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Original Article

Comparative analysis of winning and losing teams in rugby union

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Abstract:
Analyzing performance indicators in rugby is essential for improving training programs and team dynamics. A key direction is to compare these indicators between winning and losing teams in prestigious rugby tournaments to identify patterns and strategic insights that can enhance team performance. However, current research frequently examines isolated competitions and lacks thorough comparative analysis across different tournaments. This study aims to analyze and identify the differences between winning and losing men's rugby union teams across various competitions in 2023. This study analysed performance data from men's rugby competitions in 2023, encompassing matches from The Six Nations Championship, The Rugby Championship, and the Rugby World Cup. A total of 68 matches were examined, categorizing 47 matches from the Rugby World Cup and 21 from international competitions for comparative analysis. Data collection included 32 performance indicators for both winning and losing teams, analysed using statistical methods to identify significant differences. Comparative analysis of team performance indicators between the Rugby World Cup and international competitions, including The Six Nations Championship and The Rugby Championship, reveals significant differences. Winning teams in the Rugby World Cup scored significantly higher points on average (41.5 ± 13.2) compared to international competitions (32.8 ± 7.7), reflecting greater variability in performance at the World Cup. Conversely, losing teams in the Rugby World Cup averaged fewer points (13.2 ± 8.0) compared to international competitions (16.3 ± 6.9). These findings underscore distinct competitive levels across different rugby tournaments. The analysis revealed that in the World Cup, 18 indicators (56.3%) exhibit statistically significant differences between losing and winning teams, whereas the analysis of performances in international competitions identified only 4 (12.5%) statistically significant differences between losing and winning teams.
Key Words: **rugby, performance indicators, team, analytics, competitions**

Introduction

The analysis of player and team performance is foundational in optimizing training process and enhancing competitive success in sports. Over the past few decades, the advent of advanced technologies and analytical methods has revolutionized performance analysis, particularly in team sports. Studying sports through the observation of player and team behavior is essential for the organization, planning, and structuring of the training process (Hughes & Bartlett, 2002; Korobeynikov et al., 2022). This approach remains relevant throughout the development of sports. A thorough analysis of the most significant performance indicators of athletes and teams enables coaches and managers to optimize and more precisely plan the training process (van Rooyen, 2012; Bompa & Buzzichelli, 2015; Latyshev et al., 2020).

In rugby, this shift has led to a more detailed understanding of game dynamics and performance indicators that differentiate winning teams from losing ones. Performance analysis in rugby has a long history, primarily focusing on describing the patterns of the game (McKenzie et al., 1989; Eaves & Hughes, 2003; Rodrigues & Passos, 2013) and performance indicators (Jones et al., 2004; James et al., 2005). Subsequent research has also developed a focus on identifying differences between winning and losing teams, as well as determining key indicators that influence game results. Despite significant progress, research in rugby often remains limited to specific competitions or focuses on narrow aspects of performance without broader contextual analysis.

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Most studies focus on a single type of competition, with the objective of analyzing the statistical differences in rugby games between winning and losing teams. For instance, analyses have been conducted solely on the Six Nations Championship, without examining the impact on match outcomes, only comparing winners and losers (Ortega et al., 2009). In their articles, Jones et al. (2004) and James et al. (2005) also described differences between winning and losing teams. However, unlike the aforementioned studies, they assessed the performance of only one team and its performance in a single confrontation between two teams. The results from these studies demonstrate that teams secure more balls in the line-out within the opponent's territory when they win compared to when they lose.

While numerous studies have identified key performance indicators, the diversity in methodologies and the focus on single events or leagues pose challenges for coaches and analysts in generalizing findings. In the past two to three decades, there has been a remarkable growth in performance analysis research across various sports, particularly in team sports (Latyshev et al., 2017; Doroshenko et al., 2019, Korobeynikov et al., 2020; Ranaweera et al. 2022; Tropin et al., 2022; Curby et al., 2023). This has been largely facilitated by the advancement and accessibility of computer and video technologies, as well as the development of machine learning (Bunker & Susnjak, 2022; Latyshev et al., 2022). It should be noted that today, modeling and prediction methods are used ubiquitously and at all stages of athlete and team preparation (Fontana, 2017; Rovniy et al., 2018; Brodani et al., 2023).

In the study conducted by Parmar et al. (2017), extensive research was carried out to determine the significance of performance indicators that predict match outcomes and points difference in professional rugby league. This study assessed 24 relative performance indicators (home value minus away) from all rounds of the 2012, 2013, and 2014 European Super League seasons. Various methods were used to identify performance indicators and key performance indicators. Similar studies were conducted on a total of 396 matches played during the 2017 to 2019 Super Rugby seasons, which demonstrate more contemporary aspects of competitive activity (Nicholls et al., 2024). Research has also been carried out comparing indicators depending on the different stages of the World Cup (Vaz et al., 2019): for winning and losing teams across the group stage matches and the play-off matches (Bunker & Spencer, 2020).

Additionally, an analysis was conducted on twenty-seven performance indicators selected from 96 matches during the 2020–21 United Rugby Championship (Scott et al., 2023a). Similar research has been carried out for university-level competitions. This study aimed to determine performance indicators that discriminate between winning and losing male university-level rugby sevens teams (Moolman et al., 2021). It is also worth noting that such competitions are held for women's rugby, aiming to identify performance indicators that maximize prediction accuracy of match outcomes (Hughes et al., 2017; Scott et al., 2023b).

The identification and analysis of the most significant team performance indicators are closely related to modeling and forecasting. Several studies have been conducted in this direction in recent years (Colomer et al., 2020; Kvasnytsya et al., 2024). However, as demonstrated in the research, most specialists use different indicators for specific purposes, which complicates comparisons between results but necessitates the search for the optimal quantity and combination of indicators to assess teams (Scott et al., 2023). In conclusion, it is noteworthy that we identified studies comparing team indicators across different leagues (Schoeman et al., 2017; Schoeman & Schall, 2019). However, these studies did not distinguish between winners and losers, which defined the aim of our research.

The aim of this study is to analyze and identify the differences between winning and losing men's rugby union teams across various competitions in 2023.

Material & methods

Participants

Data were collected from the performances of teams in three rugby competitions in 2023 among men: The Six Nations Championship (www.sixnationsrugby.com) – all 15 matches among 6 teams, The Rugby Championship (www.super.rugby) – all 6 matches among 4 teams, and the Rugby World Cup (www.rugbyworldcup.com) – 47 out of 48 matches among 20 teams (McGarry, 2009). One group stage match in the Rugby World Cup ended in a draw, which is a rare occurrence in rugby union and was excluded from the analysis because team performance indicators cannot be categorized into winners and losers. In total, data from 68 matches were analyzed. All matches were categorized into two groups for comparative analysis: 47 matches from the Rugby World Cup and 21 matches from international competitions (The Six Nations Championship and The Rugby Championship). It is important to note that all countries participating in the international competitions also competed in the Rugby World Cup.

Data collection

For each match, data were collected separately for 32 indicators for both the winning and losing teams. These indicators include: Tries, Conversion Goals, Penalty Goals, Kick Success Rate, Meters Run, Kicks from Hand, Passes, Runs, Total Scrums, Won Scrums, Total Lineouts, Won Lineouts, Total Tackles, Successful Tackles, Possession 1H, Possession 2H, Territory 1H, Territory 2H, Clean Breaks, Defenders Beaten, Offloads, Won Rucks, Total Rucks, Won Mauls, Total Mauls, Turnovers Conceded, Possession, Territory, Red Cards,

Yellow Cards, Total Free Kicks Conceded, Penalties Conceded. The match outcomes were also separately analyzed. All data (match statistics) were sourced from the official competition websites and the International Rugby Federation (www.world.rugby).

Statistical analysis

The mean values and standard deviations (SD) of performance indicators for winning and losing teams were calculated. The analysis revealed that the distributions of some indicators did not follow a normal distribution. Therefore, the Mann-Whitney U test was used to determine statistically significant differences between the indicators at the significance levels of 0.05 and 0.01 (Hopkins et al.,1999). Python programming language was employed for data preparation, processing, and statistical calculations.

Results

An analysis of the Rugby World Cup and international competitions, including the Six Nations Championship and Rugby Championship, revealed differences in team performance indicators between winners and losers. In Rugby World Cup matches, winning teams (41.5 ± 13.2) scored more points compared to international competitions (32.8 ± 7.7). It is worth noting the higher standard deviation, indicating significant variability in results at the Rugby World Cup. Teams that lost in the Rugby World Cup had an average score of 13.2 ± 8.0 points, which is lower than the average score of losing teams in international competitions (16.3 ± 6.9 points). These results underscore differences in the level of competition between teams in the Rugby World Cup and international competitions. A more detailed analysis of match outcomes is presented in the tables. Table One presents indicators related to points scored and offensive actions by teams.

Table 1. Team Performance Indicators in Rugby Union across Competitions: Scoring (scores) and Offensive Performance

Indicators	Rugby World Cup				International competitions			
	Winning teams		Dif., %	p	Losing teams		Dif., %	p
	Mean ± SD	Mean ± SD			Mean ± SD	Mean ± SD		
Tries	5.4 ± 3.8	1.5 ± 1.1	265.2	<0.01	4.5 ± 1.2	1.9 ± 1.0	137.5	<0.01
Conversion Goals	4.4 ± 3.4	1.0 ± 1.0	329.2	<0.01	3.1 ± 1.1	1.4 ± 1.1	113.3	<0.01
Penalty Goals	1.9 ± 1.8	1.2 ± 1.2	55.4	0.13	1.2 ± 0.8	1.2 ± 1.3	0.0	0.66
Kick Percent Success	81.4 ± 15.6	64.3 ± 35.1	26.6	<0.05	72.5 ± 17.3	78.5 ± 25.0	-7.6	0.29
Meters Run	540.7 ± 210.6	400.8 ± 139.1	34.9	<0.01	470.3 ± 119.2	414.8 ± 94.4	13.4	0.17
Kicks from Hand	27.3 ± 8.2	22.6 ± 8.2	20.7	<0.01	29.0 ± 7.3	24.4 ± 7.3	18.5	0.06
Passes	149.8 ± 48.2	131.9 ± 47.6	13.6	<0.05	155.8 ± 41.0	171.0 ± 31.3	-8.9	0.21
Runs	118.4 ± 28.6	109.6 ± 30.0	8.0	0.17	124.1 ± 30.3	124.0 ± 24.5	0.1	0.63

A comparative analysis of performance indicators between winning and losing teams revealed more statistically significant differences among World Cup teams (6 indicators) than in international competitions (2 indicators). Two indicators, Tries and Conversion Goals, show the greatest difference between winning and losing teams (over 100%). It is noteworthy that indicators such as Kick Percent Success and Passes are more prevalent among World Cup winners, whereas in international competitions, losing teams tend to have higher average scores in these indicators. Table 2 presents the indicators related to territory possession and attacking actions in set-piece situations.

Table 2. Team Performance Indicators in Rugby Union across Competitions: Territory Possession and Set Piece Offense

Indicators								
	Winning teams		Dif., %	p	Losing teams		Dif., %	p
	Mean ± SD	Mean ± SD			Mean ± SD	Mean ± SD		
Possession 1H	53.5 ± 8.5	46.5 ± 8.5	15.2	<0.01	53.3 ± 8.5	46.7 ± 8.5	14.07	<0.05
Possession 2H	52.4 ± 9.9	47.6 ± 9.9	10.2	<0.05	48.1 ± 8.0	52.0 ± 8.0	-7.52	0.17
Territory 1H	52.6 ± 10.5	47.4 ± 10.5	10.9	<0.05	50.3 ± 12.0	49.7 ± 12.0	1.34	0.68
Territory 2H	51.0 ± 12.1	49.0 ± 12.1	4.3	0.48	51.1 ± 12.2	49.0 ± 12.2	4.28	0.29
Clean Breaks	8.6 ± 5.8	4.6 ± 2.6	87.9	<0.01	7.4 ± 2.3	4.1 ± 2.5	80.23	<0.01
Defenders Beaten	26.6 ± 13.0	21.2 ± 8.6	25.8	<0.05	25.1 ± 8.4	22.3 ± 8.2	12.39	0.28
Offload	8.2 ± 5.6	5.7 ± 3.4	44.2	<0.05	6.7 ± 3.2	8.0 ± 3.4	-16.17	0.21
Won Rucks	74.9 ± 20.1	75.7 ± 23.0	-1.1	0.86	88.1 ± 25.4	90.0 ± 20.0	-2.01	0.49
Total Rucks	77.8 ± 20.1	79.8 ± 23.3	-2.5	0.67	91.5 ± 26.1	94.1 ± 20.5	-2.73	0.41
Won Mauls	5.3 ± 2.5	2.8 ± 1.7	89.4	<0.01	5.4 ± 3.2	4.2 ± 2.3	28.09	0.24
Total Mauls	5.9 ± 2.6	3.4 ± 1.8	75.3	<0.01	5.9 ± 3.3	5.1 ± 2.2	16.98	0.44
Turnovers Conceded	13.2 ± 4.1	14.5 ± 3.3	-8.9	0.18	12.7 ± 4.3	13.5 ± 2.8	-5.65	0.21
Possession	52.9 ± 6.9	47.1 ± 6.9	12.3	<0.01	50.5 ± 5.8	49.5 ± 5.8	2.12	0.82
Territory	51.7 ± 7.8	48.3 ± 7.8	7.2	0.06	50.7 ± 9.7	49.3 ± 9.7	2.70	0.55

Only one indicator showed statistically significant differences ($p < 0.01$) between winners and losers across all analyzed competitions – Clean Breaks. It is noteworthy that this is the sole indicator for international competitions. However, in the analysis of World Cup results, nine indicators were identified with statistically significant differences between losing and winning teams. The greatest percentage differences between losing and winning teams were found in the following indicators: Clean Breaks, Possession 1H, Won Mauls, Total Mauls, and Defenders Beaten. There are also indicators that show contradictory results across different championships (differences in advantage between winning and losing teams): Offload and Possession 2H.

Table 3. Team Performance Indicators in Rugby Union across Competitions: Set Piece Defense and Discipline

Indicators								
	Winning teams		Dif., %	p	Losing teams		Dif., %	p
	Mean ± SD	Mean ± SD			Mean ± SD	Mean ± SD		
Total Scrums	7.8 ± 3.0	6.7 ± 2.6	17.2	0.07	6.5 ± 2.1	6.3 ± 2.9	3.8	0.75
Win Scrums	6.3 ± 2.5	5.1 ± 2.3	24.8	<0.05	5.0 ± 1.9	4.8 ± 2.0	4.9	0.70
Total Lineouts	14.2 ± 4.5	12.6 ± 3.5	12.8	0.06	13.5 ± 4.3	13.7 ± 2.9	-1.1	0.74
Win Lineouts	12.5 ± 4.1	10.0 ± 3.5	25.0	<0.01	12.1 ± 4.2	12.0 ± 3.0	1.2	0.92
Total Tackles	150.7 ± 47.0	154.7 ± 41.7	-2.6	0.55	167.5 ± 35.2	175.0 ± 47.4	-4.3	0.92
Successful Tackles	129.6 ± 41.0	128.1 ± 34.6	1.1	0.94	145.2 ± 34.6	149.9 ± 43.9	-3.1	0.88
Red Cards	0.1 ± 0.2	0.1 ± 0.3	-66.7	0.14	0.1 ± 0.2	0.1 ± 0.3	-50.0	0.14
Yellow Cards	0.5 ± 0.7	0.6 ± 0.7	-20.0	0.28	0.1 ± 0.4	0.8 ± 0.8	-81.3	0.28
Total Free Kicks Conceded	0.7 ± 0.9	0.7 ± 0.8	12.9	0.71	1.0 ± 1.0	0.5 ± 0.5	90.9	0.71
Penalties Conceded	8.7 ± 2.6	11.3 ± 3.3	-23.3	<0.01	9.8 ± 3.5	11.1 ± 2.7	-12.0	<0.01

Performance indicators in set pieces are higher among winning teams in the World Cup compared to losing teams, although such significant percentage advantages were not identified among winning and losing teams in international competitions. The only indicator showing statistically significant differences ($p < 0.01$) between winners and losers across all competitions is Penalties Conceded. Discipline indicators are lower among losing teams compared to winning teams across all competitions.

Overall, the analysis revealed that in the World Cup, 18 indicators (56.3%) exhibit statistically significant differences between losing and winning teams, whereas the analysis of performances in international competitions identified only 4 (12.5%) statistically significant differences between losing and winning teams. Absolute values of indicators vary slightly across different competitions (but not significantly), indicating a consistent overall trend in rugby union. Among the differences noted, international competitions involve more Rucks and Tackles, whereas the World Cup slightly favors more Scrums and Meters Run.

Discussion

The analysis of performance indicators in rugby teams and players spans a significant historical period. Studies dating back more than two decades (McKenzie et al., 1989; Hughes & Bartlett, 2002) have already investigated to identify the most significant indicators distinguishing winning teams from losing ones. In recent years, this field has gained even more popularity, coinciding with the increasing use of machine learning methods for modeling and prediction (Watson et al., 2021; Kvasnytsya et al., 2024). However, the main question remains the practical application of these findings, providing information for coaches and managers that could optimize training processes.

Overall, our research complements previously established facts while presenting several distinct features. Indicators such as Tries and Conversion Goals remain paramount, determining match outcomes as affirmed by numerous prior studies (Jones et al., 2004; Ortega et al., 2009; Hughes et al., 2017; Watson et al., 2017). Our study identified statistically significant differences between Clean Breaks indicators of winning and losing teams across both levels of competition, as well as for Penalties Conceded, confirming findings from specific studies (Schoeman et al., 2017; Watson et al., 2017; Scott et al., 2023). Additionally, Lineout is highlighted as a significant indicator in many studies (Jones et al., 2004; Hughes et al., 2017), emphasizing its importance specifically in the World Cup in our research.

The significance of indicators shows varying trends depending on specific aspects: competition level, time period, research objectives, specific indicator values, and others (Colomer et al., 2020). Some researchers have highlighted the importance of indicators such as Offload and Mauls (Rodrigues & Passos, 2013), which is supported by our findings for the World Cup; however, the significance of the Mauls indicator was not confirmed in the study for Super Rugby Competitions (Nicholls et al., 2024).

The importance of indicators such as Possession and Territory is supported by certain studies, but their use and interpretation vary (Fontana et al., 2017; Colomer et al., 2020). Our research has established statistical significance for these indicators at both competition levels for only one indicator (Possession 1H). In terms of

match outcome prediction during the game, this indicator should be noted (differences between winning and losing teams exceed 10.0%). Meanwhile, the differences in Territory 1H indicators are not as significant.

While several studies (Ortega et al. 2009; Vaz et al., 2019) emphasize the importance of indicators such as Tackles, we did not find significant differences between winning and losing teams across all competitions. At this stage, the question remains about the diversity of performance indicators, noted by some authors (Colomer et al., 2020). Specialists apply different indicators depending on the research objectives, complicating comparisons and correlations. Many indicators can vary depending on their use: total count, number won or lost, percentage of total, etc. Sometimes, specific indicators are used for modeling or forecasting. All of these factors contribute to the diversity of indicators and the nuances of analysis. Some specialists have explored ways to optimize the number of indicators for analysis (Jones et al., 2004; Parmar et al., 2017; Watson et al., 2017; Scott et al., 2023), but the issue remains relevant today.

Conclusions

The conducted analysis overall confirms previous studies, with the most significant indicators remaining unchanged. Coaches and managers should continue to focus on these indicators. However, it has been shown that teams in The Six Nations Championship and The Rugby Championship are closer in level to each other compared to teams in the World Championship. It is worth noting that the advantages identified between losing and winning teams in specific competitions may not fully correspond to results obtained in other competitions, and sometimes contradictory data may even be obtained. Therefore, it is essential to align with the results of performance indicator analysis specific to each competition to optimize the training process.

Future research will focus on analyzing the dynamics of team performance indicators over a long period. This approach will enable us to observe general trends and develop models for training activities, which will be instrumental in preparing teams for future competitions.

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