Journal of Science and Medicine in Sport 25 (2022) 520–523

Contents lists available at ScienceDirect

Journal of Science and Medicine in Sport

journal homepage: www.elsevier.com/locate/jsams

Original research

Home advantage and LBW decisions: The contribution of umpiring to the home-ground (dis)advantage in cricket

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ARTICLE INFO

Article history:
Received 12 September 2021
Received in revised form 24 January 2022
Accepted 30 January 2022
Available online 3 February 2022

Keywords:
Home disadvantage
Sports officiating
Referee bias
Decision-making

ABSTRACT

Objectives: This study aimed to determine whether elite cricket umpires' decisions contribute to home advantage via leg-before-wicket decisions.
Design: Leg-before-wicket decisions ($n = 4971$) from actual elite level cricket matches in Australia between 2009 and 2016 were analysed using a binomial logistic regression to predict the umpires' leg-before-wicket decisions.
Methods: Regressions were performed to determine whether the batter's team (home or away) influenced the likelihood that the umpire would give them out leg-before-wicket.
Results: We found no evidence of home advantage in umpires' leg-before-wicket decisions. In fact, we found evidence that umpires in some instances disadvantage the home team.
Conclusions: We suggest that the increased professionalism of sports officials, and the scrutiny they are placed under, may lead umpires to reduce or even overcompensate for any existing biases in their decision making.

Practical implications

- Cricket umpires do not favour the home team in LBW decisions.
- Batters from the home team are more likely to be incorrectly given out than batters from the away team.
- Increased professionalisation of officials could explain why umpires do not make decision-making errors that would favour the home team.

1. Introduction

Sport teams are more likely to succeed when playing at their 'home' ground.[1] For example in cricket, the advantage experienced by teams playing at home (see Connor et al.[2]) has been attributed to several contributing factors including the degree of crowd support, familiarity with the performance environment, or the need for away-teams to travel to compete.[3] Familiarity with the playing environment may be particularly important for home advantage in cricket given that, unlike most sports, it is played on a constantly changing surface (i.e., the pitch).[3] As such, personal knowledge of how the playing surface deteriorates, particularly in multi-day matches, may provide a performance advantage for players from the home team.

Another factor known to contribute to this home advantage is a potential bias in the judgements of sports officials adjudicating those matches.[4] Previous research suggests football referees favour the home team when making foul judgements, typically awarding fewer fouls to the away team.[3] This effect is particularly evident when large crowds are present. One explanation is referees erroneously utilise crowd noise as a cue when making foul decisions.[5,6] For example, a recent study showed football referees award fewer fouls and red/yellow cards against the home team in front of a crowd, whereas matches played without crowds due to COVID-19 showed no difference between teams.[7] There has been a general decline in home advantage in recent years, particularly in football. Researchers have argued that improved training and support for officials has led to an increase in decision-making performance, and subsequently, a decrease in home advantage.[8]

To date, studies of home advantage in sports officiating have focussed on reactive decisions/judgements made based on what the official has seen (e.g., football referees determining if a foul has been committed). In cricket, umpires not only make reactive judgements based on their perceptual experience, but also make predictive judgements. For example, in leg-before-wicket (LBW) decisions, umpires must initially make reactive spatial judgements (e.g., where did the ball bounce and hit the batter, and did it hit their bat before hitting them?), but the later elements of the judgements are unique: The umpire must also predict where the ball would have travelled had it not hit the batter. Specifically, umpires must adjudicate whether a ball would – after hitting the batter's body – have gone on to hit the stumps to determine whether the batter should be 'out' or 'not out'. The current study explores whether home advantage effects are present in the

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https://doi.org/10.1016/j.jsams.2022.01.009
1440-2440/

decision-making of elite-level cricket umpires when making LBW decisions that require the integration of reactive and predictive judgements.

Previous analyses of LBW rates in cricket have attempted to understand home advantage for LBW decisions in cricket. Crowe and Middeldorp[9] used generalised linear models to determine whether touring (away) teams were more likely to be given out LBW than the home team in test matches played in Australia between 1977 and 1994. During that period, host nations provided the umpires. Crowe and Middeldorp[9] found batters from England, South Africa, and Sri Lanka were significantly more likely to be adjudicated LBW than Australians. However, the authors noted that this effect might not be due to umpire bias, but instead could be due to away batters' unfamiliarity with Australian pitches, or different batting and bowling styles. Regardless, the perceived tendency for home teams to be more likely to receive favourable decisions resulted in the International Cricket Council (ICC) from 1994 requiring one umpire to be from a neutral country, and from 2002 both umpires should be from a neutral country.[4]

Sacheti et al.[4] explored whether LBW decisions were more favourable for home (as opposed to away) batters prior to introducing neutral umpires, and found umpires tended to favour the home team. Sacheti et al. also found bias in favour of the home team decreased with the introduction of a single neutral umpire, and further decreased with the introduction of two neutral umpires. Their approach examined the number of LBWs awarded to home and away teams in international cricket matches to determine whether umpires showed systematic biases against the away team. However, this approach is problematic because it remains unknown whether the umpires' decisions were correct. It is unclear whether the decisions favoured the home team because of unwanted systematic bias from home umpires, or rather, away teams were simply more likely to be dismissed LBW due to their lack of familiarity with (or poor attunement to) environmental constraints such as pitch characteristics (i.e., bounce [coefficient of restitution], amount of spin possible) in the performance environment.

The type of cricket match being played (i.e., four-day, one-day, or T20) has recently been shown to also influence the LBW judgements made by umpires.[10] As a result, home advantage might differ according to match format. In domestic matches (i.e., at a national rather than international level), cricket umpires have been shown to make less accurate LBW judgements, and are more conservative (i.e., tend to say not out) in T20 matches compared to four-day and one-day matches.[10] Adie et al. suggested that this effect could be due to the fact T20 matches, the shortest format of the game, are typically played in front of large crowds and televised to large audience while the other formats are not. The authors proposed increased scrutiny and pressure from larger crowds and TV audiences may lead umpires to adhere to the social norm of giving the benefit of the doubt to the batter. As a result, home advantage might be greater in Australian domestic T20 matches where larger crowds are typically in attendance.

The present study sought to clarify whether cricket umpires are biased to favour the home team when making LBW decisions. We examined historical data from elite-level cricket matches in Australia where a designated match official with access to video replays made an official adjudication of whether each decision made by the on-field official was correct. This meant that we could use multi-level binomial regressions to control for whether the batter should have been given out by the on-field umpire (i.e., whether the decision was correct or not). We also assessed whether the match format (four-day, one-day, or T20) contributed to the magnitude of home advantage. Moreover, we sought to uncover how any home advantage might alter LBW decisions. Umpires could favour the home team by adjudicating a home batter as 'not out' when they should be out, and/or they could adjudicate an away batter as 'out' when they should be 'not out'. We therefore also included an interaction term between the batting team (home V away) and whether the batter *should* be given 'out' or 'not out'. We had no specific hypothesis about which would best explain any home-ground advantage.

2. Method

Historical LBW data from professional domestic ('first-class' state/provincial) cricket matches were obtained from Cricket Australia. The data included, for all games (four-day, one-day, and T20) between 2009 and 2016, the decision made by the umpire for each LBW appeal ("out" or "not out"), the team of the batter, and an official judgement made by the match referee about accuracy of the LBW decision ("correct", "incorrect", or "inconclusive"). In cricket, the match referee oversees both player conduct and assessing the umpires' performance in each match. Match referees' judgements were based on video footage that they could view multiple times, and the ball tracking software in T20 matches. We used the match referee's judgements of the correctness of each umpiring decision to establish which decision the umpire *should* have made as an estimate of truth. Decisions were rated as inconclusive if the match referee deemed that there was insufficient evidence to accurately assess the accuracy of a decision. Batters were coded as "Home", "Away", or "Neutral" based on match scorecards. Inconclusive decisions were removed, as were decisions from matches that were played at a neutral ground ($n = 679$). A total of 4971 (four-day = 3981, one-day = 646, T20 = 344) LBW decisions (18.7% rated as out) were included in our analyses. Decisions were made by 19 umpires, with an average of 261.6 decisions per umpire ($SD = 190.1$). We classified the on-field umpires as 'elite' based on Kittel et al.'s[11] recommendations, defined as a person officiating at the national level in a large sporting nation.

We performed binomial logistic regressions in R-Statistics using the 'glm' function in the 'lme4' package.[12] In each model, we predicted umpires' decisions (Out v Not Out), with batting team (Home v Away) and decision truth (Out v Not Out) as fixed effects, while also including an interaction term between batting team and truth. We first created a model for all match types together, then repeated the model using data from each match format individually (four-day, one-day, T20). Following a significant main effect, post-hoc estimates of marginal effects (Delta Method) were performed using the 'modmarg' package in R-Statistics. Following a significant interaction, post-hoc estimates of the marginal effect of batting team at each level of truth (simple slopes) were also performed using this package. We also reported a home advantage percentage (HA%) which represented the number of LBW dismissals achieved by the home team (i.e., where an away batter was given out) expressed as a percentage of all LBW dismissals.

3. Results

When all match formats were considered together, umpires responded 'out' for 19.9% of appeals for batters from the home team, compared to 18.3% of appeals from the away team. The HA% across all matches was 49.47%. Batting team was a significant and small predictor of umpires' decisions ($z = 2.86$, $p = 0.004$). Post-hoc estimates of marginal effects showed the probability that home batters would be given out LBW was 19.4% ($SE = 0.3\%$) compared to 18.8% ($SE = 0.2\%$) for away batters. Decision truth was also a significant predictor in the overall model ($z = 23.59$, $p < 0.001$). Post hoc estimates of marginal effects of truth showed if the batter should be given out, the likelihood that an umpire will respond out is 95.5% ($SE = 0.7\%$), compared to 1.4% ($SE = 0.2\%$) when the batter should be given not out. In the overall model, the interaction between batting team and truth was also significant ($z = -2.84$, $p = 0.005$). Estimates of marginal effects of batting team at each level of truth showed when the batter should be given out, batters from the home team have a 94.6% probability of being given out, compared to away batters who have a 96.4% probability. This difference was not significant ($z = -1.28$, $p = 0.201$, *95% CI* $= -0.04, 0.01$), suggesting no difference in the likelihood of the umpire incorrectly responding "not out" for home and away batters. Comparatively when the batter should be given not out, batters from the home team (2.0%) had a significantly higher probability of being given out compared to away batters (0.9%) ($z = 2.90$, $p = 0.004$,

Table 1
Regression table for all match types (pooled).

Predictors	Overall		
	Odds ratios	*CI*	*p*
(Intercept)	0.01	0.01–0.01	**<0.001**
Batting team	2.24	1.31–3.97	**0.004**
Decision truth	2892.26	1541.61–5819.91	**<0.001**
Batting team * decision truth	0.30	0.13–0.68	**0.005**
Observations	4971		
R^2 Tjur	0.873		

Significant results are highlighted in bold.

95% CI = 0.00, 0.02). Table 1 shows the odds ratios and estimated effect sizes of the overall model. For the batting team predictor, an odds ratio >1 indicates that home batters are more likely to be given out compared to away batters. For the decision truth predictor, an odds ratio >1 indicates that batters are more likely to be given out by the umpire when they *should* be given out compared to when they *shouldn't*.

In four-day matches, umpires responded 'out' for 20.0% of appeals for home batters, compared to 18.8% of appeals for away batters. The HA% for four-day matches was 50.32%. Batting team was not a significant predictor of umpires' decisions for four-day matches ($z = 1.62$, $p = 0.106$). Truth was a significant predictor in four-day matches ($z = 19.63$, $p < 0.001$). Estimates of marginal effects showed batters who *should* be given out had a 96.7% ($SE = 0.6\%$) chance of being given out, compared to a 1.1% ($SE = 0.2\%$) chance for batters who *should* be given not out. The interaction between batting team and truth was significant ($z = -2.14$, $p = 0.032$). Estimates of marginal effects of batting team at each level of truth showed in four-day matches, when the batter *should* be given out, batters from the home team have a 95.8% probability of being given out, compared to away batters who have a 97.7% probability. This difference was not significant ($z = -1.46$, $p = 0.144$, *95% CI* = −0.04, 0.01). Similarly, when the batter should be given not out, the model showed no significant difference between probabilities for batters from the home team (1.4%) compared to the away team (0.8%) ($z = 1.62$, $p = 0.105$, *95% CI* = 0.00, 0.01). Table 2 shows odds ratios and estimated effect size for the four-day, one-day, and T20 models.

In one-day matches, umpires responded 'out' to 19.4% of appeals for home batters, compared to 17.4% for away batters. The HA% for one-day matches was 47.06%. Batting team was not a significant predictor of the umpire's decision for one-day matches ($z = 1.46$, $p = 0.145$). Similarly, there was no significant interaction between batting team and truth ($z = -0.62$, $p = 0.533$). Truth was a significant predictor in one-day matches ($z = 9.64$, $p < 0.001$). Estimates of marginal effects showed that batters who *should* be given out had a 92.0% ($SE = 2.6\%$) chance of being given out, compared to a 3.0% ($SE = 0.7\%$) chance for batters who should be given not out.

In T20 matches, umpires responded 'out' to 19.8% of appeals for home batters, compared to 14.1% for away batters. The HA% for T20 matches was 43.11%. Batting team was not a significant predictor of the umpire's decision in T20 matches ($z = 1.94$, $p = 0.052$), nor was the interaction between batting team and truth ($z = 1.89$, $p = 0.058$). Truth was a significant predictor in T20 matches ($z = 6.03$, $p < 0.001$). Estimates of marginal effects showed batters who *should* be given out had an 86.5% ($SE = 4.5\%$) chance of being given out, compared to a 2.8% chance for batters who *should* be given not out.

4. Discussion

Sports teams and athletes are more likely to succeed when performing at home (home advantage) in many sports (e.g., football, basketball, & futsal;[13]). This study aimed to determine whether elite cricket umpires favour the home team when making LBW decisions. We found no evidence of home-ground bias for LBW decisions made in Australian first-class matches, suggesting that umpires do not contribute to the home advantage summarised by Connor et al.[2] When collapsing across formats, we found that umpires favoured the *away* team, with home batters being significantly more likely to be incorrectly given out LBW than away batters. We found no evidence umpires favoured the home team by incorrectly judging a batter to be 'not out' more frequently than they do for the away team. The strongest predictor of whether an umpire would respond out, both overall and by match type, was whether the batter *should* be given out.

We found no evidence that umpires favour the home team in LBW decisions in any of the three match formats. However, there was a significant interaction between match type and batting team in four-day matches. Estimates of marginal effects however did not reveal a significant difference between home and away teams in four-day matches for decisions when the batter should be given out, nor decisions when the batter should be given not out.

The findings of our study contrast with previous studies of home advantage in LBW decisions (e.g., Crowe & Middeldorp[9]; Sacheti et al.[4]). We speculate that this could in part be because most matches in this study were not played in front of large crowds (i.e., in the four-day and one-day matches). Therefore, it could be that there was insufficient noise from the home crowd to elicit bias in favour of the home team. However, in T20 matches this explanation does not apply, because those matches were typically played in front of large crowds (mean crowd size = 19,287 in the 2016/17 season) which suggests even in front of large crowds, cricket umpires do not favour the home team in LBW decisions. Another explanation could be even when a crowd is present, spectators at a cricket match are not in a position to see and accurately give an opinion on an LBW appeal, which could reduce the chance of an umpire being swayed by crowd opinions. Spectators are likely to react to the possible opportunity of a dismissal, rather than more specifically to the likelihood of the dismissal, meaning that the crowd noise provides the umpire with no useful information about the likelihood that the LBW decision is actually out. Similarly, it may be that because LBW decisions are not related to player behaviour or rule transgressions (as is the case for foul judgements in football), crowd reactions may not provide umpires with useful information. This contrasts with sports like football, where the majority of the crowd is able to see when a foul or transgression has occurred against their team and react accordingly.

An alternative explanation for the lack of a home advantage could be any advantage has been eliminated as part of the increased professionalisation of officiating.[8] Every decision an umpire makes (in Australia at least) is scrutinised by a match referee, making umpires

Table 2
Regression table for four-day, one-day, and T20 matches.

Predictors	Four-day			One-day			T20		
	Odds ratios	*CI*	*p*	Odds ratios	*CI*	*p*	Odds ratios	*CI*	*p*
(Intercept)	0.01	0.00–0.01	**<0.001**	0.02	0.01–0.04	**<0.001**	0.01	0.00–0.03	**<0.001**
Batting team	1.77	0.90–3.65	0.106	2.22	0.79–7.12	0.145	8.09	1.41–152.16	0.052
Decision truth	5342.95	2399.07–13,458.94	**<0.001**	530.4	165.02–2174.20	**<0.001**	1192	175.53–25,470.44	**<0.001**
Batting team * decision truth	0.31	0.10–0.89	**0.032**	0.57	0.10–3.35	0.533	0.08	0.00–0.85	0.058
Observations	3981			646			344		
R^2 Tjur	0.907			0.756			0.699		

Significant results are highlighted in bold.

directly accountable for errors. This scrutiny may mean umpires are made aware of any home bias in their decision-making and could seek to eliminate it. Similarly, the overall tendency for umpires to favour the away team identified in this study could be due to umpires going too far in the opposite direction, to avoid contributing to home advantage. To determine whether professionalisation is the cause, we would need to compare decisions prior to the introduction of professional contracted umpires at the national level, however this data was not available. Similarly, the decline in home advantage identified by Sacheti et al.[4] could also result from increased professionalism. The authors attributed the decline to the introduction of neutral umpires, however the mandate for one neutral umpire coincided with the ICC's introduction of a professional International Panel of ICC Umpires in 1998, and the mandate for two neutral umpires coincided with the introduction of the Elite Panel of ICC Umpires in 2002. It is therefore plausible that their findings may not be purely related to umpire neutrality.

While it is clear much of the data in our study came from four-day matches, the pattern of results in the one-day and T20 matches does not provide any reason to believe the results would differ in those match formats. In particular, the results for the T20 matches, while not significant, were largely consistent with the overall pattern of findings. While more data on those shorter match formats is desirable and should become available in the future, we have no reason at this stage to believe the pattern of results differs markedly across the three formats.

It is also important to consider the assessments of the decisions by the match referees were subjective, and therefore, may not in all cases reflect the ground truth. Judgements made by the match referee were based on video footage of varying quality, and from a viewpoint that differed to the on-field umpire. This footage was typically from a higher position behind the bowler, rather than directly behind the stumps, which may impact the accuracy of match referee judgements.[14] Additionally, televised matches (i.e., T20) had higher quality footage for match referees to assess, and in some cases the match referee had post-match access to ball tracking analysis which predicted the flightpath of the ball. It is therefore possible judgements from the T20 matches are more accurate than those in longer form matches. With these caveats in mind, future explorations of cricket umpire decision-making could incorporate the ball-tracking software (e.g., hawk-eye) in all instances to ensure ratings of umpire performance are less subjective. It may also be prudent for future studies to explore whether the inclusion of technologies (e.g., ball tracking) impacts umpires' biases related to home advantage. For example future studies could attempt to replicate our findings in other competitions that incorporate technology-assisted decision reviews. Further, it may be beneficial to include data from professional matches in other countries and international games to determine whether these findings generalise to other competitions. It would also be beneficial for future studies to explore whether these findings generalise to women's professional cricket matches.

Another potential limitation of this study is that we did not control for the quality of the opposition or individual performance in our models. Previous studies have shown that higher calibre teams perform better at home (e.g., Liu et al.[15]), and that star players are penalised significantly less when playing at home.[16] As such, future studies could explore whether the quality of the opposition or individual performance impacts umpires' LBW decisions. Further, it may be possible that batters from the home team are only advantaged when the pitch is most difficult to bat on (i.e., when it has deteriorated) due to their personal knowledge of the playing surface. As such, future studies could include the changing condition of the pitch as a predictor of home advantage for LBW decisions.

5. Conclusion

This study aimed to determine whether elite cricket umpires favour the home team when making LBW decisions. We used extensive historical data from real matches, and found no evidence that umpires favour the home team. Instead, we found evidence that umpires in some instances favour the away team.

Funding information

The research was supported by a QUT Postgraduate Research Scholarship to the lead author.

Declaration of interest statement

None.

Confirmation of ethical compliance

The research was conducted under ethical approval from the Queensland University of Technology (Ref: 1800001056) and adhered to the University's ethical guidelines and the Declaration of Helsinki.

Acknowledgements

The research was supported by a QUT Postgraduate Research Scholarship to the lead author. The authors wish to thank Cricket Australia for providing the data for this study.

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