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Home team advantage in international cricket: Impact of pitches, rank and toss on the match outcome

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Abstract This paper investigates whether match covariates, such as pitch, outfield and toss, contribute to a possible home advantage in men's international cricket for matches played between 2019 and 2024. Team rankings, referee-assigned pitch ratings and outfield ratings were regressed against match outcomes. Referee pitch ratings were found consistent, and pitches rated 'Good' and 'Very Good' provided competitive balance. The toss does not impact Test matches, weakly influences T20Is, but increases the likelihood of a home-team win in ODIs. Team ranking emerges as a strong predictor of match outcomes; higher-ranked teams are more likely to win, substantiating the long-term knowledge assimilation and sports entry barrier hypotheses.

Introduction

Home advantage is a well-established research area in sports (Dawson et al., 2009; Sarangi & Singh, 2023). Conceptualised as a multidimensional aspect, there remains debate about the sources of home advantage in sports (Bray, 1999; Carron et al., 2005; Clarke & Norman, 1995; Deval et al., 2021; Morley & Thomas, 2005; Puram et al., 2023; Srivastava et al., 2023). In the context of cricket, limited research has been conducted to understand the sources of home advantage (Connor et al., 2022). Anecdotally, it is often attributed to playing conditions, such as pitch and outfield conditions, and is frequently observed by players, experts, coaches and commentators. Cricket pitches have been the centre of curiosity from geophysical and engineering perspectives (Bhatnagar & Bhatnagar, 2025; James et al., 2005). However, limited academic investigation has been undertaken from a sports management perspective. Since 2006, the role of referees in assigning pitch and outfield ratings has been largely procedural, ensuring that future games are played under balanced conditions on the same ground. These ratings, however, have not been utilised by researchers (Massey & Hogan, 2025). Nevertheless, this process has done little to mitigate debates within media channels. For instance, the second Test match between India and South Africa in the

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Freedom Trophy (December 2023 – January 2024) concluded within two days, rather than the scheduled five days (ESPNCricinfo.com, 2024). Consequently, the pitch was rated unsatisfactory, followed by criticism of the South African team for doctoring the pitch in favour of their bowlers (Hindustan Times, 2024). The International Cricket Council (ICC) Men's ODI (One-Day International) World Cup 2023 final, between India and Australia, also drew controversy owing to the flat nature of the pitch, which made the toss particularly influential. The pitch was ultimately rated average, and the home side lost both the toss and the match (Hindustan Times, 2023).

Further, in the long term, countries have consciously chosen to invest in pitches that align with their teams' playing preferences. For instance, to facilitate England's "Bazball" approach, investment was directed towards making English pitches more batter-friendly, thereby reducing their seam bowling characteristics (Duncan & Heenan, 2025). However, academic research on referee-assigned ratings remains sparse (Kumar & Balasubramanian, 2023). At the same time, substantial debate persists in both the media and expert communities. This paper intends to fill this lacuna by initiating research at the intersection of pitch engineering and referee-based managerial assessments of pitches based on match outcomes.

The familiarity level of players with the ground, particularly the pitch and outfield conditions, plays a pivotal role in determining the possibility of home advantage for the team. Pitch curation is crucial to cricket, as it creates advantages or constraints for teams (Crowther et al., 2020; Premkumar et al., 2020). Cricket players are usually accustomed to pitches and outfield conditions within their country, region or geographical area (Asif & McHale, 2016). In a bilateral series, the players of the host country attempt to capitalise on their familiarity with the pitch, outfield and playing conditions to their advantage, thereby earning rating and ranking points.

Cricket pitches have been studied from multiple perspectives (Alway et al., 2025; Crowther et al., 2020; Lindsay et al., 2025). Players adopt different strategies to bat against bowling variations based on their skills and understanding of pitch characteristics (Crowther et al., 2020; James et al., 2004, 2005). In Test matches played over five days/four innings, the extent of deterioration the pitch undergoes after each inning can also impact team composition. Batting on a fresh pitch on the first day, as opposed to batting towards the end of the fourth innings, presents different complexities, making the toss a significant determinant of match outcome (Forrest & Dorsey, 2008). While the pitch plays a crucial role in the game, the importance of the outfield[1] also cannot be overlooked (Lopez & Chinnery, 2010). Fielders[2] are strategically positioned in the outfield to catch the ball and prevent bowlers from conceding runs. The nature of the outfield (surface type, moisture content, slope and size) often decides how many runs the batting team can score. A statistically weaker, yet significant impact of the toss or decision to bat or bowl was found in county matches played between 2000 and 2019 (Jewell et al., 2020). Thus, winning the toss and deciding whether to bat or bowl play a crucial role in the chances of winning the game (Jaipuria & Jha, 2022; Jewell et al., 2020). Previous studies have argued that the probability of winning depends on the team's current and historical form (Asif & McHale, 2016; International Cricket Council, 2024a). The study, therefore, also examines past team rankings, establishing the concept of historical sports domination through knowledge assimilation by teams (Jewell et al., 2020; Puram et al., 2023). Furthermore, while researchers have studied various factors, such as the venues of cricket matches, different types of toss mechanisms in county cricket aimed at reducing the home advantage, and the impact of past performance on the outcome of matches played in international and domestic leagues (Table 1), the results have been largely ambiguous.

These diverse outcomes regarding the toss, along with the limited research on pitch and outfield ratings by the match referees, establish the necessity for further systematic investigation. Additionally, home advantage, referee-provided pitch and outfield ratings, as well as toss and team performance, have not been comprehensively considered in prior studies. Further, there are limited cross-format studies based on game duration (Test/ODI/T20I), and our findings suggest varied results across formats. This research work, therefore, investigates three research questions:

Research Question 1: Do home conditions, including pitch and outfield, influence the outcome of an international cricket match?
Research Question 2: Does the toss influence the outcome of an international cricket match?
Research Question 3: Does past team performance become a source of home advantage and influence the outcome of an international cricket match?

These research questions aim to contribute to understanding home advantage through the lens of the Game Location Framework within the sports analytics domain. Our study analyses the pitch and outfield ratings that influence competitive balance and evaluates them in light of the ICC's regulatory measures and managerial (referee) decision-making. Additionally, it integrates previously studied variables, such as the toss, rank and the difference in ranks between teams, to provide a more nuanced understanding of their impact on match outcomes and subsequent referee decision-making regarding pitch/outfield ratings. We extend prior research on cricket by conducting a cross-format analysis across the three prominent and recognised formats of the game (T20I, ODI and Test matches). This multi-format approach provides a more nuanced and holistic understanding of home advantage and the influence of prior performance. This research, alongside similar studies, will provide sports bodies with a critical perspective on these ratings within the framework of existing regulations and assist in identifying areas where future changes are required. Thus, our research findings are likely to provide actionable inputs to sports managers and governance bodies. This study has utilised secondary data from 2019 to 2024 for T20Is, ODIs and Test matches, for which ratings were available on the ICC's official website. The dataset comprises pitch and outfield ratings, toss, home and away wins, and rankings for 273 ODIs, 179 Test matches and 209 T20Is.

The remainder of this paper is structured as follows: the second section provides the theoretical foundation of the

[1] The area around the pitch.
[2] The remaining ten players of the bowling team.

Table 1 Prior research work on toss, pitch and team performance.

Research work	Dataset	Toss	Advantage (Home/Away)			Findings
			Pitch	Outfield	Team rank	
Puram et al., 2023	T20I - IPL (2008-2016)	✓	✓ (Match location)			Momentum (past performance) affects future wins, toss (bat first) influences team win
Srivastava et al., 2023	Test, ODI, T20I (2016-2020)	✓	✓ (Match location)			Environmental factors are equally important as the team's internal qualitative factors.
Deval et al., 2021	Test match (2008-2017)	✓	✓			Innings declaration timings can predict the chances of win or loss.
Crowther et al., 2020	Self-generated through experiment		✓			Pitch soil type affects spin, and environmental constraints affect performance.
James et al., 2004, 2005	County Cricket England (1999-2002)		✓			Moisture and clay content inversely affect the pace.
Forrest and Dorsey, 2008	County Cricket England (1993-2006)	✓				Toss and weather have a significant impact on the outcome.
Jewell et al., 2020	County Cricket England (2000-2019)	✓	✓	✓	✓	Weak evidence of toss affecting the outcome.
Morley and Thomas, 2005	English one-day cricket league (1996-1997)	✓	✓	✓		Toss and venue do not significantly impact the outcome. Current team form (rank/performance) significantly impacts the outcome.
Lopez and Chinnery, 2010	ICC Men's World Cup 2007		✓	✓	✓	Grass-based or soil-based outfields have a significant impact on ball rolling distance.
Asif and McHale, 2016	606 ODIs (2004-2010)	✓	✓	✓	✓	Home advantage is not beyond the first inning.

study, followed by the literature review. The subsequent sections outline the methodology, data analysis and discussion of the findings. The final section concludes the paper with the limitations and future research directions.

Theoretical foundation of the study

This study is grounded in the Game Location Framework, also known as the Home Advantage Research Framework, which provides a structured approach for examining the factors that contribute to home advantage in sport. The framework (Carronet al., 2005; Connor et al., 2022) identifies five core dimensions contributing to home advantage in cricket: crowd and umpiring/refereeing; fatigue due to travel; specific rules/privileges; familiarity with and adaptability to playing conditions; and performance-related aspects.

Prior literature has extensively studied the influence of crowd and travel-related fatigue, establishing their importance in contributing to home advantage across sports (Courneya and Carron, 1991; Ponzo & Scopa, 2018; Smith et al., 2000). Coping with crowd pressure is predominantly psychological, while managing travel-related fatigue is primarily physiological and logistical. Given the significant body of work in these domains, the present study does not replicate those lines of inquiry. Instead, it focuses on the playing-conditions dimension (specifically pitch and ground characteristics) and the performance-related dimension, both of which remain underexplored in cricket.

Notably, within the ambit of cricket and home advantage research, prior studies provide ambiguous evidence on the home advantage associated with rules and privileges. In the context of cricket, the visiting captain's privilege to call the toss represents a distinctive feature, warranting investigation within the ambit of home advantage. The modified application of the Game Location Framework, along with its associated operationalisation in the context of cricket, is presented in Figure 1.

Literature review

Researchers have discussed the concepts of toss, home advantage, familiarity with the local environment, and the overall effect of teams' recent and past performance (Allsop & Clarke, 2004; Clarke & Norman, 1995; De Silva & Schwarz, 1998; Lopez & Chinnery, 2010). The following sub-sections provide a synthesis of the pre-match and post-match covariates examined in relation to match outcomes.

Home advantage

Home advantage in sports has been established by researchers across professional and amateur sports, as well as across team

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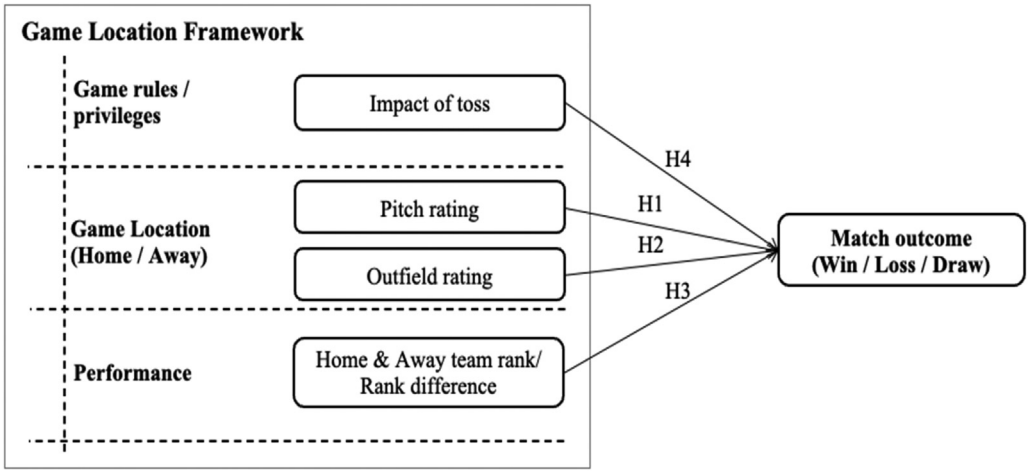

Figure 1 Basic research model.

and individual sports (Carron & Hausenblas, 1998; Carron et al., 2005). Courneya and Carron (1992) defined home advantage as "the term used to describe the consistent finding that home teams in sport competitions win over 50% of the games played under a balanced home and away schedule" (p. 13). Home advantage, thus, can be attributed to the game location and its associated factors. Home advantage for a team is termed as familiarity with the venue, weather conditions, audience, travel and rule-related factors (Jamieson, 2010). The concept has been studied across multiple sports (Asif & McHale, 2016; Clarke & Norman, 1995; Nevill & Holder, 1999), including English one-day cricket matches (Morley & Thomas, 2005) and Indian Premier League (IPL) cricket matches (Jaipuria & Jha, 2022). An analysis of 1288 men's ODIs found a significant home advantage for countries such as India and New Zealand, and a disadvantage for Australia (McEwan et al., 2023). Home advantage remains significant across sports and does not vary by sport or by the level at which the match is played (Jamieson, 2010). Home advantage is more pronounced when the home team is stronger or ranked higher (Bray et al., 2003; Jamieson, 2010). However, some studies have found that home advantage did not matter during the COVID-19 American championships, such as the National Hockey League and the National Basketball Association (Higgs & Stavness, 2021).

Different research works thus yield varied outcomes regarding home advantage. They also suggest further systematic investigation of home advantage across various sports and championships (Gerrard & Kringstad, 2023). Therefore, home advantage has been investigated in the present research model.

Impact of pitch

Pitches are influenced by soil structure, including grass type and length, or external environmental factors such as weather. The relationship between soil structure, moisture content, grass length and ball behaviour has been studied in detail in the past (Table 1; Alway et al., 2025; Crowther et al., 2020; Lindsay et al., 2025; Lopez & Chinnery, 2010). Furthermore, the impact of extraneous weather conditions, such as dew, cloud cover & other geographic factors, on the pitch has also been extensively studied (Carré et al., 1999, 2004; James et al., 2004; Perera et al., 2016). Researchers have also established that these conditions influence player performance and teams exploit them to their advantage (Connor et al., 2021; Premkumar et al., 2020). Kumar and Balasubramanian (2023) found that these decisions were influenced by match statistics, such as runs scored, wickets taken and overs bowled, with ratings of 'good' and 'very good' forming one cluster, providing for a more competitive balance. Sports administrators, such as the ICC, modify their rules periodically to eliminate any undue advantages (if present) (Kumar & Balasubramanian, 2023). To ensure competitive balance, the ICC provides benchmarking for post-match pitch ratings assigned by the referee. The referee-assigned pitch ratings are a culmination of the effects of all these factors, including pitch curation, and the match outcome through the lens of competitive balance. Lower pitch ratings, such as "below average," "poor" or "unfit", reduce the likelihood of future matches being held at the venue. Thus, cricket pitch ratings serve as good indicators of the match's outcome and competitive balance. Based on this, the study proposes that:

H1: Pitch condition influences the outcome of an international cricket match.

Impact of outfield

Similar to pitches, the outfield is also affected by factors such as soil type, grass density, height and moisture (Lopez & Chinnery, 2010). Outfield or ground conditions have been a major area of study that correlates with player performance, primarily through their impact on biomechanics such as rebound, injury and player safety (Wardenaar et al., 2023). The ideas for studying surfaces have primarily focused on either player performance (e.g., football, rugby) or ball behaviour (e.g., lawn tennis, cricket) (Lambrich & Muehlbauer, 2023; Wardenaar et al., 2023). However, cricket is a unique sport that allows both the administration and the fraternity to critique the pitch and the outfield, thus making the curation and the physiological aspects of the ground part of the performance debate. Whether it is the length of the grass affecting the speed and bounce of the ball (Adams & Gibbs, 1994; Lopez &

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Chinnery, 2010) or fielding performance, such as catching (Scholes & Shafizadeh, 2014), the impact of outfield conditions on sports performance is evident. These aspects make referee ratings crucial for both the game location and long-term sports analysis. However, limited research has examined the impact of outfield ratings on match outcomes. The study, therefore, analyses these ratings alongside match outcomes. Based on this, the study proposes that:

H2: Outfield conditions influence the outcome of an international cricket match.

Impact of team rank

In addition to the aforementioned factors, team strength is a major determinant of match outcome. Sports organisations provide team rankings based on past performances, making them a suitable proxy for past performance and relative team strength (Mukherjee et al., 2019). A consistently high ranking signifies the importance of the knowledge assimilated by the team, its coaches, and administration in exploiting match conditions, such as pitch, outfield and toss. Asif and McHale (2016) found a strong relationship between team ranking, past performance and winning probability. Lopez et al. (2018) analysed the probability of a team with better past performance winning across different leagues in the USA and found a strong correlation. Team ratings, as well as individual player ratings, were found to be effective predictors of wins in the English League Football seasons 2009–10 and 2018–19 (Arntzen & Hvattum, 2021). Leitner et al. (2010) predicted the winning probabilities for the EURO 2008 football championship using Elo-based team ratings and bookmakers' odds, where bookmakers' odds performed better at win prediction. Therefore, it can be stated that past performance (as reflected in team rankings) also plays a significant role in determining the match outcome. This study, therefore, considers the team's ranking over the past year as one of the independent variables.

H3: Past performance, reflected in the team's ranking, influences the outcome of an international cricket match.

Impact of toss

In cricket, the pre-match coin toss is used to determine the batting/bowling orders of the teams. The toss-winning captain gets the privilege to choose to bat or bowl, based on the favourable conditions provided by the pitch, outfield and weather. The toss remains a debatable influencing factor among experts and academics alike, especially given the general preference to bat first after a toss win (Allsopp & Clarke, 2004). For example, a higher number of runs scored (lead) in the first innings was a significant advantage for the home team for international Test matches played between 1997 and 2001 (Allsop & Clarke, 2004). A significant impact of the toss was found on the outcome of county cricket matches played between 1993 and 2006 (Forrest & Dorsey, 2008) and in the IPL between 2008 and 2018 (Jaipuria & Jha, 2022). However, Jewell et al. (2020) found weak statistical significance for the toss affecting county cricket matches played between 2000 and 2019. Asif and McHale (2016) found no significant impact of the toss and highlighted that home advantage would be more psychological than a field-based phenomenon. No impact was found for the different types of tosses used in county cricket in the limited-overs one-day format (Morley & Thomas, 2005). The home team, having won the toss, has a higher probability of winning the match in day-night ODIs (Dawson et al., 2009; Puram et al., 2023). Studies also indicate that home advantage in tosses can differ across playing conditions, such as day-night matches (Bhaskar, 2009; De Silva & Swartz, 1998). These mixed results provide grounds for further investigation of the impact of the toss across formats. It is therefore hypothesised that:

H4: Toss influences the match outcome of an international cricket match.

Figure 1 presents the basic research model, and the following section outlines the methodology.

Methodology

The game of cricket is data-rich (Elderton & Wood, 1945; Gulati & Mutigwe, 2021). While variables such as the toss, and home and away venues are binary, other variables such as win-loss-draw, pitch ratings and outfield ratings are categorical. Given that match outcomes do not necessarily follow a strictly ordered structure and are distinct nominal outcomes, binomial and multinomial logit models have been considered appropriate for this study (Hvattum, 2017). Furthermore, multinomial models are more suitable for three-way outcomes (Egidi & Torelli, 2021). To understand these models, the paper first discusses the game's structure, followed by the methodology adopted for analysis.

Structure of the game and data collection

Cricket is a contest between bat and ball. Bowling and batting take place at the centre of the field, with the batter and bowler placed 22 yards apart. The space in between is called the pitch and is curated for the play. The game begins with a toss, in which one team wins and decides the playing order. The game is played primarily in three formats: T20Is (20 overs per side), ODIs (50 overs per side) and Test matches (five days). Each over consists of six balls to be bowled. The team that scores more runs and bowls out the other team wins. A total of 10 wickets must be taken, with 11 players in each team and runs scored by batters running between the two ends of the pitch. The roles are reversed when either the 10 wickets have fallen (for all match formats) or the batting team has scored enough runs and declared the innings over (only for Test matches). There are two on-ground umpires; for international cricket matches, a third umpire (television umpire) and a match referee are also present. All of them ensure the fair conduct of the game, with the referee providing pitch and outfield ratings for the venue at the end of the game.

In the present study, data were collected for men's international cricket teams' T20Is (209 matches), ODIs (273 matches) and Test matches (179 matches) played between 2019 and 2024. Only those matches for which pitch and

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outfield ratings were available (International Cricket Council, 2024b) were considered. The other parameters of the match were collected from data-aggregating websites such as Cricbuzz and ESPNcricinfo. In the subsequent section, the study examines model development using logit regression.

Logit regression and model development

The study analysed three different datasets. The dependent variable (Match win) is categorical. In the case of the ODI and T20I matches, the dependent variable (y_i) is binary as shown in Equation (1). When the dependent variable is binary, logistic regression is the preferred analysis technique.

Theoretically, ODIs and T20Is can end in a tie; however, such instances are rare in our dataset. Consequently, two possible outcomes – win and loss – are retained. In the case of Test matches, the dependent variable (y_i) is a nominal variable which exhibits a polychotomous nature (as shown in Equation (2)). In this case, the basic model to be estimated has been provided in Equation (3). M_{ij} represents the predicted probability of match i resulting in outcome j; $\beta_{j,0}$ is the intercept term for outcome j; β_k captures the coefficients corresponding to each independent variable k (where k runs from 1 to p); x_{ik} is the value of the k predictor for the i_{th} match and θ_{ij} is the error term.

Binomial and multinomial logistic regression estimate the probabilities of each outcome category relative to a reference category. For T20I and ODI matches, the binary logistic regression equation is presented in Equation (4), where P_i is the predicted probability of the desired match outcome about the base category for the i^{th} match. For Test matches, the multinomial equation is represented in Equation (5), where P_{ij} is the predicted probability that match i results in outcome j out of a total of J outcomes. m is an index that iterates over all possible outcomes in the model (1 through J).

The Maximum Likelihood Estimation (MLE) method is an appropriate estimation method for the binary and three-category dependent variables (Greene, 2012). Therefore, parameters β in Equations (4) and (5) are estimated through MLE. For the binary logit models (T20I and ODI), the likelihood of observing the sample outcomes is given in Equation (6). The corresponding log-likelihood function, which is maximised in estimation, is shown in Equation (7). For the multinomial logit model (Test matches) with Jp possible outcomes, the likelihood takes the form of Equation (8) with the log-likelihood shown in Equation (9), where $y_{ij} = 1$ if match i results in outcome j, and 0 otherwise. Both specifications assume independently and identically distributed Type I Extreme Value (Gumbel) errors, consistent with standard logit-based estimation (Greene, 2012) (Table 2).

Notably, the interpretation of coefficients (β) of a nonlinear model is complex, primarily because they indicate the change in log odds of the outcome relative to the base outcome for a unit change in the independent variable (Greene, 2012). The literature therefore suggests using Relative Risk Ratios (RRRs) to analyse results (Paudel et al., 2013; Powers & Xie, 2008). RRRs or odds ratios are easier to interpret than Beta coefficients. These are calculated using Equation (10), where β is the logit beta coefficient of the predictor variable. The odds ratio indicates the increase in the odds of an event occurring with a one-unit change in the predictor variable. The operationalisation of each variable is provided in Table 3.

Table 2 Model framework and estimation equations.

Equation no.	Equation
1	$y_i = \{0 \text{ if the Home team loses the match} 1 \text{ if the Home team wins the match}$
2	$y_i = \{0 \text{ if the Home team loses the match} 1 \text{ if the Home team wins the match} 2 \text{ if the match outcome is a draw}$
3	$M_{ij} = \beta_{j,0} + \sum_{k=1}^{p} \beta_k \cdot x_{ik} + \theta_{ij}$
4	$P_i = \frac{e^{(\beta_0 + \sum_{k=1}^{p} \beta_k \cdot x_{ik})}}{1 + e^{(\beta_0 + \sum_{k=1}^{p} \beta_k \cdot x_{ik})}}$
5	$P_{ij} = \frac{e^{(\beta_{j,0} + \sum_{k=1}^{p} \beta_k \cdot x_{ik})}}{\sum_{m=1}^{J} e^{\beta_{m,0} + \sum_{k=1}^{p} \beta_{m,k} x_{ik}}}$
6	$\mathscr{L}(\beta) = \prod_{i=1}^{N} P_i^{y_i} (1 - P_i)^{(1-y_i)}$
7	$ln\, \mathscr{L}(\beta) = \sum_{i=1}^{N} [y_i ln P_i + (1 - y_i) ln\, (1 - P_i)$
8	$\mathscr{L}(\beta) = \prod_{i-1}^{N} \prod_{j=1}^{J} P_{ij}^{y_{ij}}$
9	$ln\, \mathscr{L}(\beta) = \sum_{i=1}^{N} \sum_{j=1}^{J} y_{ij} ln P_{ij}$
10	$Relative\ Risk\ Ratio = exp^{\beta}$

Data analysis

Descriptive statistics

Table 4 presents the frequency and percentage details for the three datasets used in the analysis. The table highlights several categories of the dimensions of Pitch Rating and Outfield Rating, which contained very few observations, as indicated by their low percentages (ranging from 0.3% to 2.8%). This data sparseness induces quasi-complete separation and prevents convergence of MLE in logit models (Hosmer et al., 2013; Long & Freese, 2014). To ensure a stable, convergent model, these sparse categories were merged with conceptually adjacent categories, which is a standard practice. Specifically, Outfield Ratings for T20Is, 'Average (1.4%)' and 'Satisfactory (4.19%)' were merged with 'Average'. The categories 'Below Average (0.46%)' and 'Satisfactory (4.65%)' were merged for Pitch Rating. Similarly, for Test matches, categories 'Below Average (1.12%)' and 'Satisfactory (0.56%)' were merged and labelled 'Below Average' for Outfield Rating. Again, for Test matches, the Pitch Rating – 'Below Average (3.91%)', 'Satisfactory (2.79%)', 'Unsatisfactory (1.12%)' and 'Poor (0.56%)' – were merged and labelled 'Below Average'. Lastly, in the ODI dataset, the pitch ratings 'Below Average (0.37%)' and 'Satisfactory (2.93%)' were merged and labelled 'Below Average'.

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Table 3 Description of operationalisation of variables.

Match win	0 for a home win, 1 for an away win and 2 for a draw
Toss	1 if the away team wins the toss, 0 otherwise
Rank Location	1 if the home team has a higher rank, 0 otherwise
Outfield Rating_1	1 if Outfield is rated Average, 0 otherwise
Outfield Rating_2	1 if Outfield is rated Below Average, 0 otherwise
Outfield Rating_3	1 if Outfield is rated Good, 0 otherwise
Outfield Rating_4	1 if Outfield is rated Satisfactory, 0 otherwise
Outfield Rating_5	1 if Outfield is rated Very Good, 0 otherwise
Pitch Rating_1	1 if the Pitch Rating is Average, 0 otherwise
Pitch Rating_2	1 if the Pitch Rating is Below Average, 0 otherwise
Pitch Rating_3	1 if the Pitch Rating is Good, 0 otherwise
Pitch Rating_4	1 if the Pitch Rating is Poor, 0 otherwise
Pitch Rating_5	1 if the Pitch Rating is Satisfactory, 0 otherwise
Pitch Rating_6	1 if the Pitch Rating is Unsatisfactory, 0 otherwise
Pitch Rating_7	1 if the Pitch Rating is Very Good, 0 otherwise
Rank difference	Home team rank – Away team rank (Modulus)

Relationship among variables

The dependent and independent variables (except for the rank difference) were categorical, with more than two categories for some variables, so the correlation matrix and correlation coefficients do not accurately reflect the relationships (Chen & Popovich, 2002). In such cases, the relationship between the dependent and independent variables is assessed using Cramér's V, which was found to be less than 0.6 (Table 5), indicating no strong correlation between the predictor and dependent variables (Kalliga et al., 2024; Morgan et al., 2019). Pearson's correlation was used to check the correlation between 'Rank difference' and 'Match win'. Pearson's correlation coefficients ranged between –0.5 and 0.5, indicating a low correlation. This rules out multicollinearity in the datasets (Appendix 1).

The Independence of Irrelevant Alternatives (IIA) test precedes the multinomial logistic regression. In line with accepted practices in logit regression (Greene, 2012), the present study has applied the Hausman IIA test to assess whether the IIA assumption holds. As shown in Table 6, the IIA assumption is met, which favours the application of the MLE method.

Results

In T20Is and ODIs, the dependent variable has predominantly two outcomes (win or loss) across all matches. Therefore, the MLE used the Away team's win as the base reference category (Table 7). However, outcomes for Test matches are distributed between wins, losses and draws. Thus, the MLE

Table 4 Descriptive statistics – ODI, T20I and Test matches (2019–24).

Match type variables	ODI Freq. (%)	T20I Freq. (%)	Test match Freq. (%)
Match Win			
Away	96 (35.16%)	97 (45.12%)	55 (30.73%)
Home	177 (64.84%)	118 (54.88%)	97 (54.19%)
Draw	Nil	Nil	27 (15.08%)
Toss Win			
Away	146 (53.48%)	100 (46.51%)	81 (45.25%)
Home	127 (46.52%)	115 (53.49%)	98 (54.75%)
Pitch Ratings			
Very Good	105 (38.46%)	133 (61.86%)	44 (24.58%)
Good	117 (42.86%)	58 (26.97%)	81 (45.25%)
Average	42 (15.38%)	13 (6.04%)	39 (21.79%)
Below Average	1 (0.37%)	1 (0.46%)	7 (3.91%)
Satisfactory	8 (2.93%)	10 (4.65%)	5 (2.79%)
Unsatisfactory	Nil	Nil	2 (1.12%)
Poor	Nil	Nil	1 (0.56%)
Outfield Ratings			
Very Good	196 (71.79%)	157 (73.02%)	114 (63.69%)
Good	60 (21.98%)	46 (21.4%)	55 (30.73%)
Average	11 (4.03%)	3 (1.4%)	7 (3.91%)
Below Average	Nil	Nil	2 (1.12%)
Satisfactory	6 (2.2%)	9 (4.19%)	1 (0.56%)
Team with Higher Rank			
Away	136 (49.82%)	101 (47%)	104 (58.1%)
Home	137 (50.18%)	114 (53%)	75 (41.9%)

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Table 5 Cramér's V values.

	Match win		
Dependent variable	T20I	ODI	Test match
Independent variables	**Cramér's V values**		
Pitch Rating	0.158	0.220	0.292
Outfield Rating	0.150	0.105	0.123
Rank Location	0.083	0.218	0.440
Toss Win	0.221	0.072	0.070
Pearson's correlation coefficient			
Rank Difference	-0.027	-0.142*	-0.032

Table 6 Hausman-McFadden test of IIA assumption.

H_o: Odds (Outcome-J vs Outcome-K) are independent of other alternatives.

Omitted	χ^2	df	$P>\chi^2$	Evidence
Home	0	6	1.00	for H_o
Away	0	2	1.00	for H_o
Draw	0	8	1.00	for H_o

regresses the model once for the Away team's win and once for the Draw as the base reference categories (Table 8). Format-wise summary of the hypotheses versus results is provided in Table 9. Figure 2 presents the effect-size estimates, expressed as Relative Risk Ratios (RRRs) with 95% confidence intervals, for the independent variables across match formats. Values to the right of RRR = 1 indicate a higher likelihood of the outcome relative to the reference category, whereas values to the left of RRR = 1 denote a lower likelihood relative to the reference category. The positive coefficient and RRR greater than 1 indicate increased odds of a home win. Therefore, the results should be interpreted from the coefficient signs and RRR values.

Impact of pitch

For T20Is, 'Very Good', 'Good' or 'Below Average' rated pitches have negative coefficients (-0.136, -0.139 and -0.141, respectively, with $p<0.01$). Further, the RRR values are also less than 1 at 0.873, 0.869 and 0.868 ($p<0.01$), suggesting that for the shortest format of the game, the impact of the pitch remains minimal. For ODIs, results are significant only for 'Very Good' and 'Good' pitches with β of 0.824 and 0.306 ($p<0.01$) and RRR values at 2.281 and 1.358 ($p<0.01$). These results indicate a higher likelihood of the home team winning when pitches are rated above average or average. For Test matches, results are significant for pitches rated 'Good' as indicated by β and RRR of -1.055 and 0.348 ($p<0.01$) for Draw vs Away matches. A negative coefficient and RRR<1 indicate that competitive balance is only achieved for away teams when pitches are rated 'Good', where the odds of a draw are reduced significantly (Table 8). For Home vs Away team win, results indicate an increase in the odds of a Home Win compared to an Away Win on fields rated 'Very Good' compared to 'Good' rated fields (significant at 1%). The negative coefficient and an RRR of 0.387 for 'Below Average' Pitch Rating in the case of a Home vs Away win suggests a decrease in the odds of a Home win in comparison to an Away team win when the reference category is 'Average' ($p<0.01$). Thus, a 'Below Average' pitch might be disadvantageous to the Home team. In contrast, a 'Very Good' rated pitch is advantageous for the home team to win (RRR = 1.165, $p<0.01$).

Impact of outfield

The 'Average' rating is used as the base category for all cases. In the case of T20I matches, 'Very Good' and 'Good' rated outfields significantly increase the likelihood of the home team winning (β =0.594 and 0.553, RRR = 1.881 and 1.738, $p<0.01$). However, for ODIs, 'Good' and 'Very Good' pitch ratings significantly reduce the win likelihood for the home teams. This is because the coefficients are negative and significant (-0.625 and -0.473, respectively), and the RRR values are less than 1 and statistically significant (RRR = 0.623; $p<0.01$, and 0.535; $p<0.01$). In the case of Test matches, the odds of a Draw and Home win are lower in matches where the outfield has a 'Good' outfield rating compared to an 'Average' rating, when compared to the Away result (significant at 1%). This finding shows that from the outfield's perspective, 'Good' rated pitches provide the highest levels of competitive balance. Furthermore, the positive coefficient and RRR of 1.593 indicate an increase in the odds of a Home win compared to an Away win on fields rated 'Very Good' compared to 'Good' rated fields ($p<0.01$).

Impact of Rank Location (Winning team - Home or Away) and Rank difference

The paper also analysed the influence of the ranks of the winning teams and losing teams, as well as the differences

Table 7 Multinomial logit model T20I and ODI matches (Relative Risk Ratios – RRR).

	T20 matches		ODI matches		
Independent variable Away Win (Reference category)	β coefficients	RRR	β coefficients	RRR	Hypothesis supported
Toss (Ref. category = Away) Home	0.003** (0.001)	1.003** (0.501)	0.315*** (0.118)	1.370*** (0.516)	H4(Yes)
Pitch Rating (Ref. category = Average)					
Very Good	-0.136*** (0.051)	0.873*** (0.033)	0.824*** (0.310)	2.281*** (0.860)	H1(Yes)
Good	-0.139*** (0.053)	0.869*** (0.327)	0.306*** (0.115)	1.358*** (0.518)	
Below Average (Merged groups – Satisfactory and Unsatisfactory)	-0.141*** (0.051)	0.868*** (0.331)	-0.764 (1.018)	0.465 (0.694)	
Outfield Rating (Ref. category = Average)					
Very Good	0.594** (0.290)	1.881** (0.941)	-0.473** (0.231)	0.623** (0.312)	
Good	0.553*** (0.209)	1.738*** (0.663)	-0.625*** (0.239)	0.535*** (0.207)	H2(Yes)
Below Average			-0.473** (0.237)	0.623** (0.304)	
Rank Difference (Home team's rank – Away team's rank)	0.008 (0.000)	1.008 (0.126)	-0.223** (0.112)	0.800** (0.414)	H3 (No) H3 (Yes)
Team Rank (Ref. category= Away) Home	0.280** (0.137)	1.323** (0.675)	0.468** (0.028)	1.597** (0.760)	H3 (Yes)
Constant	13.270*** (5.143)		0.875 (1.275)	2.399 (3.075)	
Observations	209		273		
Log Pseudolikelihood	-138.684		-160.500		
McFadden's Pseudo R2	0.342		0.293		
Wald Chi2 (8)	546.080		202.860		
Prob>Chi2	0.000		0.000		
AIC	373.295		343.001		
BIC	325.454		382.705		

Note: Robust standard errors in parentheses; *$p < .1$. **$p < .05$. ***$p < .01$.

between them. Rank Difference (Home team rank – Away team rank) captures the magnitude of the pre-match disparity in team strength. This continuous-variable test examines whether larger gaps in ranking systematically affect the probability of a home win, identifying the marginal impact of each additional unit of separation between teams. Rank Location (1 if the higher-ranked team is the home side, 0 otherwise) indicates whether the stronger team also enjoys the home advantage. This binary variable examines whether having both competitive strength and favourable venue conditions for the same team provides an extra edge in determining match outcomes. Together, these two measures help distinguish between the size of the strength gap and the placement of that advantage across venues.

RRR>1 means the odds of the home team with a higher rank or positive rank difference having a higher chance of winning as compared to the away team. When the home team is ranked higher than the away team, the home team's odds of winning increase by 32.0% compared to the away team ($p < 0.05$). The rank difference is considered to be incremental. Thus, the regression analysis found that for every unit increase in rank difference, the odds of a home team winning increased by 8%, but this difference was not statistically significant. For ODIs, the rank difference and the rank of the winning team are statistically significant at the 5% level. This implies that the odds of a home team with a higher rank winning (RRR = 1.597) are 60% higher than those of an away team. These results are consistent for the rank difference – the negative coefficient and RRR of 0.800 (significant at 5%) indicates that when the home team is ranked lower (i.e., has a higher numeric rank) than the away team, their chances of winning decrease. This aligns with the general idea that a lower-ranked team should have lower odds of winning, even at home. For Test matches, results are not significant for a Draw as the outcome. For a Home vs Away win, the RRR of 1.216 ($p<0.01$) and β of 0.196 suggest an increase in the odds of the match resulting in a Home win compared to an Away win when the home team has a higher rank (compared to the away team). From the rank difference between the teams, the result (RRR>1.139) indicates that as the rank difference increases by 1 unit, the likelihood of the Home win increases.

Impact of toss

In T20Is, the toss is significant at a 5% level. The positive coefficient and RRR of 1.003 indicate a positive but negligible increase in the odds of the 'Home' team winning the match when the toss is won by the 'Home' team ($p<0.05$). In the case of ODIs, a positive β and RRR of 1.384 ($p < 0.05$) highlight that the 'Home' team winning the toss significantly

Table 8 Multinomial logit model Test matches (Relative Risk Ratios – RRR).

Variable Away Win (Base category)	β coefficients	RRR	Hypothesis supported
Draw			
Toss (Ref. category = Home)			
Away	-0.0996 (0.567)	0.905 (0.513)	H4 (No)
Pitch Rating (Ref. category = Average)			
Very Good	-0.263 (0.423)	0.769 (0.342)	
Good	-2.269*** (0.381)	0.103*** (0.082)	H1 (Yes)
Below Average	0.216 (0.534)	1.241 (0.857)	
Outfield Rating (Ref. category = Average)			
Good	-1.055*** (1.736)	0.348*** (0.269)	H2 (Yes)
Below Average	-1.307 (1.805)	0.271 (1.115)	
Very Good	0.522 (0.502)	1.686 (0.903)	
Rank (Ref. category = Away)			
Home	-0.0125 (0.052)	0.988 (0.546)	H3 (No)
Rank Difference	-0.283*** (0.108)	0.754*** (0.128)	H3 (Yes)
Constant	-0.754 (0.690)	0.470 (0.275)	
Away Win (Base category)	β coefficients	RRR	
Home Win			
Toss (Ref. category = Home)			
Away	-0.163*** (0.063)	0.849*** (0.317)	H4 (Yes)
Pitch Rating (*Ref. category = Average*)			
Very Good	0.153*** (0.059)	1.165*** (0.340)	H1 (Yes)
Good	-0.568 (0.502)	0.566 (0.279)	
Below Average	-0.948*** (0.367)	0.387*** (0.126)	
Outfield Rating *(Ref. category = Average)* Good	-0.387*** (0.150)	0.679*** (0.257)	
Below Average	0.136 (0.728)	1.146 (1.529)	H2 (Yes)
Very Good	0.466*** (0.178)	1.593*** (0.601)	
Rank (Ref. category = Away)			
Home	0.196*** (0.0.074)	1.216*** (0.471)	H3 (Yes)
Rank Difference	-0.0812*** (0.031)	0.922*** (0.281)	H3 (Yes)
Constant	-0.228 (0.523)	0.921 (0.561)	
Observations	179		
Log Pseudolikelihood	-246.6621		
McFadden's Pseudo R2	0.328		
Wald Chi^2 (9)	653.13		
Prob>Chi^2	0.000		
AIC	335.652		
BIC	424.892		

Note: Robust standard errors in parentheses; *$p < .1$; **$p < .05$; ***$p < .01$.

increases the odds of it winning the match compared to the Away team. For Test matches, where the Away team wins the toss, the odds of the Home team winning the match decrease compared to the odds of the Away team winning the match (β = - 0.163, RRR = 0.849, $p<0.01$).

Discussion

The results shown in Tables 7 and 8 provide evidence for and against competitive balance. The findings suggest that the game location, specifically the ground rating, plays a crucial role in determining home advantage. 'Good' and 'Very Good' rated pitches provide competitive balance, nullifying any home advantage across all formats, and are significant for away wins. Considering that more than 80% of pitches were rated 'Good' or 'Very good' across all formats, statistically, it can be argued that the majority of the pitches provide a balanced competitive environment. These findings are consistent with results from matches played in Australian leagues (Massey & Hogan, 2025). Therefore, doctored pitches for home advantage can be considered a one-off phenomenon – probably based on anecdotal evidence. Team managers and pitch curators should thus look into team building and pitch preparation to achieve pitches that are good or better.

Theoretical implications

Sports function within the two dialectic forces of exploiting the capabilities and environment of the team vis-à-vis the administrator's objective to ensure fairness through

Table 9 Summary of hypothesis results across all three formats.

Hypothesis	Test	ODIs	T20Is
H1 - Pitch Ratings	Supported	Supported	Supported
H2 - Outfield Rating	Supported	Supported	Supported
H3 - Rank Location	Supported	Not Supported	Not Supported
H3 - Rank Difference	Supported	Supported	Supported
H4 - Toss	Not Supported	Supported	Supported

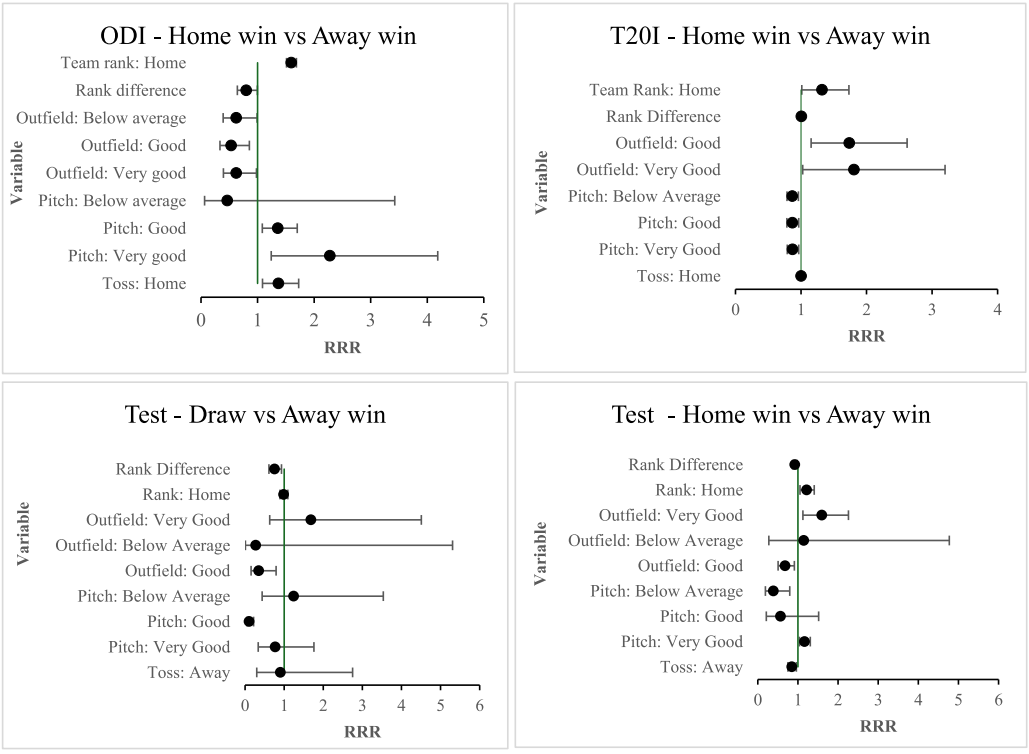

Figure 2 RRR and effect sizes (95% CI).
Note: RRRs > 1 indicate a higher likelihood of influencing the outcome.

competitive balance. The modified Game Location Framework allows for the identification of these inputs and balancing elements. A measurement of environmental conditions that provides this balance, through post-match pitch and outfield ratings, provides a long-term understanding of match outcomes. The results indicate the presence of home advantage, which is pronounced by the team's past performance, even when pitches are rated as good or very good. Theoretically, this means that outcome-oriented pitch doctoring as a short-term measure has little to no significance. Teams should instead focus on long-term capabilities from the Game Location Framework perspective, such as physical conditions (environment) and players' performance (Courneya & Carron, 1992; Puram et al., 2023).

The toss's influence on the match outcome was only found for ODIs. While there is a significant but weaker influence on T20Is and no influence on Test matches, there remains a significant chance of winning ODIs when the team also wins the toss. This can be attributed to the fact that most ODIs are played as day-night matches, where environmental conditions across innings vary significantly. From a pitch perspective, one can theorise that the deterioration of the pitch during a T20I match remains insignificant in terms of being influenced by the toss. In contrast, the deterioration of the pitch remains significant in ODI matches. In Test matches, gradual deterioration over five days might reduce the impact of the toss. The impact of winning the toss in Test matches is often overshadowed by the player's skill set and other conditions after the first few sessions of play (Deval et al., 2021; Morley & Thomas, 2005).

The combined effect of long-term team-based knowledge, as reflected in team rankings, enables teams to effectively exploit pitch conditions. At the same time, team rankings and their influence on match outcomes provide a theoretical understanding of the entry barriers for cricket teams aspiring to become Test-playing nations or to be among the top 10 ICC teams. The impact might also be the reason why newly inducted teams in the top league take years to win their first T20I, ODI or Test match against the Test-playing nations; for example, Sri Lanka and Bangladesh

took a decade or more to win their first Test match or Test series against the Test-playing nations.

Our academic enquiry examines and finds consistency in the ICC categorisation of pitch and outfield ratings, as well as in the referee allocation of these ratings over the long term. Theoretically, we support the notion that curating good and very good pitches favours the home teams in the long run, and that doctored pitches are a one-off phenomenon, providing minimal home team advantage. This also means that the pitch rating policy has supported both the player and referee effects in providing competitive balance (Boyko et al., 2007).

Managerial and policy implications

The managerial and policy implications emerging from the findings are relevant to team managers, sports administrators, and pitch and ground curators. The present research uses the Game Location Framework as the underpinning theory (Courneya & Carron, 1992). Factors that influence pitch and outfield ratings can be manipulated, making the referee's job crucial. To ensure a fair and competitive balance, the ICC should ensure that the conditions for rating pitches as good or very good are met. We substantiate the idea that the factors such as toss do not significantly affect most matches, except in ODIs. This also means that strategies for ODIs should be dual script in nature, based on the outcome of the toss, whether it is a win or a loss. Managerially, this substantiates the idea of skill enhancement, a culture of competitive performance and the long-term impact of a familiar environment. A good example of this is the England cricket team, which now follows the Bazball approach of aggressive batting. As a result, most English pitches have become batter-friendly over the last few years.

Our research informs the coaches and players' strategy and planning, especially the opposition teams. They now know the major factors to prepare against a possible home advantage. Teams can prepare counterstrategies to mitigate the home advantage stemming from familiarity with the ground or the environment. At the policy level, the ICC needs to focus on creating specific guidelines for pitch curators to ensure that pitches with better ratings are prepared, thereby providing an even contest. Pitch rating audits should be conducted at regular intervals to assess the consistency of refereeing and ground conditions. Our research also has policy implications for both nodal agencies controlling the sport of cricket, such as the ICC, and domestic agencies in charge of organising cricket. The first recommendation to the ICC would be to mandatorily conduct pitch and outfield audits at regular intervals and increase the audit frequency in case specific venues receive lower pitch or outfield ratings. Additionally, we recommend that the ICC establish an independent panel to conduct audits of the pitch and outfield, especially for essential tournaments, to ensure fairness. Second, the ICC can compile a best practices approach and institute the Best Grounds Person or Pitch Curator Award, ensuring that some form of knowledge transfer takes place across all pitch and outfield curating staff internationally. Third, the ICC can explore options for neutral venues in international tournaments, particularly where home advantage, due to pitch and outfield curation, is likely to impact the outcome. Currently, for the ICC Test championship, the ICC practices the neutral venue approach. Finally, our recommendation to the ICC would be to strengthen the existing targeted assistance and performance program to reduce competitive inequality between the established and emerging cricket nations. The ICC can also explore options for knowledge transfer between established and emerging nations to ensure parity in infrastructure.

Conclusion

The present study investigated the potential influence of pitch or outfield ratings, toss and past performance on the outcomes of Test matches, ODIs and T20Is at the international level. The results indicated that higher-rated pitches (Good or Very Good) provide a good competitive balance, supporting the hypothesis. An outfield rating of Good or above creates an advantageous situation for the home team. Past performance or team rankings are the most significant influencers, with a significant positive effect on ODI and T20I wins for a high-ranked home team. The research also found that the toss does not significantly affect the outcomes of T20Is and Test matches at the international level. The study thus extends the existing literature on pre-match and post-match variates and establishes new relationships, using the Game Location Framework. For online gaming, this provides valuable input for gamers and software designers to consider these additional parameters and rank teams or players, thereby improving the gaming experience. For sports policy managers, the research offers insights into why pitches and outfields should be managed to gain or balance a competitive advantage. These findings extend those of some researchers while contradicting others, providing significant grounds for future research.

Limitations and future research

Like any other research study, this study has limitations and offers avenues for future research. The pseudo R^2 of the proposed model is on the lower side, suggesting that there might be interaction effects or additional variables influencing the match outcome. A larger model encompassing more variables can be explored in future research. The post-toss decision to bat or bowl has not been modelled in the current study and could be explored as a future research topic. We suggest that future research can also map session-by-session pitch behaviour and deterioration to understand the pitch ratings and the importance of the toss. Pre-match and post-match variables do not always provide the same level of detail as those available during the match. Hence, future studies can use enriched, session-wise data at a higher frequency, which may provide better insight into predicting the home advantage, if any. The ICC has changed the pitch and outfield rating system since November 2023. In this context, researchers can generate datasets to compare the new and old rating systems and provide policymakers with insights. COVID-19 changed the rules, such as restricting saliva to be used to shine the cricket ball. The impact needs to be studied in terms of pitch and ball dynamics. The impact of day and night matches can be studied for all game formats.

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Supplementary materials

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