. *International Journal of Sports Medicine*, 28(3), 222-227.
- Ensum, J., Taylor, S., Williams, M. (2002). A quantitative analysis of attacking set plays. *Insight*, 4(5): 68-72.
- Grant, A.G., Williams, A.M. & Reilly, T. (1999). Analysis of the goals scored in the 1998 World Cup. *Journal of Sport Science*, 17:826–827.
- Gratton, C. and Jones, I. (2010). *Research methods for sports studies*. 2<sup>nd</sup> ed. Oxon: Routledge.
- Groom, R. & Cushion, C.J., (2004). Coaches perceptions of the use of video analysis: a case study. *Insight*, 7, 56-58.
- Hughes, A., Barnes, A., Churchill, S., & Stone, J. (2017). Performance indicators that discriminate winning and losing in elite men's and women's Rugby Union. *International Journal of Performance Analysis in Sport*, 17(4), 534-544.
- Hughes, M., Caudrelier, T., James, N., Donnelly, I., Kirkbride, A., & Duschesne, C. (2012). Moneyball and Soccer - An Analysis of the Key Performance Indicators of Elite Male Soccer Players by Position. *Journal of Human Sport and Exercise*, 7(2), 402-412.
- Hughes, M. & Bartlett, R., (2008). What is performance analysis. In M. Hughes, & I.M. Franks, (Eds), *The essentials of performance analysis: an introduction*. (pp: 8-20). Oxon: Routledge.
- Hughes, M.D., Franks, I. (2005). Analysis of passing sequences, shots and goals in soccer. *Journal of Sport Sciences*. 23(5): 509-514.
- Hughes, M. and Bartlett, R. (2002). 'The use of performance indicators in performance analysis', *Journal of Sports Sciences*, 20: 739–54.
- Hughes, M., Cooper, S.M. & Nevill, A., (2002). Analysis procedures for non-parametric data from performance analysis. *International Journal of Performance Analysis in Sport*, 2(1), 6-20.
- Johnson, K., & Murphy, A. (2010). Passing and goal scoring

characteristics in the Australian A-League. *Journal of Science and Medicine in Sport*, 12, e118.

- Jones, N., Mellalieu, S., & James, N. (2004). Team performance indicators as a function of winning and losing in rugby union. *International Journal of Performance Analysis in Sport*, 4(1), 61-71.
- Jones P., James N., Mellalieu SD. (2004). Possession as a Performance Indicator in Soccer. *International Journal of Performance Analysis in Sport*. 4(1): 98-102.
- Lago-Peñas, C., Lago-Ballesteros, J., & Rey, E. (2011). Differences in Performance Indicators Between Winning and Losing Teams in the UEFA Champions League. *Journal of Human Kinetics*, 27(-1).
- Lago-Peñas, C., Lago J., Dellal A., Gomez M. (2010) Game-related statistics that discriminated winning, drawing and losing teams from the Spanish soccer league, *Journal of Sport Sciences*. 9(2): 288-293.
- Laird, P. & Waters, L., (2008). Eyewitness recollection of sports coaches. *International Journal of Performance Analysis in Sport*, 8, 76-84.
- MacKenzie, R. & Cushion, C., (2013). Performance analysis in football: a critical review and implications for future research. *Journal of Sports Sciences*, 31(6), 639-676.
- O'Donoghue, P. (2015). *An Introduction to Performance Analysis of Sport*. Abingdon, Oxon: Routledge.
- O'Donoghue, P. (2012). *Statistics for sport and exercise studies: An Introduction*. Oxon: Routledge.
- O'Donoghue, P. (2010). *Research Methods for Sports Performance Analysis*. London: Routledge.
- O'Donoghue, P. (2008). Time motion analysis. In: Hughes, M. and Franks, I.M., eds. *The essentials of performance analysis: an introduction*. Oxon: Routledge, 180-205.
- O'Donoghue, P. (2005). Normative profiles of sports performance. *International Journal of Performance Analysis in Sport*. 5(1): 104-119.
- Ortega, E., Villarejo, D. & Palao, J.M. (2009). Differences in game statistics between winning and losing rugby teams in the Six Nations Tournament. *Journal of Sports Science and Medicine*. 8: 523-527.
- Robins, M. & Hughes, M., (2015). Dynamic systems and perturbations. In M. Hughes, & I.M. Franks, (eds.), *Essentials of Performance Analysis: An*

Introduction. 2<sup>nd</sup> Ed. London: Routledge.

- Sajadi, N., Rahnama, N. (2007). Analysis of goals in 2006 FIFA World Cup. *Journal of Sports Science and Medicine*. (suppl. 10):3.
- Szwarc, A. (2004). Effectiveness of Brazilian and German teams and the teams defeated by them during the 17<sup>th</sup> Fifa World Cup. *Kinesiology*. 36(1): 83-89.
- Vinson, D., & Peters, D. (2015). Position-specific performance indicators that discriminate between successful and unsuccessful teams in elite women's indoor field hockey: implications for coaching. *Journal of Sports Sciences*, 34(4), 311-320.
- Williams, J.J., (2015). Rule changes in sport and the role of notation. In M. Hughes, & I.M. Franks, (Eds), *Essentials of performance analysis in sport*. 2<sup>nd</sup> Ed. (pp: 334-349). Oxon: Routledge.
- Yamanaka K, Hughes M, Lott M. An analysis of playing patterns in the 1990 World Cup for association football. (1993). In Reilly T., Clarys J., Stibbe, A. (eds): *Science and Football II*. London: E. & F.N. Spon, pp 206-214.