SCIENTIFIC JOURNAL OF SPORT AND PERFORMANCE

REVIEW ARTICLE

Home advantage and the influence of officiating decisions: A current review of the literature and strategies for reducing referee bias

Simcha Avugos . *School of Human Movement and Sport Sciences. Academic Center Levinsky-Wingate – Wingate Campus. Wingate Institute. Netanya, Israel.*

ABSTRACT

Even after decades of research, it is largely unclear how the various factors that cause the home advantage act and interact with one another. This paper provides an updated narrative review of the home advantage in sports, with a particular interest in the impact of refereeing. We used multiple sources for data collection and limited our search to peer-reviewed journals. Detailed information was extracted and documented from each of the retrieved articles. Bibliometric data were also calculated and assessed to evaluate the evolution of research in this field. The findings of this review show that home advantage is elevated in certain type of sports and due to properties of the crowd. In particular, the social pressure of the home crowds has direct and indirect effects on both home advantage and referee bias. Studies on games played in empty stadiums provided significant evidence for a reduced referee bias, and a decline in athlete-related variables. Several potential directions for future research emerged from this review. More research on the home advantage in women's sports, in individual sports, and at lower levels of play is warranted. These efforts will contribute to further extend our understanding of this fascinating phenomenon.

Keywords: Home advantage, Referee bias, Sport performance, Crowd effects, Officiating decisions.

Cite this article as:
Avugos, S. (2024). Home advantage and the influence of officiating decisions: A current review of the literature and strategies for reducing referee bias. *Scientific Journal of Sport and Performance*, *3*(2), 188-219. https://doi.org/10.55860/DUBO8273

Corresponding author. *School of Human Movement and Sport Sciences, Academic Center Levinsky-Wingate – Wingate Campus, Wingate Institute, Netanya 4290200, Israel.*
E-mail: avugos@gmail.com
Submitted for publication January 09, 2024.
Accepted for publication February 07, 2024.
Published March 03, 2024.
Scientific Journal of Sport and Performance. ISSN 2794-0586.

doi: https://doi.org/10.55860/DUBO8273

INTRODUCTION

Officials play an important role in most competitive sports. Over the past two decades, research on sports officiating has greatly increased, covering a range of aspects relating to the officials' development, training, and performance. Notably, an expanding body of research has focused on the judgment and decision making of sport officials (e.g. Helsen et al., 2019; Raab et al., 2020; Samuel et al., 2021), due to the potential impact of their decisions on match outcomes.

While officials are expected to avoid making erroneous decisions, it is inevitable that mistakes occur. Errors can arise from internal factors related to the competitors and the referees themselves, as well as external situational factors (Plessner & Haar, 2006). These sources of error include individual heuristics, limited information, contextual influences, emotional factors, time pressure, and cognitive load. Research has extensively addressed issues of visibility, such as referees' on-field positioning, and visual perceptions, such as attention and distracting cues, and how these factors contribute to referee errors (e.g. Hüttermann et al., 2018; Spitz et al., 2016). In some sports, being in an optimal position or being able to move to the best position is of the utmost importance when picking up on information about the actual situation (e.g. offside judgments in soccer; Oudejans et al., 2000).

Biased referee judgments could also stem from various factors, including the reputation, nationality, physical appearance, uniform colour, and stereotyping of athletes or teams (e.g. McCarrick et al., 2020; Price & Wolfers, 2010; Souchon et al., 2009; Stone et al., 1997). Other documented bias-based decisions were impacted by the current status of the match, with favouritism being shown towards the more successful team (e.g. Erikstad & Johansen, 2020; Lago-Peñas & Gómez-López, 2016). Even prior decisions made by referees could impact their subsequent decisions in a game – as they attempt to convey consistency in their enforcing of the rules and ensure the flow of the game (Unkelbach & Memmert, 2008).

This literature review focuses on a specific type of referee bias known as *home bias*, which is proved to be one of the main causes of the home advantage (HA). The HA is the consistent and robust phenomenon in sports whereby the home team or athlete wins more often (> 50%) than the visiting opponent when competing in their home ground (Courneya & Carron, 1992; Pollard, 1986, 2008)[1]. An early publication from one hundred years ago (Luehring, 1923) suggested that officials were biased towards the home team when officiating a match between basketball teams from the east and west of the United States. The pioneering paper by Schwartz & Barsky (1977) further confirmed the existence of HA in organized sports, attributing it to factors such as travel, familiarity with the playing field, and the presence of home fans. Subsequent studies across various sports and a recently published book by Gómez-Ruano et al. (2021) have provided extensive evidence on the HA effect, exploring its causes and impact on performance.

This study offers a useful summary of a research area that has recently received increasing attention, in light of the COVID-19 pandemic that rendered numerous sport events to take place behind closed doors (e.g. Alonso et al., 2022; Bryson et al., 2021; Endrich & Gesche, 2020; Fischer & Haucap, 2021; Gong, 2022; Sors et al., 2023). Expanding on recent reviews (Dohmen & Sauermann, 2016: biased behaviour of sports referees; Leitner et al., 2022: the HA in soccer during ghost games in the 2020-2021 season; also see the Introduction by Reade et al., 2022), this paper further refines and extends that existing knowledge in a number of ways. First, this review provides an extensive and updated overview of the literature on the HA in general,

[1] Home advantage should not be confused with home performance. In order to be of relevance to HA, home performance has to be compared with away performance.

and about referee bias in particular, spanning almost five decades of research (1977-2022) and a range of sports. As such, the study addresses the still-emerging literature stream regarding the impact of empty stadiums on refereeing decisions during the COVID pandemic, pulling all scientific published papers throughout the entire period. In addition, it incorporates concise bibliometric information to trace the evolution of research in this field and its resulting outputs. Second, this review draws the attention to the perspectives of key stakeholders involved in this phenomenon, an aspect largely overlooked in existing literature, which may affect the formation and degree of the HA. Third, drawing upon the classical conceptual framework initially introduced by Courneya and Carron (1992), and later refined by Pollard (2008), the study proposes a modified version of the HA model that accounts for both the direct and indirect effects of the crowd through its influence on sports officials (see Figure 2). Finally, the study discusses strategies for reducing referee bias to improve the quality of decisions and outlines possible paths for future research.

METHODS

Approach to secondary research

Previous reviews on the HA used a rigorous and systematic methodology, mainly aiming to minimize reviewer bias. However, recent critiques have challenged the traditional hierarchy, questioning the superiority of systematic reviews over unsystematic or narrative reviews (e.g. Collins & Fauser, 2005; Greenhalgh, 2012; Greenhalgh et al., 2018). Calls have been made to strike a balance between these two typical review types, leveraging the strengths of each approach.

In line with these contemporary perspectives, this study applied a narrative synthesis approach to consolidate previously published information. Since no strict published guidelines prescribe precisely what should or should not be included in a quality narrative overview, we have followed recommendations that are generally acceptable in many journals (e.g., Green et al., 2006).

Data sources and search strategy

We searched the databases Web of Science (WOS), SPORT Discus, and Google Scholar using the key terms *home advantage* and *referee bias*. These databases are widely recognized as comprehensive bibliographic data sources in the social sciences and sports. In order to ensure inclusiveness, we considered various denominations of the HA construct, such as home field, home court, home team, home ground, and home site advantage. These terms were combined with specific queries related to sports, including team sports, sport performance, performance analysis, and decision making. The search was conducted within the title, abstract, and keywords of the articles indexed. We collected studies available in these databases up until October 2022, which served as the cutoff date for data retrieval for this review. References lists of the obtained articles were searched by hand.

Eligibility criteria

For this review, we exclusively included original studies published in peer-reviewed journals due to their adherence to scientific rigor and credibility standards. We excluded articles with incomplete full-text availability, those not written in English, and those classified as grey literature. Dissertations were also excluded from consideration, as many of them are subsequently published in journals. Additionally, we removed studies that were not relevant to the focused purpose of the present study (e.g. Fuxjager et al., 2009: winner effects and hormone changes).

After several rounds of manual screening and duplicate checks, a total of 426 articles were deemed suitable for review. Most of these articles involved empirical investigations of the phenomenon, while a few were

purely descriptive. To ensure consistency, the same reviewer (the author of this article) re-evaluated the selected articles a few weeks later, establishing intra-rater reliability.

Clearly, not all articles could be cited due to their sheer quantity. However, to ensure citation breadth, we have cited a comprehensive range of literature (158 items), and the studies cited are representative of those available.

Data extraction

We read through each of the retrieved articles and noted down their basic information (year, authorship, journal) and the following specific details pertaining to their properties: study's objectives, research design or methods employed, type of sport (individual vs. team sport), specific sport, analysed league(s), level of competition (e.g. professional, collegiate), analysed factors (e.g. win ratio, goals, fouls, cards), statistics used, and key findings and conclusions. We used Excel spreadsheets to collect the data extracted from each paper reviewed.

RESULTS

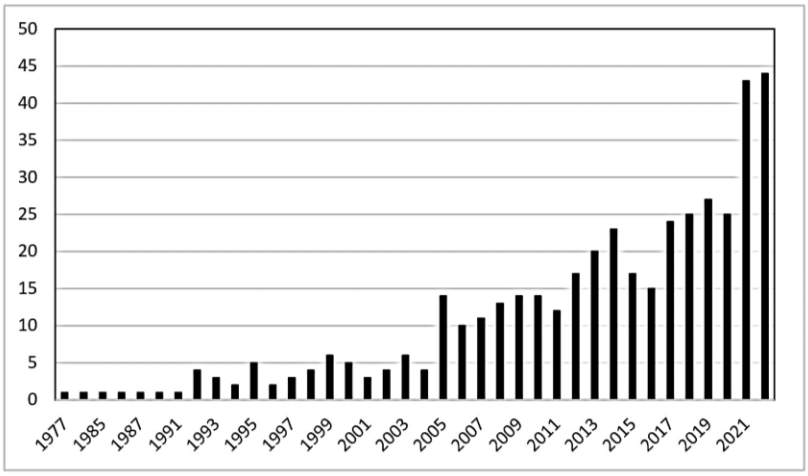
Our dataset shows that studies have been conducted in 16 different team sports and about twice that number of individual sports, including the Olympic summer and winter sports. Several studies used data from multiple sports (e.g. Gómez et al., 2011; Pollard, 2002). Notably, soccer emerged as one of the most extensively researched sports, accounting for about 50% of the studies, likely attributed to the popularity of men's soccer globally. In contrast, only 18 studies in our dataset examined the HA in women's sports, some of which compared women's and men's leagues.

Our review develops as follows: we start with the description of some bibliometric data. Then, we review the literature on the HA in competitive sports and its causes. Finally, we present the research findings on the crowd effects and referee bias.

Bibliometric characteristics

Our final dataset comprised 426 papers authored by 207 researchers, affiliated with 206 institutions, and from 49 countries/regions. The countries of the corresponding authors with the highest number of articles were the United States (107), England (89), Spain (63), Australia (41), and Germany (34). Brazil, Canada, and Portugal follow these countries with over 20 publications each. Of these 426 papers, 16 were published during 1977-1994, 25 during 1995-2000, 93 during 2001-2010, and 205 during 2011-2020. In addition, 87 articles were published or assigned to an issue during 2021-2022, mainly on matches held without spectators following the outbreak of the COVID-19 pandemic in early 2020.

The distribution of publications by year is displayed in Figure 1, and it reflects the evolution of production in this field over the past 46 years (Prieto, 2021). The graph shows the growing interest in HA research, especially since 2005. In April 2005, the *Journal of Sports Sciences* published a special issue on the HA, featuring articles from leading authors in the field. Since then, several reviews and meta-analyses have contributed to the literature (e.g. Jamieson, 2010; Pollard, 2006, 2008). A considerably small number of articles were published prior to 1995, with the following distribution: two in 1994, three in 1993, four in 1992, one in 1991, one in 1990, one in 1987, one in 1986, one in 1985, one in 1983, and one in 1977.



Note: Records for the year 2022 are up until October, when this review was conducted.

Figure 1. Distribution of home advantage publications by year.

The 426 articles were published in 129 different journals. The top five most active journals in HA research include the *Journal of Sports Sciences* (43 published articles; IF=3.943)[2], *International Journal of Performance Analysis in Sport* (40; IF=2.488), *Journal of Sports Economics* (25; IF=1.848), *Perceptual and Motor Skills* (25; IF=2.212), and *Psychology of Sport and Exercise* (15; IF=5.118), having published 34.7% of the total number of articles in the current analysis. Among the authors, the five most productive authors include Gómez (28 articles), Pollard (25), Nevill (15), Lago-Peñas (12), and Sampaio (11). In terms of citation impact, the five most cited papers throughout the analysed period include Courneya and Carron (1992), Nevill et al. (2002), Nevill and Holder (1999), Lago-Peñas and Martín (2007), and Pollard (1986). These papers have received an average number of annual citations of 10.16, 13.95, 9.5, 14, and 5.84, respectively. The research areas in the HA field include sport sciences, social sciences, psychology, and business economics – which indicate a multidisciplinary approach to the study of the HA phenomena.

Evidence for HA in competitive sports

The vast majority of team sports follow a league format where teams meet twice, both at home and away. Unlike team sports, most events in individual sports are organized as tournaments, at fixed locations. This setup creates difficulties in comparing the performance of an athlete at home with performance under similar conditions away. Typically, home players belong to the country hosting the tournament, while the rest are considered away players. However, complexities arise when athletes change nationalities, further complicating the assessment. As a consequence, estimates of HA in individual sports are more involved and by far less researched compared to team sports.

The HA has been examined in various outdoor and indoor team sports, including American football, soccer, baseball, basketball, handball, volleyball, futsal, hockey, rugby, cricket, and water polo (e.g. Carron et al., 2005; Nevill & Holder, 1999; for sport-specific HA studies, see Gómez-Ruano et al., 2021), as well as the Summer and Winter Olympic sports (Balmer et al., 2001, 2003). While HA has consistently been found to impact points and goals (e.g. Ribeiro et al., 2016; Sors et al., 2021), it has also been observed in other performance-related variables, including ball possession, passes, tackles, distance covered, shooting attempts, and corner kicks (e.g. Lago-Peñas & Martín, 2007; Lago-Peñas et al., 2017). A recent study that

[2]*IF: 2021-2022 Journal Citation Reports (JCR) Impact Factor.*

compared the magnitude of the HA in a range of sports, for both genders and across countries, found evidence of this effect in all sports examined, yet with a greater effect observed in men's leagues than in women's (Pollard et al., 2017). Evidence from other studies suggest that HA tends to play a much smaller role in individual sports, such as golf, tennis, and boxing (Jones, 2013) and in one-on-one situations in team sports (e.g. ice-hockey shootouts) – with the exception of subjectively rated sports (e.g. diving, gymnastics, and figure skating; Balmer et al., 2003).

A meta-analysis by Jamieson (2010) examined the impact of several moderator variables on HA in 10 different sports. The analysis revealed a significant HA effect in all sports, however the magnitude of the effect varied depending on *era* (with greater HA observed before 1950), *season length* (with sports featuring over 100 games per season exhibiting a lower HA), *game type* (with high-pressure championships and playoff games showing a stronger HA effect), and *the sport itself* (with soccer demonstrating higher HA values and baseball showing lower HA values). Similar patterns were observed in an analysis of data from nine different professional team sports in Spain, further supporting the aforementioned findings (Gómez et al, 2011). However, rugby displayed the highest HA (67%), possibly due to the aggressive and intense nature of the sport.

In general, research shows that the home team or competitor wins about 60% of their contests, regardless of the level of competition (i.e. amateur, professional, or elite). For specific sports, home winning percentages were found to be about 55% for American Major League Baseball, 55-60% for ice hockey and American football, 60-65% for basketball and handball, and 60-70% for soccer (Carron et al., 2005; Pollard & Pollard, 2005). These figured indicate substantial differences in the odds.

The literature mostly examines the HA at the club level. Yet several studies have identified a highly significant and robust HA effect at the international level, such as World Cup matches and the Olympic games, with hosting nations achieving a higher number of wins or medals (Franchini & Takito, 2016). Variations in HA across different nations have been attributed to cultural and social characteristics (Gelade, 2015). For example, a particularly high HA has been identified within the Balkans, Andean nations of South America (such as Bolivia and Ecuador), and certain African countries (notably Nigeria, with an HA of almost 87%). This was also seen in games played by soccer teams from Corsica and Sicily – two ethnically distinct and isolated locations within their respective countries (Pollard, 2006; Pollard et al., 2017). Moreover, HA was significantly higher for teams playing in cities with a large ethnically distinct population and/or in geographically distinct parts of the country – in countries such as Bulgaria, Albania, Bosnia, Serbia, Turkey, and Greece (Armatas & Pollard, 2014). Differences in HA were also found in the Brazilian soccer league for teams playing in more isolated regions of the country. Finally, HA has also been associated with the city level, with a greater effect observed for teams playing in non-capital cities.

One possible explanation suggests that HA tends to be more prominent in countries characterized by high levels of collectivism and in-group favouritism. It is also higher in countries where the officials' integrity, such as the referees' normative values, and their adherence to rules and laws, including attitudes toward violence or corruption, are relatively low (Gelade, 2015; Sánchez & García-de-Alcaraz, 2021). Such explanation is consistent with the concept of HA as a social phenomenon, influenced by both the impact of the crowd on match officials and the sense of territoriality among players inhabiting these regions. It is plausible that such territoriality could be particularly pronounced in areas experiencing armed conflicts.

Causes of HA

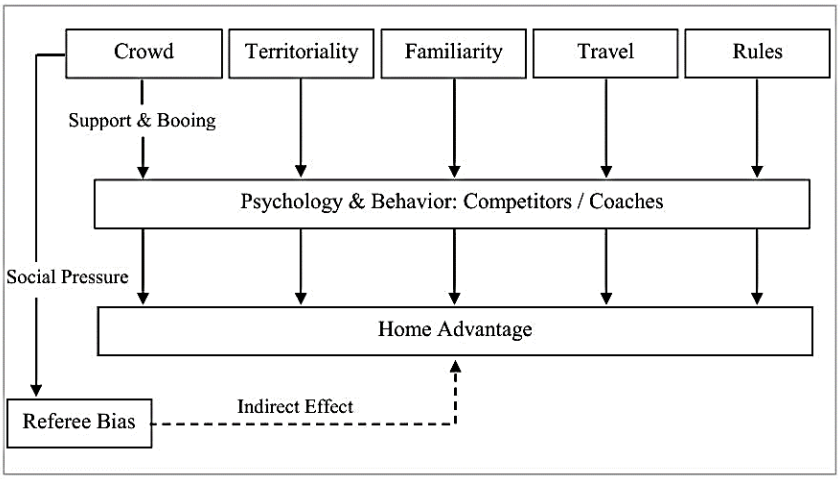
Even after decades of research, the exact causes of HA are still debated. The literature points to six main factors, which can act independently or interact with one another: (1) crowd effects (e.g. Salminen, 1993); (2) the adverse effects of travel, including fatigue, changes in time zones or climate (e.g. Pace & Carron, 1992); (3) territoriality, i.e. a feeling of ownership, and the territorial protective response to the invasion of rivals – as part of the social bonding when competing at home (Neave & Wolfson, 2003); (4) familiarity with the local facility, such as the stadium architecture (Pollard, 2002) or playing surfaces (van Ours, 2019); (5) rules of the sport that directly or indirectly favour the home team or athlete (relevant in a limited number of sports; e.g. the advantage of batting last in baseball; Courneya & Carron, 1990); and (6) referee bias, including disciplinary sanctions used and points decisions (e.g. Balmer et al., 2005; Dohmen & Sauermann, 2016). HA can also be the result of different tactics and playing styles, such as teams who display more effective offensive actions (rather than defensive ones), quicker attacks, and more collective tactical behaviour among the home players (Staufenbiel et al., 2015).

The HA is commonly explained through three main frameworks, each outlining factors that impact the psychological, behavioural, and physiological states of the athletes, coaches, and officials (Carron et al., 2005; Courneya & Carron, 1992; Dosseville et al., 2016; Pollard, 2008; for a review see Allen & Jones, 2014). These changes, in turn, impact performance outcomes. Courneya and Carron (1992) were the first to introduce a conceptual HA model, drawing upon theories from several fields, including biology (e.g. territoriality of local players with increased testosterone levels), psychology (e.g. the impact of arousal and anxiety on both local and visiting players), cognition (e.g. increased assertiveness among local players), and sociology (e.g. social support for local players' behaviour). A later revision of this model removed the term *officials*, as they were deemed to lack a home or away status (Carron et al., 2005).

The possible sources of HA differ across competitions and teams. Specifically, travel factors are not so relevant in most individual sports due to tournaments being held in fixed locations. In addition, familiarity with local conditions may be helpful in some specific cases than in other cases, such as a tennis player's familiarity with a particular playing surface. Rule-related advantages may also apply selectively, for example, seeding an athlete in the schedule. As for crowd noise or crowd support for athletes, although it may influence referees in many individual sports, as it happens in team sports, this is not the case in all sports. For example, golf audiences usually stand along the fairways of the holes, and typically applaud good strokes by both the home and visiting competitors. In addition, golf players are trusted to act fairly according to the rules, with the referees mainly having a consulting role in case of disagreement over a rules issue between players. One additional source of HA relevant to just individual sports is that, in some cases, home athletes may have better access to participation in tournaments than away athletes, on the basis of wild cards given to them by the tournament organization (Koning, 2011). These athletes from the home country have the opportunity to enter the competition although being not qualified to participate in the usual way.

As for team sports, since most sports use a league format in their competitions, travel effects (e.g. travel fatigue, sleep loss, or jet lag) are negligible when match site is a short distance away and within the same time zone (Courneya, & Carron, 1991). Some studies examining the effect of traveling across time zones did identify significant fluctuation in HA (e.g. Jehue et al., 1993). Overall, travel factors are not thought to be a major cause of the HA. In several sports, rule advantages and familiarity have been shown to be insignificant factors (Nevill & Holder, 1999), however not when teams have had to relocate to a new stadium (Pollard, 2002). In contrast, the evidence from studies investigating crowd factors appeared to provide the most dominant causes of HA. Two possible mechanisms were proposed to explain these observations. We will discuss the crowd effects, and the related referee bias, in more detail later.

Research on several team sports (e.g. Gómez et al., 2016; Yi et al., 2020) shows that match location (home/away) interacts with several other situational variables, such as the type of competition (e.g. regular season vs. knockout stage, playoffs, first leg vs. second leg), match status (i.e. the score-line: win/lose/draw, margins in the score), match period (e.g. first half vs. second half, set number), and quality of opposition (e.g. weak team vs. strong team). Other contextually influencing factors include match day, daytime, points earned in last matches, and the time elapsed since last match (Fischer & Haucap, 2021). Although these factors do not solely constitute the HA, they may add to its degree. Thus, investigating the complex interplay of causes of HA requires either a multivariate approach or careful control for possible confounding variables that are not among the main likely causes of the phenomenon, such as game importance or number of prior games played (Pollard, 2008).



Note: The model represents a modified version of Courneya and Carron's (1992) model, taking into account both the direct and indirect effects of the crowd on the home advantage and sports officials.

Figure 2. Conceptual framework of the home advantage and referee bias.

Dosseville et al. (2016) recently proposed a new HA framework that directly integrates the impact of sports officials, not solely thorough the influence of the crowd, but through four additional dimensions. These include *game situation*, which relates to factors that influence current decision making (e.g. the sport official's emotional state; Laborde et al., 2013); *expectations* that sports officials may develop towards teams (e.g. rank or reputation), crowd reaction (e.g. excited derbies or high match stakes), and the stadium (e.g. artificial playing field or the structural design of the stadium); *individual factors*, including individual differences in the official's personality, coping strategies, and emotional intelligence (Poolton et al., 2011), as well as differences in communications, social interactions, and player management (Avugos et al., 2021) – all of which could influence decision making processes and may have practical consequences; and *external pressures* that stem from ethical, cultural, and economic factors that should be considered when addressing the HA (e.g. a cultural closeness between the referee and the athlete or team, with regard to region or language; Torgler, 2004).

At the methodological level, the magnitude of HA in team sports has been quantified and compared in different sports, between teams or leagues, and over different time periods – at domestic or international level competitions. Studies commonly used simple outcome measures such as home winning percentage (calculated as the number of homes wins out of the number of total wins both at home and away), or in some sports the team's score difference (e.g. Courneya & Carron, 1992; Pollard & Pollard, 2005), known as the

Pollard method. For winning percentage, specific adjustments are needed for certain team sports, where games may end without a winner (e.g. soccer), and calculations may be based on the proportion of points won at home (Pollard, 1986).

Basic methods for quantifying HA (e.g. paired comparisons; Goumas, 2014) have been criticized for not addressing differences between the competing teams in a league or the situational variables that might affect the magnitude of the advantage, such as crowd size, venue size, and travel distance. Specifically, it is more likely for better quality teams to win games both at home and away, regardless of any home bias, as was found, for example, in the analysis of data from the English soccer league (Allen & Jones, 2014). To identify the true effect of HA, some studies have used different regression models that take into consideration various predictor variables (e.g. Armatas & Pollard, 2014).

In individual sports, estimates of HA are usually obtained through the analysis of either the relative performance (the probability that athlete *A* wins against athlete *B*; boxing: Balmer et al., 2005; tennis: Koning, 2011; judo: Krumer, 2017), absolute performance (e.g. finish time; skeleton: Chun & Park, 2021; biathlon: Harb-Wu & Krumer, 2019; speed skating: Koning, 2005), or medals won at the country level (e.g. combat sports; Franchini & Takito, 2016).

HA and referee bias: The crowd effect

As stated earlier, crowd factors appear to provide the most dominant causes of HA. However, there has been conflicting evidence as to how important crowd support is in contributing to HA. The crowd effect has been investigated in relation to noise (e.g. calm vs. pressing), size (attendance), density (percentage of ground capacity), and composition of the crowd (i.e. the balance between home and away supporters). For example, increased crowd noise due to the stadium architecture was found to be associated with greater HA effect in baseball and American football (Romanowich, 2012; Zeller & Jurkovac, 1989). Early studies investigated the impact of both crowd size and crowd density, yet only found evidence for either the impact of size (e.g. Pollard, 1986) or crowd density (e.g. Agnew & Carron, 1994), or that no such impact existed at all. However, according to a more recent study by Goumas (2014), it is crowd density that determines the HA and referee bias.

Boyko et al. (2007) found that crowd size (but not crowd density) and referee affected goal differential in the English Premier League, by affecting both home scoring and away scoring. It was also shown that larger crowds reduced the number of yellow and red cards given to the home team, and that crowd density negatively correlated with the number of away penalties. Conflicting evidence also exists regarding the impact of crowd composition on the results. The composition of the crowd is assumed to be influenced by the distance travelled by the visiting team, whereby the closer the home and away stadiums, the more likely the supporters of the away team are to travel to see their team play (Fontenla & Izón, 2018; Garicano et al., 2005).

Laboratory studies (e.g. Balmer et al., 2007; Nevill et al. 2002), as well as archival data (e.g. Balmer et al., 2001), were used to advance this line of research. It has even become possible to study the crowd effect in real-world settings, when teams have had to play home matches in empty stadiums – prior to the COVID crisis. For example, in the 2006-2007 season, tight safety regulations forced some teams in the Italian soccer league to play without spectators. Data on fouls, yellow cards, and red cards collected from 21 games played without spectators (out of 842 games that season) revealed a large and significant HA effect, whereby home teams were favoured in games *with spectators* compared to games *without spectators*, and whereby visiting teams were punished 20%-70% more harshly when crowds were present in the stadium (Pettersson-Lidbom

& Priks, 2010). However, player's performance (e.g. number of shots on target or number of tackles) does not seem to be affected by the presence or lack of spectators during games, for both home and away teams.

Further analysis of the same Italian league series of games showed that home crowd support is not a necessary precondition for HA, as the home team still had an advantage in games where no audience was present. Furthermore, in some same-stadium derbies (games played between 2 teams that share a stadium; e.g. AC Milan vs. Internazionale in soccer), the home team always has more crowd support (mainly thanks to season ticket holders; van de Ven, 2011), but in these games no HA existed. Sharing the same stadium by both teams from the same city cancels out the effect of travel fatigue and familiarity with the stadium. Yet when the study was replicated using twice the number of same-stadium derbies (128 observations), HA was seen, thereby suggesting that crowd noise does have an effect (Ponzo & Scoppa, 2018). Together, the current data show that crowd support contributes to the HA, but HA may still occur where no crowd is present. The phenomena might thus be much broader than assumed so far.

The global COVID-19 pandemic provided a semi-natural experiment to comprehensively test the effect of crowds on both referees and players. This has been possible due to a series of lockdowns and social distancing limitations that forced professional leagues around the world to play in empty stadiums (also known as "*ghost games*"). A literature review published by Leitner et al. (2022), when the pandemic was still raging, examined 20 peer-reviewed articles (out of 26) that were published up until April 2021 on soccer games without crowds. These studies vary in scope – ranging from an analysis of matches played in individual league or between leagues within the same country (e.g. Endrich & Gesche, 2020), to a number of leagues across countries (e.g. Benz & Lopez, 2021; Bryson et al., 2021). Almost all studies focused on European Leagues.

We extended Leitner et al.'s analysis to include an updated search, which yielded 61 peer-reviewed articles (5 in 2020; 28 in 2021; and 28 in 2022). The rich dataset contains studies in various team sports, including soccer (44), basketball (10), baseball (4), American football (2), rugby (3), and hockey (4), and involves teams with a range of abilities (see Table 1). The top four countries in the UEFA ranking (England, Germany, Italy, and Spain) stand out in the data, however data were also collected from North American leagues, Brazil, and Australia. The studies compared the HA, performance, and disciplinary aspects with or without crowds, and in few cases with partial attendance (games played with socially distanced fans under COVID-19 protocols; e.g. Ehrlich & Potter, 2023).

We found that most analysis has focused on the differences in wins, points, and goals scored for the home and away teams pre- and post-pandemic. However, other within-game performance indicators were also examined (e.g. Almeida & Leite, 2021; Bustamante-Sánchez et al., 2022; Link & Anzer, 2022), including team activity (e.g. running distance, number of sprints) and team performances (e.g. number of goal shots, corner kicks). About half of the studies on games played in empty stadiums (n=33) involve the analysis of referee's decisions regarding the number of warnings issued (e.g. fouls, penalties, yellow cards), send-offs (red cards), and extra time decisions. This proportion of referee-bias research is also observed in our overall dataset. Among the possible covariates examined by about third of the studies are players' experience, referee age and experience, team quality/strength, travel distance, days of rest before the match, altitude, daily weather, and stadium running track.

While the general trend seen in the data indicates slightly reduced HA during ghost games (yet with large differences between countries and competitions), more pronounced differences were seen in referee-related variables. For example, an analysis of 841 matches played by different national soccer leagues behind closed

doors showed a slight decrease in the percentage of points and number of home victories, yet not for ball possession and corner kicks – and the absence of referee bias in terms of fouls, disciplinary cards, penalties, and recovery time given at the end of normal time (Sors et al., 2021). It seems that a certain degree of HA still exists even without spectators, due to the influence of other factors such as travel fatigue, familiarity with the pitch, and pre-match routines.

Table 1. Peer-reviewed studies on HA during the COVID-19 pandemic, by date.

No.	Year	Month	Author(s)	Sport	Data source/ Leagues/ Competition	Analysed factors (& possible covariates)
1	2020	Oct	Sánchez & Lavín	Soccer	Austria, England, Germany, Italy, Spain	Win ratio; Points; Goals; Budget; Stadium; Number of foreigners; Players' experience; Table position; Average attendance; Cards
2	2020	Nov	Tilp & Thaller	Soccer	Germany	Win ratio; Points; Goals; Table position; Fouls; Cards; Penalty kicks
3	2020	Nov	Sors et al.	Soccer	England, Germany, Italy, Spain	Win ratio; Points (Team strength); Goals; Ball possession; Shots; Shots on target; Corner kicks; Fouls; Cards; Penalty kicks; Extra time
4	2020	Dec	McHill & Chinoy	Basketball	NBA	Win ratio; Points; Shooting accuracy; Turnovers; Rebounds; Travel distance
5	2020	Dec	Endrich & Gesche	Soccer	Germany	Fouls; Yellow cards
6	2021	Jan	Bryson et al.	Soccer	Albania, Australia, Austria, Costa Rica, Denmark, England, Germany, Greece, Hungary, Italy, Poland, Portugal, Romania, Serbia, Slovenia, Spain, Ukraine	Win ratio; Goals; Cards
7	2021	Jan	Scoppa	Soccer	England, Germany, Italy, Portugal, Spain	Points (Team quality); Goals; Shots; Shots on target; Corner kicks; Days of rest before the match; Fouls; Cards; Penalty kicks
8	2021	Feb	Hegarty	Soccer	England, Germany, Italy, Spain; Asian Handicap market	Win ratio; Goals; Betting market pricing
9	2021	Feb	Winkelmann et al.	Soccer	Germany; Betting odds	Win ratio; Goals; Betting market pricing
10	2021	Mar	Santana et al.	Soccer	Germany	Win ratio; Goals; Goal attempts; Ball possession; Passes; Passes accuracy; Tackles; Corner kicks; Team distance covered; Sprints; Fouls; Offside
11	2021	Mar	Wunderlich et al.	Soccer	England, Germany, Italy, Portugal, Spain, Turkey	Points; Expected points; Goals; Shots; Shots on target; Betting odds; Fouls; Cards
12	2021	Mar	Almeida & Leite	Soccer	England, Germany, Italy, Portugal, Spain	Points; Goals; Shots; Shots on target; Ball possession; Passes; Aerial duels; Tackles; Cards
13	2021	Apr	Matos et al.	Soccer	Portugal	Points
14	2021	Apr	Hill & Van Yperen	Soccer	England, Germany, Italy, Spain	Points; Goals; Shots; Ball possession; Fouls; Cards
15	2021	May	Zimmer et al.	Baseball	MLB	Win ratio; Extra innings; Runs per game; Daytime
16	2021	Jun	Ferraresi & Gucciardi	Soccer	England, France, Germany, Italy, Spain	Scored and unscored penalties; Attendance

17	2021	Jun	Correia-Oliveira & Andrade-Souza	Soccer	England, Germany, Italy, Spain	Win ratio; Points; Goals; Team quality
18	2021	Jul	Fischer & Haucap	Soccer	Germany	Win ratio; Points; Shots; Corner kicks; Player market value; Table position; Rest pause from last match; Points earned in last three matches; Travel distance; Altitude; New coach; Derby; Matchday; Daytime; Stadium running track; Share standing places; Stadium capacity; Fouls; Yellow cards
19	2021	Jul	Higgs & Stavness	American Football, Baseball, Basketball, Hockey	NFL, MLB, NBA, NHL	Points
20	2021	Jul	Benz & Lopez	Soccer	Austria, Denmark, England, Germany, Greece, Italy, Norway, Portugal, Russia, Spain, Sweden, Switzerland, Turkey	Goals; Yellow cards
21	2021	Aug	Link & Anzer	Soccer	Germany	Win ratio; Goals; Expected Goals; Shots; Ball possession; Passes; Outplayed opponents; Pressure; Duels; Running activity; Contact times; Fouls; Yellow cards
22	2021	Aug	Leitner & Richlan	Soccer	Austria, Czech Republic, England, Germany, Italy, Russia, Spain, Turkey	Win ratio; Fouls; Yellow cards
23	2021	Aug	Guérette et al.	Hockey	NHL, Canadian Hockey League	Penalties
24	2021	Aug	Rovetta & Abate	Soccer	Italy	Points; Passes; Fouls; Cards; Penalty kicks
25	2021	Aug	Meier et al.	Soccer	England, Germany, Italy, Spain; Betting odds	Winning probability; Betting market pricing
26	2021	Aug	Losak & Sabel	Baseball	MLB; Betting odds	Win ratio; Batting order in the inning; Number of prior games played; Travel fatigue; Team ability; Betting market pricing
27	2021	Aug	Ramchandani & Millar	Soccer	England, Germany, Italy, Portugal, Spain	Win ratio; Points
28	2021	Sep	McCarrick et al.	Soccer	Austria, Denmark, England, Germany, Greece, Italy, Portugal, Russia, Spain, Switzerland, Turkey	Points; Goals; Shots; Shots on target; Corner kicks; Team dominance; Fouls; Yellow cards
29	2021	Oct	Sedeaud et al.	Soccer, Rugby	Belgium, England, France, Germany, Greece, Italy, Portugal, Scotland, Spain, Turkey, Celtic League	Win ratio
30	2021	Nov	Bilalić et al.	Soccer	Austria, England, Germany, Greece, Italy, Portugal, Spain, Turkey	Points; Goals; Shots; Shots on target; Corner kicks; Fouls; Cards
31	2021	Dec	Ungureanu at el.	Rugby	England, France, South Africa, New Zealand	Win ratio; Points, Substitution; Scored try; Penalty try; Missed penalty; Kick at goal; Cards
32	2021	Dec	Reade et al.	Soccer	France, Italy, European cup competitions	Win ratio; Goals; Attendance; Cards; Penalty kicks

33	2021	Dec	Arboix-Alió et al.	Rink Hockey	Italy, Portugal, Spain	Points, Goals; Set-pieces shots; Table position; Fouls; Blue and red cards
34	2022	Jan	Ghahfarokhi et al.	Soccer	England, France, Germany, Italy, Spain	Points; Goals scored; Goals conceded
35	2022	Jan	Gong	Basketball	NBA	Foul call; Player all-star status; Player nationality; Seconds left in the match; Nationally televised game; Point spread; Score differential; Referee age; Referee experience
36	2022	Jan	Vandoni et al.	Soccer	Italy	Points; Fouls, Cards; Penalty kicks
37	2022	Feb	Ribeiro et al.	Soccer	Brazil	Win ratio; Points; Goals scored; Goals conceded
38	2022	Feb	Alonso et al.	Basketball	Germany, Greece, Israel, Italy, Spain	Win ratio; Team ability (seasonal winning percentage)
39	2022	Mar	Fischer & Haucap	Soccer	Germany; Betting odds	Win ratio; Points; Shots; Corner kicks; Table position; Player market value; Betting market pricing; Fouls; Yellow cards
40	2022	Mar	Sors et al.	Soccer	UEFA Nations League	Win ratio; Points; Goals; Shots; Shots on goal, Ball possession; Corner kicks; Attendance; Fouls; Cards; Penalty kicks; Extra time
41	2022	Mar	Lee et al.	Soccer	England, Germany, Italy, Spain; Match estimated home advantage model	Expected score; Goal difference
42	2022	Apr	Macedo-Rego	Soccer	Brazil	Win ratio; Goals; Points; Scoring the first goal; Team strength; Crowd size
43	2022	Apr	Jiang et al.	Soccer	China	Win ratio; Shots; Shots not on target; Touches; Passes; Corner kicks; Aerial duels; Offside; Dribbles; Take on; Interception; Tackles; Crosses; Match location; Foul; Cards
44	2022	Apr	Ehrlich & Potter	Basketball	NBA	Points; Team strength; Team-specific fatigue; Travel distance; Win shares of missing players; Days rest since last game; Attendance; Free throw attempts; Personal fouls
45	2022	Apr	Morita & Araki	Soccer	Japan	Fouls; Yellow cards
46	2022	Apr	Bustamante-Sánchez et al.	Basketball	NBA	Points; Field goals; Rebounds; Assists; Transitions; Cuts; Pick-and-roll; Pick-and-pop; Fouls
47	2022	May	Szabó	Basketball, American Football, Hockey	NBA, NFL, NHL	Win ratio; Points; Attendance; Penalty kicks
48	2022	May	Fazackerley et al.	Rugby	NRL - Australia and New Zealand	Decoys; Post-contact meters; Support runs; Tackle breaks; Missed tackles; Total distance; High-speed running
49	2022	May	Cross & Uhrig	Soccer	England, Germany, Italy, Spain	Win ratio; Goals; Expected goals; Stadium distance; Daily weather
50	2022	May	Chiu & Chang	Baseball	MLB	Win ratio; Wins above replacement
51	2022	May	Destefanis et al.	Soccer	England, France, Germany, Italy, Spain	Points; Goals scored; Goals conceded; Shots; Ball possession; Dribbles; Through balls; Cross; Tackles; Attendance; Penalties attempted; Penalties converted
52	2022	Jun	Couto & Sayers	Soccer	Brazil	Win ratio; Points; Goals; Cards; Extra time

53	2022	Jul	Chen et al.	Soccer	China	Total distance; Sprint distance/efforts; High-speed running distance/efforts; High-intensity running distance/efforts; Ball possession; Shots; Shots accuracy; Passes; Cross; Ground duel/won; Air duel/won; Tackles/won; Corner kicks; Table position; Fouls; Offside
54	2022	Aug	Steinfeldt et al.	Basketball	NBA	Points; Matchday; Batting odds; Attendance
55	2022	Aug	Silva et al.	Soccer	Brazil	Win ratio; Points; Goals; Corner kicks; Shots; Ball possession; Absent athletes; Fouls; Cards
56	2022	Aug	Krumer & Smith	Soccer (Women)	Sweden	Win ratio; Points; Goals; Betting odds; Cards
57	2022	Sep	Nomura	Soccer	Japan	Points; Goals; Goal shots; Corner kicks; Running distance; Sprints; Attendance; Cards
58	2022	Sep	Paulauskas et al.	Basketball	Euroleague Basketball	Win ratio; Points; Free throws attempted; Free throws made; Turnovers; Three-point shots attempted; Three-point shots made; Two-point shots made; Ball possession; Offensive rebounds; Blocks; Steals; Fouls; Technical fouls
59	2022	Sep	De Angelis & Reade	Basketball	Adriatic League (Bosnia and Herzegovina, Croatia, Montenegro, North Macedonia, Serbia, Slovenia), France, Germany, Greece, Israel, Italy, Lithuania, Russia, Spain, Turkey; Betting odds	Win ratio; Betting market pricing
60	2022	Oct	Piancastelli et al.	Soccer	England	Goals
61	2022	Oct	Ferraresi & Gucciardi	Soccer	England, France, Germany, Italy, Spain	Points; Teams' international experience; Quality of opponents (Quota paid by bookmakers); Attendance

Note. The publication date of items no. 3, 21, 27, 32, 33, 40, 44, 45, 49, 52, 56, 59, 60 and 61 represents an early, pre-print online publication date; Items no. 8, 9, 25, 26, 39, and 59 investigated the betting market efficiency in light of the transition to playing games behind closed doors; The list of domestic leagues analysed (in alphabetical order): Albania, Australia, Austria, Belgium, Bosnia and Herzegovina, Brazil, Canada, China, Costa Rica, Croatia, Czech Republic, Denmark, England, France, Germany, Greece, Hungary, Ireland, Israel, Italy, Japan, Lithuania, Montenegro, New Zealand, North Macedonia, Norway, Poland, Portugal, Romania, Russia, Scotland, Serbia, Slovenia, South Africa, Spain, Sweden, Switzerland, Turkey, Ukraine, United States, Wales.

The literature is rich in studies indicating that referees tend to favour the home team – consciously or unconsciously – in their decision making, and that this favouritism is assumed to be caused by social pressure (e.g. Buraimo et al., 2010, 2012; Dohmen, 2008; Page & Page, 2010). Clear indications of biased calls made by the referee can be found with regard to fouls (e.g. Balmer et al., 2007; Nevill et al., 2002; Sapp et al., 2018), yellow cards (e.g. Balmer et al., 2007; Goumas, 2014; Unkelbach & Memmert, 2010), red cards (e.g. Dawson et al., 2007; Pettersson-Lidbom & Priks, 2010), penalties (e.g. Armatas & Pollard, 2014), and extra injury time at the end of a match (e.g. Garicano et al., 2005; Scoppa, 2008; Sutter & Kocher, 2004). Data from the German Bundesliga also shows that referee bias greatly increases when there is no running track that separates between the supporters and the pitch (Buraimo et al. 2010).

The underlying mechanism of the crowd's impact on the referees' judgment calls remains unclear. One possibility is that referees either use crowd noise (volume and intensity) as a decision heuristic (e.g. how severe a foul is), or as useful additional information for guiding their decision making. One common, normative type of conformity effects suggests that sports officials strive to satisfy the crowd in the stadium, thereby demonstrating agreement with the opinion of the more dominant crowd (Myers et al., 2014). It is also possible that referees might feel intimidated by the crowd in a way that influences their ability to conduct a fair match. For example, Anders and Rotthoff (2014) found that part of the home-field bias arises from the prospect of fan violence. However, typical crowd behaviours at sporting events, as well as the extent to which referees are willing to please the home crowd, are apparently subject to cultural differences and therefore may vary between countries (Gelade, 2015).

It also remains to be determined whether crowd noise affects referees differently, with some referees being more prone to crowd influence than others (Page & Page, 2010). Nevill et al. (2002), for example, found in their experiments that highly experienced referees were as biased towards the home team as less experienced ones – suggesting that expert referees may not be more capable of applying improved strategies for coping with stressors, such as crowd support, when making decisions. However, other studies have reached different conclusions. For example, an analysis of real-match data showed that the more experienced and skilled soccer referees were less susceptible to home team effects in terms of issuing yellow cards to the visiting team (Goumas, 2013). Moreover, referees who showed a tendency to over-involve consciousness in decision making made less decisions in favour of the home team compared to those who were categorized as high "*decision ruminators*" (Poolton et al., 2011). These individual differences must be taken into consideration when striving to decrease home bias and improve referee practices.

Laboratory experiments have manipulated crowd noise through the use of video-recorded tackles with and without crowd noise. Balmer et al. (2007) and Nevill et al. (1999, 2002), for example, found that refereeing in the presence of crowd noise resulted in a significant imbalance of decisions in favour of the home team, as well as fewer fouls against the home players, compared to the "*no noise*" condition. Unkelbach and Memmert (2010) improved on previously designed laboratory set-ups by using a larger sample of videos, with high and low volumes of crowd reactions to fouls at different stadiums. The study demonstrated the impact of crowd noise on referees' yellow card decisions, whereby more yellow cards were given to the visiting team when crowd noise was present, compared to the fewer penalties given to the home team.

While experimental designs enable the exclusion of certain confounding effects that could threaten the internal validity of the study, the referees who participated in these experiments were not making decisions in front of a live crowd who cared about their decisions, as in real live stadiums. To enhance external validity, Myers and Balmer (2012) conducted a unique controlled experiment using a live tournament setting, at venues of various sizes, with various crowd sizes and crowd densities, and qualified judges with varying experience. The study used a combat sport with varying levels of competition. In the 'no noise' condition, judges had noise-cancelling headphones. The results showed a significant difference in points in favour of the home fighter for the live "*crowd noise*" condition, across all settings.

One possible explanation for inconsistent decisions made by referees, in crowd noise compared to quiet conditions, could stem from the referees' increased stress during the game. Using a single measure of bias, Balmer et al. (2007) found that referees who exhibited greatest HA bias were more likely to have higher levels of cognitive anxiety and exercise greater mental effort when performing the task. This implies that to avoid negative consequences of anxiety, when making unpopular decisions against the home team (which are likely to produce vociferous crowd noise), referees tend to award fewer decisions against the home team.

Some studies suggested that supportive crowds may not necessarily result in superior home performances (e.g. Strauss, 2002) – and in some cases (e.g. when the stakes are extremely high) might even have a detrimental effect on performance (Wallace et al., 2005). As such, Balmer et al. (2007) attributed the imbalance that they found, in favour of home competitors, to the referees' biased decisions due to crowd noise – rather than to superior home performance.

HA: The perspective of key stakeholders

While the actual effects of the HA and referee bias have been widely investigated, especially in relation to the crowd, the beliefs and perceptions of fans, athletes, coaches, and officials have only attracted marginal research attention (Fothergill et al. 2014). The existing studies show that in general, fans, and even the media, believe that the crowd is the main cause of HA (Smith, 2005). For example, English soccer fans reported that they are able to affect the outcome of a match by motivating their team, distracting the opponents, and biasing the referees' decisions (Wolfson et al., 2005). Yet fans perceived officials to be more influenced by the teams' ranking than by the location of the game. Relatively stronger perceptions, about their ability to bias officials to favour the home team, were found among fans in the American Football League (Goldschmied & Hochuli, 2014). The officials themselves, on the other hand, perceived the fans' impact on their decisions to be negligible, but in their opinion other officials are slightly affected by the fans. However, both officials and fans believe that fans contribute to the HA through their ability to affect the athletes' performances (Goldschmied & Hochuli, 2014).

Similar perceptions were found in a survey of soccer players, fans, and referees in England, with the three groups attributing the HA mainly to crowd support and environmental familiarity (Anderson et al., 2012). As expected, referees in the study reported that they are robust to the crowd effect. Previously, athletes had reported travel-related factors as being one of the three most important variables that impact HA (Bray & Widmeyer, 2000). A more recent survey of a handball premier league, conducted with these target groups, including coaches, provided overall support for previous research, whereby the crowd is perceived as the most important factor that contributes to the HA phenomenon (Gershgorn et al., 2021). However, differences were found between groups. While fans over-ranked their contribution to the HA effect, officials under-ranked their contribution to this bias in comparison to the other groups. The players in the study ranked their own related factors (i.e. familiarity, travel, territory, and psychological attributes) as high in importance, yet coaches emphasized external factors, such as travel and officiating, that are beyond their control. The authors attributed these differences to self-serving bias, whereby each group strives to protect her ego, i.e., to achieve feelings of pride, or at the very least, to avoid feeling embarrassed.

Indeed, the question of how different groups perceive the HA and its causes is important and may affect the formation and rate of this phenomenon. Yet it is important to expand the existing literature on the topic of these stakeholders' view, about the causes of HA in general, and the crowd effect in particular, as the literature is lacking in this area.

DISCUSSION

The HA has been extensively studied, mainly in team sports, with officiating bias attracting research attention as one of its major causes. Our review shows that HA is elevated in sports that entail higher levels of physical contact (e.g. rugby, soccer, and basketball); when there are larger crowds; when competitions are held in smaller stadiums; and when the crowd is physically closer to the pitch. However, while crowd effects are present across many sports, it is difficult to determine whether the influence of the crowd on HA is primarily due to player performance (e.g. exhibiting greater dominance, confidence, or aggressive behaviours; Furley

et al., 2018) or referee bias (e.g. favourable decisions toward the home team; Sutter & Kocher, 2004). Our review shows that the literature supports the referee bias to be the most important and dominant explanation in soccer. Yet, evidence from other sports suggests that either, or both, mechanisms are plausible. For most sports, the extent to which matches are influenced by either mechanism is difficult to assess.

As much as HA arises from referees favouring the home team, sport organizations are undoubtedly interested in reducing human error for reasons of fairness. Later in this review, we will discuss the ways sport organizations are taking to reduce referee bias. However, they might probably be less interested in reducing the HA that results from an elevated performance of players when competing at home, because games become more competitive and exciting. This makes the HA not necessarily an effect that should be minimized.

Considering player performance, several studies have demonstrated that male players experience higher testosterone levels when competing at home (e.g. McGuire et al., 1992; Neave & Wolfson, 2003), which can elicit a range of psychological and behavioural responses, such as higher motivation or aggressiveness (Carré et al., 2006). However, the impact of competing at home in front of a domestic audience, regardless of the type of sport, can vary among athletes. While it may boost confidence levels and outcome expectations for some athletes, leading to improved performance, it can also increase pressure to perform well for others, resulting in poor performance due to stress and over-cautiousness (Harb-Wu & Krumer, 2019; Wallace et al., 2005), known as the "*home disadvantage*" effect (Baumeister & Steinhilber, 1984). The athlete's experience might play a role as well (Sánchez & Lavín, 2020).

The possibility to study the effects of crowd noise in an ecological context emerged by the matches played behind closed doors due to the COVID-19 pandemic. The studies examined how the crowd size influenced the HA, performance, and disciplinary decisions in the match. The pandemic also prevented close contact between players and referees, which could have also affected fouls and punishments. Our review of the research on crowd attendance have shown mixed results, with the majority of studies showing a positive effect of crowd presence on HA (e.g. Arboix-Alió, et al., 2022; Bryson et al., 2021; Correia-Oliveira & Andrade-Souza, 2021; Hill & Van Yperen, 2021; McCarrick, et al., 2021; Scoppa, 2021; Sors et al., 2021), while others found no changes in HA over the seasons analysed (e.g. Almeida & Leite, 2021; Benz & Lopez, 2021; Matos et al., 2021; Wunderlich et al., 2021).

With the outbreak of the epidemic, it has also become possible to examine the socio-cultural and environmental robustness of HA, based on data collected from leagues within and across countries. Our review shows that the decrease in HA during ghost games varied between the different studies and seems to depend on different factors, including playing levels (e.g. first vs. second divisions) and country (e.g. German Bundesliga vs. English Premier League). For example, variation in the dynamics of HA was found in German soccer teams, with the first Bundesliga showing a more drastic reduction in HA than teams in the second and third league (Fischer & Haucap, 2021). It was suggested that playing without crowds had a much greater effect on teams that normally play in front of larger crowds at their stadiums. Likewise, Ribeiro et al. (2022) identified in Brazilian elite soccer (Series A and B) a decrease in HA only for Serie A in the absence of crowd, while Serie B analyses indicated no changes in HA over the three seasons analysed. Interestingly, the reduction in the advantage of playing at home for Serie A was found not only in the 2020 season, when there was no crowd support in the stadiums, but also in the 2019 season, when fans were present in the stadiums – compared to the 2018 season. This indicates the existence of other modulating factors of the HA effect.

Variations in HA levels between countries and populations within regions can be explained by social and cultural differences, as suggested by Pollard (2006) and Pollard et al. (2017). Yet environmental conditions may also play a significant role in HA. For example, van Damme and Baert (2019) found that soccer teams with a high-altitude home stadium (i.e. low oxygen levels) were more likely to win against teams from sea-level stadiums. Given the abundance of literature on HA, future research should focus on additional potential factors that contribute to the HA, as with van Damme and Baert (2019), rather than continuing to simply validate its existence. Part of the "*unresolved puzzle*" is the interaction of causes, which poses a challenge to investigate, isolate, and quantify how each likely cause operates with the other to establish the HA, as outlined by Pollard (2008).

Theories related to the impact of social pressure and conformity offer possible explanations for the decreased HA in ghost games. For example, Sors et al. (2021) argued that crowd noise/presence has a direct effect on referee bias, due to its related social pressure, as well as a direct and indirect effect on HA – as illustrated in Figure 2. While the *direct* effect stems from the crowd's support for the home team and/or the booing of the visiting team (Greer, 1983), the *indirect* effect is due to the occurrence of referee bias. The stadium capacity, the distance to the field, and the atmosphere created by a roaring crowd contribute to both phenomena. Thus, strategies for reducing referee bias – by coping more effectively with social pressure conveyed by the crowd – are of the utmost importance. It is worth noting, however, that although crowd is a major source of HA and referee bias (Endrich & Gesche, 2020), the evidence indicates that crowds do not have to exist in order for HA to occur – as additional factors can contribute to such bias during matches.

From a sport psychologist perspective, the COVID-19 pandemic provided a unique global opportunity for researching the emotional behaviour of players and referees (Webb, 2021). However, existing studies on this topic are scarce, with one example being the work of Leitner and Richlan (2021a). Using a video-based analysis system of nonverbal behaviour during soccer matches, the authors found that there were about 20% less emotional situations in matches without spectators, and that referees were significantly less actively involved in these emotional situations. In addition, limited attention has also been paid to exploring how the absence of fans affects the subjective experiences of players and officials, and their consequent behaviour.

Beyond the specific circumstances created by the pandemic, psychological factors are believed to play a major role in determining HA in team sports (Neave & Wolfson, 2004). One such factor is the mental attitude of players, coaches, and referees about the likelihood of winning the game when playing at home. According to Pollard (2008), such state of mind acts as a self-fulfilling phenomenon that impacts behaviour and actions, and consequently the outcome of the game and the role played by HA. Moreover, there is consistent evidence suggesting that athletes and coaches psychological states are superior when playing at home, in terms of their personal confidence and confidence in their team, as well as their emotions and mood states (Carron & Paradis, 2014). The findings support the proposal by Courneya and Carron (1992) that psychological states are influenced by game location (Terry et al., 1998). In contrast, athletes feel intimidated when competing away from home in front of unfavourable crowd. These findings lead to the conclusion that players should be better prepared to cope with the perceived disadvantage of playing away from home and the related emotions that accompanied it.

As outlined throughout this review, referee biased-decisions are thought to contribute to HA. For example, referees in Boyko et al.'s (2007) study exhibited significantly different HA in penalties and yellow cards, which the authors considered of being two potentially game-changing factors. Likewise, Nevill and Holder (1999) argued that it only takes 2 or 3 crucial decisions to go against the away team or in favour of the home team to give the side playing at home the "*edge*" during the game. However, it would be interesting to assess, for

example, the exact impact of additional 1 or 2 yellow cards for the away team on the probability of victory for the home team. One such attempt was made by Anders and Rotthoff (2010). Using two regression models, the authors found in their data from the Bundesliga that yellow and red cards negatively impact the probability of winning games. As expected, when the *home* team receives a yellow card, it decreases their probability of winning by 13 to 15 percent (depending on the model used). One player receiving two yellow cards decreases the probability of the home team winning by 22 to 27 percent, and receiving a direct red card decreases the probability of victory by 44 to 48 percent. These results were significant at the one percent level.

More important to our discussion is the away team cards. It was found that when the *away* team receives a yellow card, it increases the probability that the home team wins by 5 to 6 percent, although these estimates are insignificantly different from zero. A yellow to red card for the away team increases the home team's chances of winning by 16 percent in one of the regression models ($p = 0.05$), and receiving a direct red card increases these chances by 20 to 25 percent ($p = 0.01$). A robustness test showed that although the model had a relatively low predictive power, the estimates gave an accurate measure of the effects of yellow and red cards in soccer matches. Clearly, it is a direction in which further research is needed.

Several other potential directions for future research emerged from our review. We found that most previous studies were focused on analysing the interaction between one specific variable and match location (e.g. type of competition, score-line, quality of opposition). Therefore, a topic that needs further exploration relates to the interacting effects of several situational variables with HA. This might be achieved thorough the development of new methods and models for the analysis of HA from a multivariate perspective.

Our review also shows that the analysis of individual and dual sports, as well as female competitors is sparse. Specific to women's sports, the HA effect has been demonstrated and studied mostly in basketball, volleyball, and soccer, with a consistently smaller effect for women than it is for men (Pollard & Gómez, 2014). These differences in the HA effect between women and men can be explained by physiological factors (e.g. hormonal effect; Bateup et al., 2002) or lesser crowd support in female competitions. However, the analysis of the exact causes and the way in which the different factors operate still remains a challenge for the future.

Not only is the research on women's sports limited, but so is the research on amateur and non- and semi-professional leagues, including collegiate and youth sports. At these lower levels of play, players' experience/expertise and playing conditions (e.g. training facilities or hours of practice) are generally poorer than those at the higher levels. The results from the different studies are inconsistent. Although the same factors of HA likely affect all different competitive levels (i.e. familiarity, travel effects, crowd support, referee bias, etc.), these factors may affect players and teams' performances in different ways and intensities. Hence, it is important to study the magnitude of HA at different competitive levels, and the possible causes of HA at different levels of play.

Finally, we found that little work has been done to examine individual differences in referees' respond to factors such as crowd noise (e.g. the referee emotional state, coping strategies, and social interaction abilities) when examining the HA, as outlined, for example, by Dosseville et al. (2016) and Boyko et al. (2007). If the subjective decisions of referees vary between individuals (after controlling for other factors, such as team abilities), we would expect the home bias to systematically differ between referees. Taking such individual differences into consideration would allow better predicting and coping with the home bias.

While this review is informative and involves an extensive search of the literature, there are limitations that have to be considered. First of all, relevant evidence may have been omitted from this review if they were not identified through the applied search methods. Moreover, as with almost any review, there might be an element of selection bias. However, these concerns may be alleviated somewhat because the sample of studies included in this narrative review is quite large and may adequately represent the overall picture. A possible bias of single studies may also occur, due to the measures used by researchers for capturing the HA and referee bias, while overlooking other possible independent variables that should be controlled (e.g. team strength, travel distance, and venue size). In some cases, this could distort valid comparisons between teams, leagues, or sports. Finally, attention should also be paid to differences that may be seen in the interpreting of results in the different studies, as not all researchers and studies apply the same scaling methods (see the recommendations by Jones, 2018).

Reducing the HA effect and referee bias

Over time, positive changes have been seen in HA in a range of professional leagues (e.g. English and Scottish soccer; Nevill et al., 2013), corresponding with significant improvements in referee training. However, the smallest decrease has been observed in higher divisions with larger crowds, such as ice hockey, basketball, and soccer (Webb et al., 2018). An interesting attempt to compensate for the home team advantage has been made by several leagues, such as the UK Motorcycle Speedway League, by awarding an extra point for an away win (three points instead of two). This change to the scoring system led to an approximate 30% reduction in the HA effect for this particular sport. Unfortunately, no other research evidence was found in the articles reviewed in this paper.

In the interest of fairness, sports organizations have taken several steps to reduce judgment errors made by the officials. For example, the Union of European Football Associations (UEFA) experimented with two additional assistant referees during Champions League and Europa League matches in the 2008/9-2011/12 seasons – resulting in decreased home or "*big*" team favouritism, and an increase in yellow cards issued for both home and away teams (Albanese et al., 2020). In addition, referees in a number of sports are now allowed to correct erroneous decisions through a third-party assistant, often someone who has access to technological monitoring.

Today, monitoring devices are increasingly used in sports for reducing human error, such as the Video Assistant Referee (VAR) in soccer, video replay in basketball and field hockey, computer guided cameras in tennis and cricket (the Hawk-Eye), and the Television Match Official (TMO) in rugby. While VAR has changed the dynamics of soccer games in several leagues (e.g. Lago-Peñas et al., 2019), yet technology have not necessarily improved balance in decision making when considering the HA bias (Dawson et al., 2020; Han et al., 2020). For certain sporting events, such as the semi-finals and finals in the English men's soccer league, improved control of HA and referee bias is obtained by holding games at neutral sites (e.g. the Wembley Stadium). Yet evidence is lacking regarding reduced favouritism and bias at different levels of competition (e.g. playoffs).

The training of professional referees has also greatly improved over time, extending beyond traditional physical training programs (Weston, 2015). The introduction of new technologies, such as the Prozone and Opta systems for performance analysis, is a huge step forward for referee training. Nowadays, structured training sessions in decision making are also more common (Webb et al., 2018), with referees analysing each of their decisions through video recordings of their actual matches. The shared mental model video-based training approach, for example, was found to have a positive impact on decisions made by Rugby Union referees (Mascarenhas et al., 2005).

While referees need physical fitness training for coping with fatigue and keeping up with the game (Castagna et al., 2007), they also require adequate psychological preparation (Lane et al., 2006). In some sports clubs, referees work closely with designated referee coaches and mentors, to provide them with additional support and training. Studies show that training can help referees become increasingly aware of external crowd pressure, while learning how to apply effective strategies for filtering out such pressure. For example, referees must learn to cope with stress that is associated with their making unpopular decisions, while practicing how to demonstrate greater confidence in their decision making (Di Corrado et al., 2011).

Higher levels of professionalism following improved referee training are clearly noticeable. For example, evidence of more balanced decisions made by referees was reported by Rickman and Witt (2008), with no indication of favouritism effects in close matches in relation to extra time due to injury. Similarly, no evidence of the HA effect due to crowd size and referee bias was found over several seasons of the English soccer Premiership (Johnston, 2008). As such, governing bodies should further improve the training of their officials as a means for reducing HA and referee bias. In addition, due to individual differences (Poolton et al., 2011), there is a need to identify those referees who may be prone to negative effects of external stimuli, such as crowd noise, and pro-actively provide them with training alternatives that can improve their performance (e.g. training in environments with live audience). Greater professionalization also includes the mental preparation of athletes as part of their training process to increase their mental resilience, thereby contributing to a further decline of HA. From a scientific perspective, more research is needed regarding the mechanisms through which crowd support contributes to physiological reactivity, attention, stress responses, and decision making by athletes and officials.

SUPPORTING AGENCIES

No funding agencies were reported by the author.

DISCLOSURE STATEMENT

No potential conflict of interest was reported by the author.

REFERENCES

Agnew, G. A., & Carron, A. V. (1994). Crowd effects and the home advantage. International Journal of Sport Psychology, 25(1), 53-62.

Albanese, A., Baert, S., & Verstraeten, O. (2020). Twelve eyes see more than eight: Referee bias and the introduction of additional assistant referees in soccer. PLoS ONE, 15(2): e0227758. https://doi.org/10.1371/journal.pone.0227758

Allen, M. S., & Jones, M. V. (2014). The "home advantage" in athletic competitions. Current Directions in Psychological Science, 23(1), 48-53. https://doi.org/10.1177/0963721413513267

Almeida, C. H., & Leite, W. S. (2021). Professional football in times of COVID-19: Did the home advantage effect disappear in European domestic leagues? Biology of Sport, 38(4), 693-701. https://doi.org/10.5114/biolsport.2021.104920

Alonso, E., Lorenzo, A., Ribas, C., & Gómez, M. A. (2022). Impact of COVID-19 pandemic on home advantage in different European professional basketball leagues. Perceptual and Motor Skills, 129(2), 328-342. https://doi.org/10.1177/00315125211072483

Anders, A., & Rotthoff, K. W. (2011). Yellow cards: Do they matter? Journal of Quantitative Analysis in Sports, 7(1), Article 9. https://doi.org/10.2202/1559-0410.1286

Anders, A., & Rotthoff, K. W. (2014). Is home-field advantage driven by the fans? Evidence from across the ocean. Applied Economics Letters, 21(16), 1165-1168. https://doi.org/10.1080/13504851.2014.914139

Anderson, M., Wolfson, S., Neave, N., & Moss, M. (2012). Perspectives on the home advantage: A comparison of football players, fans and referees. Psychology of Sport and Exercise, 13(3), 311-316. https://doi.org/10.1016/j.psychsport.2011.11.012

Arboix-Alió, J., Trabal, G., Buscà, B., Peña, J., Arboix, A., & Hileno, R. (2022). The behaviour of home advantage during the COVID-19 pandemic in European rink hockey leagues. International Journal of Environmental Research and Public Health, 19(1), Article 228. https://doi.org/10.3390/ijerph19010228

Armatas, V., & Pollard, R. (2014). Home advantage in Greek football. European Journal of Sport Science, 14(2), 116-122. https://doi.org/10.1080/17461391.2012.736537

Avugos, S., MacMahon, C., Bar-Eli, M., & Raab, M. (2021). Inter-individual differences in sport refereeing: A review of theory and practice. Psychology of Sport and Exercise, 55(1), Article 101926. https://doi.org/10.1016/j.psychsport.2021.101926

Balmer, N. J., Nevill, A. M., & Lane, A. M. (2005). Do judges enhance home advantage in European championship boxing? Journal of Sports Sciences, 23(4), 409-416. https://doi.org/10.1080/02640410400021583

Balmer, N. J., Nevill, A. M., Lane, A. M., Ward, P., Williams, A. M., & Fairclough, S. H. (2007). Influence of crowd noise on soccer refereeing consistency in soccer. Journal of Sport Behavior, 30(2), 130-145.

Balmer, N. J., Nevill, A. M., & Williams, A. M. (2001). Home advantage in the Winter Olympics (1908-1998). Journal of Sports Sciences, 19(2), 129-139. https://doi.org/10.1080/026404101300036334

Balmer, N. J., Nevill, A. M., & Williams, A. M. (2003). Modelling home advantage in the Summer Olympic Games. Journal of Sports Sciences, 21(6), 469-478. https://doi.org/10.1080/0264041031000101890

Bateup, H. S., Booth, A., Shirtcliff, E. A., & Granger, D. A. (2002). Testosterone, cortisol, and women's competition. Evolution and Human Behavior, 23(3), 181-192. https://doi.org/10.1016/S1090-5138(01)00100-3

Baumeister, R. F., & Steinhilber, A. (1984). Paradoxical effects of supportive audiences on performance under pressure: The home field disadvantage in sports championships. Journal of Personality and Social Psychology, 47(1), 85-93. https://doi.org/10.1037/0022-3514.47.1.85

Benz, L. S., & Lopez, M. J. (2021). Estimating the change in soccer's home advantage during the Covid-19 pandemic using bivariate Poisson regression. AStA-Advances in Statistical Analysis, 66(2), Article 6. https://doi.org/10.1007/s10182-021-00413-9

Bilalić, M., Gula, B., & Vaci, N. (2021). Home advantage mediated (HAM) by referee bias and team performance during covid. Scientific Reports, 11(1), Article 21558. https://doi.org/10.1038/s41598-021-00784-8

Boyko, R. H., Boyko, A. R., & Boyko, M. G. (2007). Referee bias contributes to the home advantage in English Premiership football. Journal of Sports Sciences, 25(11), 1185-1194. https://doi.org/10.1080/02640410601038576

Bray, S. R., & Widmeyer, W. N. (2000). Athletes' perceptions of the home advantage: An investigation of perceived causal factors. Journal of Sport Behavior, 23(1), 1-10.

Bryson, A., Dolton, P., Reade, J. J., Schreyer, D., & Singleton, C. (2021). Causal effects of an absent crowd on performances and refereeing decisions during Covid-19. Economics Letters, 198, Article 109664. https://doi.org/10.1016/j.econlet.2020.109664

Buraimo, B., Forrest, D., & Simmons, R. (2010). The 12th man? Refereeing bias in English and German soccer. Journal of the Royal Statistical Society, Series A, 173(2), 431-449. https://doi.org/10.1111/j.1467-985X.2009.00604.x

Buraimo, B., Simmons, R., & Maciaszczyk, M. (2012). Favoritism and referee bias in European soccer: Evidence from the Spanish league and the UEFA Champions league. Contemporary Economic Policy, 30(3), 329-343. https://doi.org/10.1111/j.1465-7287.2011.00295.x

Bustamante-Sánchez, Á., Gómez, M. A., & Jiménez-Saiz, S. L. (2022). Game location effect in the NBA: A comparative analysis of playing at home, away and in a neutral court during the COVID-19 season. International Journal of Performance Analysis in Sport, 22(3), 370-381. https://doi.org/10.1080/24748668.2022.2062178

Carré, J., Muir, C., Belanger, J., & Putnam, S. K. (2006). Pre-competition hormonal and psychological levels of elite hockey players: Relationship to the 'home advantage'. Physiology and Behavior, 89(3), 392-398. https://doi.org/10.1016/j.physbeh.2006.07.011

Carron, A. V., Loughhead, T. M., & Bray, S. R. (2005). The home advantage in sport competitions: The Courneya and Carron's (1992) conceptual framework a decade later. Journal of Sports Sciences, 23(4), 395-407. https://doi.org/10.1080/02640410400021542

Carron, A. V., & Paradis, K. F. (2014). Home advantage. In R. C. Eklund, & G. Tenenbaum (Eds.), Encyclopedia of sport and exercise psychology, part 1 (pp. 350-354). Sage.

Castagna, C., Abt, G., & D'Ottavio, S. (2007). Physiological aspects of soccer refereeing performance and training. Sport Medicine, 37(7), 625-646. https://doi.org/10.2165/00007256-200737070-00006

Chen, J., Zhai, S., Xi, Z., Li, P., & Zhang, S. (2022). Impact of absent crowds on technical and physical performances in the Chinese Soccer Super League. Frontiers in Psychology, 13, Article 959213. https://doi.org/10.3389/fpsyg.2022.959213

Chiu, Y. C., & Chang, C. K. (2022). Major League Baseball during the COVID-19 pandemic: Does a lack of spectators affect home advantage? Humanities and Social Sciences Communications, 9(1), Article 178. https://doi.org/10.1057/s41599-022-01193-6

Chun, S., & Park, S. S. (2021). Home advantage in skeleton: Familiarity versus crowd support. Journal of Sports Economics, 22(1), 3-26. https://doi.org/10.1177/1527002520936737

Collins, J. A., & Fauser, B. C. J. M. (2005). Balancing the strengths of systematic and narrative reviews. Human Reproduction Update, 11(2), 103-104. https://doi.org/10.1093/humupd/dmh058

Correia-Oliveira, C. R., & Andrade-Souza, V. A. (2021). Home advantage in soccer after the break due to COVID-19 pandemic: Does crowd support matter? International Journal of Sport and Exercise Psychology, 20(4), 1245-1256. https://doi.org/10.1080/1612197X.2021.1934716

Courneya, K. S., & Carron, A. V. (1990). Batting first versus last: Implications for the home advantage. Journal of Sport and Exercise Psychology, 12(3), 312-316. https://doi.org/10.1123/jsep.12.3.312

Courneya, K. S., & Carron, A. V. (1991). Effects of travel and length of home stand/road trip on the home advantage. Journal of Sport and Exercise Psychology, 13(1), 42-49. https://doi.org/10.1123/jsep.13.1.42

Courneya, K. S., & Carron, A. V. (1992). The home advantage in sport competitions: A literature review. Journal of Sport and Exercise Psychology, 14(1), 13-27. https://doi.org/10.1123/jsep.14.1.13

Couto, B. P., & Sayers, M. G. L. (2023). Crowd social pressure in the Brazilian soccer league: Testing home advantage and referees' bias during the COVID-19 pandemic. International Journal of Sport and Exercise Psychology, 21(4), 673-688. https://doi.org/10.1080/1612197X.2022.2084763

Cross, J., & Uhrig, R. (2023). Do fans impact sports outcomes? A COVID-19 natural experiment. Journal of Sports Economics, 24(1), 3-27. https://doi.org/10.1177/15270025221100204

Dawson, P., Dobson, S., Goddard, J., & Wilson, J. (2007). Are football referees really biased and inconsistent? Evidence on the incidence of disciplinary sanction in the English Premier League. Journal of the Royal Statistical Society: Series A (Statistics in Society), 170(1), 231-250. https://doi.org/10.1111/j.1467-985X.2006.00451.x

Dawson, P., Massey, P., & Downward, P. (2020). Television match officials, referees, and home advantage: Evidence from the European Rugby Cup. Sport Management Review, 23(3), 443-454. https://doi.org/10.1016/j.smr.2019.04.002

De Angelis, L., & Reade, J. J. (2023). Home advantage and mispricing in indoor sports' ghost games: The case of European basketball. Annals of Operations Research, 325(1), 391-418. https://doi.org/10.1007/s10479-022-04950-7

Destefanis, S., Addesa, F., & Rossi, G. (2022). The impact of COVID-19 on home advantage: A conditional order-m analysis of football clubs' efficiency in the top-5 European leagues. Applied Economics, 54(58), 6639-6655. https://doi.org/10.1080/00036846.2022.2074361

Di Corrado, D., Pellarin, E., & Agostini, T. A. (2011). The phenomenon of social influence on the football pitch: Social pressure from the crowd on referees' decisions. Review of Psychology, 18(1), 33-36.

Dohmen, T. J. (2008). The influence of social forces: Evidence from the behavior of football referees. Economic Inquiry, 46(3), 411-424. https://doi.org/10.1111/j.1465-7295.2007.00112.x

Dohmen, T., & Sauermann, J. (2016). Referee bias. Journal of Economic Surveys, 30(4), 679-695. https://doi.org/10.1111/joes.12106

Dosseville, F., Edoh, K. P., & Molinaro, C. (2016). Sports officials in home advantage phenomenon: A new framework. International Journal of Sport and Exercise Psychology, 14(3), 250-254. https://doi.org/10.1080/1612197X.2015.1023422

Ehrlich, J., & Potter, J. (2023). Estimating the effect of attendance on home advantage in the National Basketball Association. Applied Economics Letters, 30(11), 1471-1482. https://doi.org/10.1080/13504851.2022.2061898

Endrich, M., & Gesche, T. (2020). Home-bias in referee decisions: Evidence from "ghost matches" during the Covid19-pandemic. Economics Letters, 197, Article 109621. https://doi.org/10.1016/j.econlet.2020.109621

Erikstad, M. K., & Johansen, B. T. (2020). Referee bias in professional football: Favoritism toward successful teams in potential penalty situations. Frontiers in Sports and Active Living, 2, Article 19. https://doi.org/10.3389/fspor.2020.00019

Fazackerley, L. A., Gorman, A. D., Minett, G. M., Caia, J., & Kelly, V. G. (2022). The influence of absent crowds on National Rugby League match player statistics and running metrics. Psychology of Sport and Exercise, 60, Article 102163. https://doi.org/10.1016/j.psychsport.2022.102163

Ferraresi, M., & Gucciardi, G. (2021). Who chokes on a penalty kick? Social environment and individual performance during Covid-19 times. Economics Letters, 203, Article 109868. https://doi.org/10.1016/j.econlet.2021.109868

Ferraresi, M., & Gucciardi, G. (2023). Team performance and the perception of being observed: Experimental evidence from top-level professional football. German Economic Review, 24(1), 1-31. https://doi.org/10.1515/ger-2021-0104

Fischer, K., & Haucap, J. (2021). Does crowd support drive the home advantage in professional football? Evidence from German ghost games during the COVID-19 pandemic. Journal of Sports Economics, 22(8), 982-1008. https://doi.org/10.1177/15270025211026552

Fischer, K., & Haucap, J. (2022). Home advantage in professional soccer and betting market efficiency: The role of spectator crowds. Kyklos, 75(2), 294-316. https://doi.org/10.1111/kykl.12291

Fontenla, M., & Izón, G. M. (2018). The effects of referees on the final score in football. Estudios Económicos, 35(70), 79-97. https://doi.org/10.52292/j.estudecon.2018.1098

Fothergill, M., Wolfson, S., & Little, L. (2014). A qualitative analysis of perceptions of venue: do professional soccer players and managers concur with the conceptual home advantage framework? International Journal of Sport and Exercise Psychology, 12(4), 316-332. https://doi.org/10.1080/1612197X.2014.932826

Franchini, E., & Takito, M. Y. (2016). Home advantage in combat sports during the Olympic games. Sport Sciences for Health, 12(3), 287-290. https://doi.org/10.1007/s11332-016-0286-9

Furley, P., Schweizer, G., & Memmert, D. (2018). Thin slices of athletes' nonverbal behavior give away game location: Testing the territoriality hypothesis of the home game advantage. Evolutionary Psychology, 16(2), 1-12. https://doi.org/10.1177/1474704918776456

Fuxjager, M. J., Mast, G., Becker, E. A., & Marler, C. A. (2009). The 'home advantage' is necessary for a full winner effect and changes in post-encounter testosterone. Hormones and Behavior, 56(2), 214-219. https://doi.org/10.1016/j.yhbeh.2009.04.009

Garicano, L, Palacios-Huerta, I., & Prendergast, C. (2005). Favoritism under social pressure. Review of Economics and Statistics, 87(2), 208-216. https://doi.org/10.1162/0034653053970267

Gelade, G. A. (2015). National culture and home advantage in football. Cross-Cultural Research, 49(3), 281-296. https://doi.org/10.1177/1069397114556055

Gershgorn, L., Levental, O., & Basevitch, I. (2021). Home advantage perceptions in elite handball: A comparison among fans, athletes, coaches, and officials. Frontiers in Psychology, 12, Article 782129. https://doi.org/10.3389/fpsyg.2021.782129

Ghahfarokhi, E. A., Soroush, S., & Hasanbeigi, H. (2022). Investigating the home advantage in the world's prestigious football leagues before and after the outbreak of COVID-19. Revista Brasileira de Futsal e Futebol, 14(57), 119-129.

Goldschmied, N., & Hochuli, R. (2014). Do fans and officials think alike when assessing the home-field advantage? Support for actor-observer asymmetry in the National Football League. Basic and Applied Social Psychology, 36(2), 155-163. https://doi.org/10.1080/01973533.2014.882258

Gómez, M. A., Gasperi, L., & Lupo, C. (2016). Performance analysis of game dynamics during the 4th game quarter of NBA close games. International Journal of Performance Analysis in Sport, 15(1), 249-263. https://doi.org/10.1080/24748668.2016.11868884

Gómez-Ruano, M. A., Pollard, R., & Lago-Peñas, C. (Eds.). (2021). Home advantage in sport: Causes and the effect on performance. Routledge. https://doi.org/10.4324/9781003081456

Gómez, M. A., Pollard, R., & Luis-Pascual, J. C. (2011). Comparison of the home advantage in nine different professional team sports in Spain. Perceptual and Motor Skills, 113(4), 150-156. https://doi.org/10.2466/05.PMS.113.4.150-156

Gong, H. (2022). The effect of the crowd on home bias: Evidence from NBA games during the COVID-19 pandemic. Journal of Sports Economics, 23(7), 950-975. https://doi.org/10.1177/15270025211073337

Goumas, C. (2013). Referee expertise and home-team bias in European football. International Journal of Sport Psychology, 44(5), 429-440.

Goumas, C. (2014). Home advantage and referee bias in European football. European Journal of Sport Science, 14(sup1), S243-S249. https://doi.org/10.1080/17461391.2012.686062

Greenhalgh, T. (2012). Outside the box: Why are Cochrane reviews so boring? British Journal of General Practice, 62(600), 371. https://doi.org/10.3399/bjgp12X652418

Greenhalgh, T., Thorne, S., & Malterud, K. (2018). Time to challenge the spurious hierarchy of systematic over narrative reviews? European Journal of Clinical Investigation, 48(6), Article e12931. https://doi.org/10.1111/eci.12931

Greer, D. L. (1983). Spectator booing and the home advantage: A study of social influence in the basketball arena. Social Psychology Quarterly, 46(3), 252-261. https://doi.org/10.2307/3033796

Guérette, J., Blais, C., & Fiset, D. (2021). The absence of fans removes the home advantage associated with penalties called by National Hockey League referees. PLoS ONE, 16(8): e0256568. https://doi.org/10.1371/journal.pone.0256568

Han, B., Chen, Q., Lago-Peñas, C., Wang, C., & Liu, T. (2020). The influence of the video assistant referee on the Chinese Super League. International Journal of Sports Science and Coaching, 15(5-6), 662-668. https://doi.org/10.1177/1747954120938984

Harb-Wu, K., & Krumer, A. (2019). Choking under pressure in front of a supportive audience: Evidence from professional biathlon. Journal of Economic Behavior and Organization, 166(2), 246-262. https://doi.org/10.1016/j.jebo.2019.09.001

Hegarty, T. (2021). Information and price efficiency in the absence of home crowd advantage. Applied Economics Letters, 28(21), 1902-1907. https://doi.org/10.1080/13504851.2021.1883525

Helsen, W., MacMahon, C., & Spitz, J. (2019). Decision making in match officials and judges. In M. Williams, & R. Jackson (Eds.), Anticipation and decision-making in sport (pp. 250-266). Routledge. https://doi.org/10.4324/9781315146270-14

Higgs, N., & Stavness, I. (2021). Bayesian analysis of home advantage in North American professional sports before and during COVID-19. Scientific Reports, 11(1), Article 14521. https://doi.org/10.1038/s41598-021-93533-w

Hill, Y., & Van Yperen, N. W. (2021). Losing the home field advantage when playing behind closed doors during COVID-19: Change or chance? Frontiers in Psychology, 12, Article 658452. https://doi.org/10.3389/fpsyg.2021.658452

Hüttermann, S., Helsen, W. F., Put, K., & Memmert, D. (2018). Does visual attention impact on decision making in complex dynamic events? Journal of Sport and Exercise Psychology, 40(3), 163-166. https://doi.org/10.1123/jsep.2017-0169

Jamieson, J. P. (2010). The home field advantage in athletics: A meta-analysis. Journal of Applied Social Psychology, 40(7), 1819-1848. https://doi.org/10.1111/j.1559-1816.2010.00641.x

Jehue, R., Street, D., & Huizenga, R. (1993). Effect of time zone and game time changes on team performance: National Football League. Medicine and Science in Sports and Exercise, 25(1), 127-131. https://doi.org/10.1249/00005768-199301000-00017

Jiang, J., Ge, H., & Cui, Y. (2022). Effect of tournament format change on team performance of Chinese Football Super League during COVID-19 pandemic. RICYDE-Revista International de Ciencias del Deporte, 18(68), 72-85. https://doi.org/10.5232/ricyde2022.06801

Johnston, R. (2008). On referee bias, crowd size, and home advantage in the English soccer Premiership. Journal of Sports Sciences, 26(6), 563-568. https://doi.org/10.1080/02640410701736780

Jones, M. B. (2013). The home advantage in individual sports: An augmented review. Psychology of Sport and Exercise, 14(3), 397-404. https://doi.org/10.1016/j.psychsport.2013.01.002

Jones, M. B. (2018). Differences in home advantage between sports. Psychology of Sport and Exercise, 34(3), 61-69. https://doi.org/10.1016/j.psychsport.2017.07.012

Koning, R. H. (2005). Home advantage in speed skating: Evidence from individual data. Journal of Sports Sciences, 23(4), 417-427. https://doi.org/10.1080/02640410400021625

Koning, R. H. (2011). Home advantage in professional tennis. Journal of Sports Sciences, 29(1), 19-27. https://doi.org/10.1080/02640414.2010.516762

Krumer, A. (2017). On winning probabilities, weight categories, and home advantage in professional judo. Journal of Sports Economics, 18(1), 77-96. https://doi.org/10.1177/1527002514560576

Krumer, A., & Smith, V. A. O. (2023). The effect of COVID-19 on home advantage in women's soccer: Evidence from Swedish Damallsvenskan. American Behavioral Scientist, 67(10), 1168-1178. https://doi.org/10.1177/00027642221118259

Laborde, S., Dosseville, F., & Raab, M. (2013). Emotions and decision making in sports: Introduction, comprehensive approach, and vision for the future. International Journal of Sport and Exercise Psychology, 11(2), 143-150. https://doi.org/10.1080/1612197X.2013.773686

Lago-Peñas, C., & Gómez-López, M. (2016). The Influence of referee bias on extra time in elite soccer matches. Perceptual and Motor Skills, 122(2), 666-677. https://doi.org/10.1177/0031512516633342

Lago-Peñas, C., Gómez, M. A., & Pollard, R. (2017). Home advantage in elite soccer matches. A transient effect? International Journal of Performance Analysis in Sport, 17(1-2), 86-95. https://doi.org/10.1080/24748668.2017.1304024

Lago-Peñas, C., & Martín, R. (2007). Determinants of possession of the ball in soccer. Journal of Sports Sciences, 25(9), 969-974. https://doi.org/10.1080/02640410600944626

Lago-Peñas, C., Rey, E., & Kalén, A. (2019). How does Video Assistant Referee (VAR) modify the game in elite soccer? International Journal of Performance Analysis in Sport, 19(4), 646-653. https://doi.org/10.1080/24748668.2019.1646521

Lane, A. M., Nevill, A. M., Ahmad, N. S., & Balmer, N. (2006). Soccer referee decision making: 'Shall I blow the whistle?' Journal of Sport Science and Medicine, 5(2), 243-253.

Lee, J., Kim, J., Kim, H., & Lee, J. S. (2022). A Bayesian approach to predict football matches with changed home advantage in spectator-free matches after the COVID-19 break. Entropy, 24(3), Article 366. https://doi.org/10.3390/e24030366

Leitner, M. C., Daumann, F., Follert, F., & Richlan, F. (2022). The cauldron has cooled down: A systematic literature review on home advantage in football during the COVID-19 pandemic from a socio-economic and psychological perspective. Management Review Quarterly, 73(2), 605-633. https://doi.org/10.1007/s11301-021-00254-5

Leitner, M. C., & Richlan, F. (2021a). Analysis system for emotional behavior in football (ASEB-F): Matches of FC Red Bull Salzburg without supporters during the COVID-19 pandemic. Humanities and Social Sciences Communications, 8(1), Article 14. https://doi.org/10.1057/s41599-020-00699-1

Leitner, M. C., & Richlan, F. (2021b). No fans - no pressure: Referees in professional football during the COVID-19 pandemic. Frontiers in Sports and Active Living, 3, Article 720488. https://doi.org/10.3389/fspor.2021.720488

Link, D., & Anzer, G. (2022). How the COVID-19 pandemic has changed the game of soccer. International Journal of Sports Medicine, 43(1), 83-93. https://doi.org/10.1055/a-1518-7778

Losak, J. M., & Sabel, J. (2021). Baseball home field advantage without fans in the stands. International Journal of Sport Finance, 16(3), 148-162. https://doi.org/10.32731/IJSF/163.082021.04

Luehring, F. W. (1923). Comparison between Eastern and Western basketball. The Athletic Journal, 6(2), 5-7.

Macedo-Rego, R. C. (2022). The effect of crowd support: Home advantage in football is reduced during the Coronavirus disease (COVID-19) pandemic. Behaviour, 159(10), 941-959. https://doi.org/10.1163/1568539X-bja10159

Mascarenhas, D. R. D., Collins, D., & Mortimer, P. W. (2005). A naturalistic approach to training accurate and coherent decision making in Rugby Union referees. The Sport Psychologist, 19(2), 131-147. https://doi.org/10.1123/tsp.19.2.131

Matos, R., Monteiro, D., Antunes, R., Mendes, D., Botas, J., Clemente, J., & Amaro, N. (2021). Home-advantage during COVID-19: An analysis in Portuguese Football League. International Journal of Environmental Research and Public Health, 18(7), Article 3761. https://doi.org/10.3390/ijerph18073761

McCarrick, D., Bilalic, M., Neave, N., & Wolfson, S. (2021). Home advantage during the COVID-19 pandemic: Analyses of European football leagues. Psychology of Sport and Exercise, 56, Article 102013. https://doi.org/10.1016/j.psychsport.2021.102013

McCarrick, D., Brewer, G., Lyons, M., Pollet, T. V., & Neave, N. (2020). Referee height influences decision making in British football leagues. BMC Psychology, 8(1), Article 4. https://doi.org/10.1186/s40359-020-0370-4

McGuire, E. J., Courneya, K. S., Widmeyer, W. N., & Carron, A. V. (1992). Aggression as a potential mediator of the home advantage in professional ice hockey. Journal of Sport and Exercise Psychology, 14(2), 148-158. https://doi.org/10.1123/jsep.14.2.148

McHill, A., & Chinoy, E. D. (2020). Utilizing the National Basketball Association's COVID-19 restart "bubble" to uncover the impact of travel and circadian disruption on athletic performance. Scientific Reports, 10(1), Article 21827. https://doi.org/10.1038/s41598-020-78901-2

Meier, P. F., Flepp, R., & Franck, E. (2021). Are sports betting markets semi-strong efficient? Evidence from the COVID-19 pandemic. International Journal of Sport Finance, 16(3), 111-126. https://doi.org/10.32731/IJSF/163.082021.01

Morita, H., & Araki, S. (2023). Social pressure in football matches: An event study of 'Remote Matches' in Japan. Applied Economics Letters, 30(11), 1522-1525. https://doi.org/10.1080/13504851.2022.2066617

Myers, T., & Balmer, N. (2012). The impact of crowd noise on officiating in Muay Thai: Achieving external validity in an experimental setting. Frontiers in Psychology, 3, Article 346. https://doi.org/10.3389/fpsyg.2012.00346

Myers, T. D., Gilson, T., & Allen, M. S. (2014). Achieving external validity in home advantage research: Generalizing crowd noise effects. Frontiers in Psychology, 5, Article 532. https://doi.org/10.3389/fpsyg.2014.00532

Neave, N., & Wolfson, S. (2003). Testosterone, territoriality, and the 'home advantage'. Physiology and Behavior, 78(2), 269-275. https://doi.org/10.1016/S0031-9384(02)00969-1

Neave N., & Wolfson S. (2004). The home advantage: Psychological and physiological factors in soccer. In D. Lavalle, J. Thatcher, & M. V. Jones (Eds.), Coping and Emotion in Sport (pp. 127-144). Nova Science.

Nevill, A., Balmer, N., & Williams, M. (1999). Crowd influence on decisions in association football. The Lancet, 353(9162), 1416. https://doi.org/10.1016/S0140-6736(99)01299-4

Nevill, A., Balmer, N. J., & Williams, A. M. (2002). The influence of crowd noise and experience upon refereeing decisions in football. Psychology of Sport and Exercise, 3(4), 261-272. https://doi.org/10.1016/S1469-0292(01)00033-4

Nevill, A. M., & Holder, R. L. (1999). Home advantage in sport: An overview of studies on the advantage of playing at home. Sports Medicine, 28(4), 221-236. https://doi.org/10.2165/00007256-199928040-00001

Nevill, A, Webb, T., & Watts, A. (2013). Improved training of football referees and the decline in home advantage post-WW2. Psychology of Sport and Exercise, 14(2), 220-227. https://doi.org/10.1016/j.psychsport.2012.11.001

Nomura, R. (2022). Influence of crowd size on home advantage in the Japanese football league. Frontiers in Sports and Active Living, 4, Article 927774. https://doi.org/10.3389/fspor.2022.927774

Oudejans, R. R. D., Verheijen, R., Bakker, F. C., Gerrits, J. C., Steinbrückner, M., & Beek, P. J. (2000). Errors in judging 'offside' in football. Nature, 404(6773), 33. https://doi.org/10.1038/35003639

Pace, A., & Carron, A. V. (1992). Travel and the home advantage. Canadian Journal of Sports Sciences, 17(10), 60-64.

Page, K., & Page, L. (2010). Alone against the crowd: Individual differences in referees' ability to cope under pressure. Journal of Economic Psychology, 31(2), 192-199. https://doi.org/10.1016/j.joep.2009.08.007

Paulauskas, R., Stumbras, M., Coutinho, D., & Figueira, B. (2022). Exploring the impact of the COVID-19 pandemic in Euroleague Basketball. Frontiers in Psychology, 13, Article 979518. https://doi.org/10.3389/fpsyg.2022.979518

Pettersson-Lidborn, P., & Priks, M. (2010). Behavior under social pressure: Empty Italian stadiums and referee bias. Economics Letters, 108(2), 212-214. https://doi.org/10.1016/j.econlet.2010.04.023

Piancastelli, L. S. C., Friel, N., Barreto-Souza, W., & Ombao, H. (2023). Multivariate Conway-Maxwell-Poisson distribution: Sarmanov method and doubly intractable Bayesian inference. Journal of

Computational and Graphical Statistics, 32(2), 483-500. https://doi.org/10.1080/10618600.2022.2116443

Plessner, H., & Haar, T. (2006). Sports performance judgments from a social cognition perspective. Psychology of Sport and Exercise, 7(6), 555-575. https://doi.org/10.1016/j.psychsport.2006.03.007

Pollard, R. (1986). Home advantage in soccer: A retrospective analysis. Journal of Sports Sciences, 4(3), 237-248. https://doi.org/10.1080/02640418608732122

Pollard, R. (2002). Evidence of a reduced home advantage when a team moves to a new stadium. Journal of Sports Sciences, 20(12), 969-973. https://doi.org/10.1080/026404102321011724

Pollard, R. (2006). Home advantage in soccer: Variations in its magnitude and a literature review of the inter-related factors associated with its existence. Journal of Sport Behavior, 29(2), 169-189.

Pollard, R. (2008). Home advantage in football: A current review of an unsolved puzzle. The Open Sports Sciences Journal, 1(1), 12-14. https://doi.org/10.2174/1875399X00801010012

Pollard, R., & Gómez, M. A. (2014). Comparison of home advantage in men's and women's football leagues in Europe. European Journal of Sport Science, 14(S1), S77-S83. https://doi.org/10.1080/17461391.2011.651490

Pollard, R., & Pollard, G. (2005). Long-term trends in home advantage in professional team sports in North America and England (1876-2003). Journal of Sports Sciences, 23(4), 337-350. https://doi.org/10.1080/02640410400021559

Pollard, R., Prieto, J., & Gómez, M. A. (2017). Global differences in home advantage by country, sport and sex. International Journal of Performance Analysis in Sport, 17(4), 586-599. https://doi.org/10.1080/24748668.2017.1372164

Ponzo, M., & Scoppa, V. (2018). Does the home advantage depend on crowd support? Evidence from same-stadium derbies. Journal of Sports Economics, 19(4), 562-582. https://doi.org/10.1177/1527002516665794

Poolton, J., Siu, C. M., & Masters, R. (2011). The home team advantage gives football referees something to ruminate about. International Journal of Sports Science and Coaching, 6(4), 545-552. https://doi.org/10.1260/1747-9541.6.4.545

Price, J., & Wolfers, J. (2010). Racial discrimination among NBA referees. The Quarterly Journal of Economics, 125(4), 1859-1887. https://doi.org/10.1162/qjec.2010.125.4.1859

Prieto, J. (2021). Science mapping: A bibliometric analysis of the home advantage phenomenon in sport. In M. A. Gómez-Ruano, R. Pollard, & C. Lago-Peñas (Eds.), Home advantage in sport: Causes and the effect on performance (pp. 24-30). Routledge. https://doi.org/10.4324/9781003081456-4

Raab, M., Avugos, S., Bar-Eli, M., & MacMahon, C. (2020). The referee's challenge: A threshold process model for decision making in sport games. International Review of Sport and Exercise Psychology, 4(1), 208-228. https://doi.org/10.1080/1750984X.2020.1783696

Ramchandani, G., & Millar, R. (2023). Investigating the "twelfth man" effect in five European domestic football leagues: A COVID-19 induced natural experiment. Journal of Global Sport Management, 8(4), 928-942. https://doi.org/10.1080/24704067.2021.1951614

Reade, J. J., Schreyer, D., & Singleton, C. (2022). Eliminating supportive crowds reduces referee bias. Economic Inquiry, 60(3), 1416-1436. https://doi.org/10.1111/ecin.13063

Ribeiro, L. C., Fonseca, F. S., Costa, G. C. T., Castro, H. O., Santos, P. V. S., & Figueiredo, L. S. (2022). Did the absence of crowd support during the Covid-19 pandemic affect the home advantage in Brazilian elite soccer? Journal of Human Kinetics, 81(1), 251-258. https://doi.org/10.2478/hukin-2022-0047

Ribeiro, H. V., Mukherjee, S., & Zeng, X. H. T. (2016). The advantage of playing home in NBA: Microscopic, team-specific and evolving features. PLoS ONE, 11(3): e0152440. https://doi.org/10.1371/journal.pone.0152440

Rickman, N., & Witt, R. (2008). Favouritism and financial incentives: A natural experiment. Economica, 75(298), 296-309. https://doi.org/10.1111/j.1468-0335.2007.00605.x

Romanowich, P. (2012). Home Advantage in retractable-roof baseball stadia. Perceptual and Motor Skills, 115(2), 559-566. https://doi.org/10.2466/06.20.23.PMS.115.5.559-566

Rovetta, A., & Abate, A. (2021). The impact of cheering on sports performance: Comparison of Serie A statistics before and during COVID-19. Cureus, 13(8), article e 17382. https://doi.org/10.7759/cureus.17382

Salminen, S. (1993). The effect of the audience on the home advantage. Perceptual and Motor Skills, 76(3_suppl), 1123-1128. https://doi.org/10.2466/pms.1993.76.3c.1123

Sampaio, J., Lago, C., Casais, L., & Leite, N. (2010). Effects of starting score-line, game location, and quality of opposition in basketball quarter score. European Journal of Sport Science, 10(6), 391-396. https://doi.org/10.1080/17461391003699104

Samuel, R. D., Tenenbaum, G., & Galily, Y. (2021). An integrated conceptual framework of decision-making in soccer refereeing. International Journal of Sport and Exercise Psychology, 19(5), 738-760. https://doi.org/10.1080/1612197X.2020.1766539

Sánchez, R., & García-de-Alcaraz, A. (2021). Crowd effects, territoriality and home advantage: A sociological explanation. In M. A. Gómez-Ruano, R. Pollard, & C. Lago-Peñas (Eds.), Home advantage in sport: Causes and the effect on performance (pp. 51-63). Routledge. https://doi.org/10.4324/9781003081456-7

Sánchez, A. J., & Lavín, J. M. (2020). Home advantage in European soccer without crowd. Soccer & Society, 22(1-2), 152-165. https://doi.org/10.1080/14660970.2020.1830067

Santana H. A. P., Bettega, O. B., & Dellagrana, R. A. (2021). An analysis of Bundesliga matches before and after social distancing by COVID-19. Science and Medicine in Football, 5(sup1), 17-21. https://doi.org/10.1080/24733938.2021.1903540

Sapp, R. M., Spangenburg, E. E., & Hagberg, J. M. (2018). Trends in aggressive play and refereeing among the top five European soccer leagues. Journal of Sports Sciences, 36(12), 1346-1354. https://doi.org/10.1080/02640414.2017.1377911

Schwartz, B., & Barsky, S. F. (1977). The home advantage. Social Forces, 55(3), 641-661. https://doi.org/10.1093/sf/55.3.641

Scoppa, V. (2008). Are subjective evaluations biased by social factors or connections? An econometric analysis of soccer referee decisions. Empirical Economics, 35(1), 123-140. https://doi.org/10.1007/s00181-007-0146-1

Scoppa, V. (2021). Social pressure in the stadiums: Do agents change behavior without crowd support? Journal of Economic Psychology, 82, Article 102344. https://doi.org/10.1016/j.joep.2020.102344

Sedeaud, A., De Larochelambert, Q., Schipman, J., & Toussaint, J. F. (2021). The COVID-19 pandemic impact on away and home victories in soccer and rugby union. Frontiers in Sports and Active Living, 3, Article 695922. https://doi.org/10.3389/fspor.2021.695922

Silva, A. C., Amaral, A. S., Facundo, L. A., Wiprich, M. T., Rechenchosky, L., & Rinaldi, W. (2022). Two years of COVID-19 pandemic: How the Brazilian Serie A Championship was affected by home advantage, performance and disciplinary aspects. International Journal of Environmental Research and Public Health, 19(16), Article 10308. https://doi.org/10.3390/ijerph191610308

Smith, R. (2005). Disconnects between popular discourse and home advantage research: What can fans and media tell us about the home advantage phenomenon? Journal of Sports Sciences, 23(4), 351-364. https://doi.org/10.1080/02640410400021633

Sors, F., Grassi, M., Agostini, T., & Murgia, M. (2021). The sound of silence in association football: Home advantage and referee bias decrease in matches played without spectators. European Journal of Sport Science, 21(12), 1597-1605. https://doi.org/10.1080/17461391.2020.1845814

Sors, F., Grassi, M., Agostini, T., & Murgia, M. (2023). The influence of spectators on home advantage and referee bias in national teams matches: Insights from UEFA Nations League. International Journal of Sport and Exercise Psychology, 21(2), 290-305. https://doi.org/10.1080/1612197X.2022.2044367

Souchon, N., Cabagno, G., Rascle, O., Traclet, A., Dosseville, F., & Maio, G. R. (2009). Referees' decision making about transgressions: The influence of player gender at the highest national level. Psychology of Women Quarterly, 33(4), 445-452. https://doi.org/10.1111/j.1471-6402.2009.01522.x

Spitz, J., Put, K., Wagemans, J., Williams, A. M., & Helsen, W. F. (2016). Visual search behaviors of association football referees during assessment of foul play situations. Cognitive Research: Principles and Implication, 1(1), Article 12. https://doi.org/10.1186/s41235-016-0013-8

Staufenbiel, K., Lobinger, B., & Strauss, B. (2015). Home advantage in soccer - a matter of expectations, goal setting and tactical decisions of coaches? Journal of Sports Sciences, 33(18), 1932-1941. https://doi.org/10.1080/02640414.2015.1018929

Steinfeldt, H., Dallmeyer, S., & Breuer, C. (2022). The silence of the fans: The impact of restricted crowds on the margin of victory in the NBA. International Journal of Sport Finance, 17(3), 165-177. https://doi.org/10.32731/IJSF/173.082022.04

Stone, J., Perry, Z. W., & Darley, J. M. (1997). "White men can't jump": Evidence for the perceptual confirmation of racial stereotypes following a basketball game. Basic and Applied Social Psychology, 19(3), 291-306. https://doi.org/10.1207/s15324834basp1903_2

Strauss, B. (2002). The impact of supportive spectator behavior on performance in team sports. International Journal of Sport Psychology, 33(4), 372-390.

Sutter, M., & Kocher, M. G. (2004). Favoritism of agents - the case of referees' home bias. Journal of Economic Psychology, 25(4), 461-469. https://doi.org/10.1016/S0167-4870(03)00013-8

Szabó, D. Z. (2022). The impact of differing audience sizes on referees and team performance from a North American perspective. Psychology of Sport and Exercise, 60, Article 102162. https://doi.org/10.1016/j.psychsport.2022.102162

Terry, P. C., Walrond, N., & Carron, A. V. (1998). The influence of game location on athletes' psychological states. Journal of Science and Medicine in Sport, 1(1), 29-37. https://doi.org/10.1016/S1440-2440(98)80006-6

Tilp, M., & Thaller, S. (2020). Covid-19 has turned home advantage into home disadvantage in the German soccer Bundesliga. Frontiers in Sports and Active Living, 2, Article 593499. https://doi.org/10.3389/fspor.2020.593499

Torgler, B. (2004). The economics of the FIFA football World Cup. Kyklos, 57(2), 287-300. https://doi.org/10.1111/j.0023-5962.2004.00255.x

Ungureanu, A. N., Lupo, C., & Brustio, P. R. (2021). A machine learning approach to analyze home advantage during COVID-19 pandemic period with regards to margin of victory and to different tournaments in professional rugby union competitions. International Journal of Environmental Research and Public Health, 18(23), Article 12711. https://doi.org/10.3390/ijerph182312711

Unkelbach, C., & Memmert, D. (2008). Game-management, context-effects and calibration: The case of yellow cards in soccer. Journal of Sport and Exercise Psychology, 30(1), 95-109. https://doi.org/10.1123/jsep.30.1.95

Unkelbach, C., & Memmert, D. (2010). Crowd noise as a cue in referee decisions contributes to the home advantage. Journal of Sport and Exercise Psychology, 32(4), 483-498. https://doi.org/10.1123/jsep.32.4.483

van Damme, N., & Baert, S. (2019). Home advantage in European international soccer: Which dimension of distance matters? Economics, 13(2019-50), 1-17. https://doi.org/10.5018/economics-ejournal.ja.2019-50

van de Ven, N. (2011). Supporters are not necessary for the home advantage: Evidence from same-stadium derbies and games without an audience. Journal of Applied Social Psychology, 41(12), 2785-2792. https://doi.org/10.1111/j.1559-1816.2011.00865.x

Vandoni, M., Ferraro, O. E., Gatti, A., Marin, L., Giuriato, M., Silvestri, D., Lovecchio, N., Puci, M. V., & Carnevale Pellino, V. (2022). The role of crowd support on home advantage during COVID-19 restrictions on Italian football competitions: Comparison between 2018-19 and 2020-21 seasons of the Italian Serie A and Serie B Championships. Sports, 10(2), Article 17. https://doi.org/10.3390/sports10020017

van Ours, J. C. (2019). A note on artificial pitches and home advantage in Dutch professional football. Economist, 167(1), 89-103. https://doi.org/10.1007/s10645-019-09332-2

Wallace, H. M., Baumeister, R. F., & Vohs, K. D. (2005). Audience support and choking under pressure: A home disadvantage? Journal of Sports Sciences, 23(4), 429-438. https://doi.org/10.1080/02640410400021666

Webb, T. (2021). The future of officiating: Analysing the impact of COVID-19 on referees in world football. Soccer & Society, 22(1-2), 12-18. https://doi.org/10.1080/14660970.2020.1768634

Webb, T., Dicks, M., Thelwell, R., & Nevill, A. (2018). The impact of referee training: Reflections on the reduction of home advantage in association football. Soccer & Society, 19(7), 1024-1037. https://doi.org/10.1080/14660970.2016.1267626

Weston, M. (2015). Match performance of soccer referees: The role of sport science. Movement and Sport Sciences, 87(1), 113-117. https://doi.org/10.3917/sm.087.0113

Winkelmann, D., Deutscher, C., & Oetting, M. (2021). Bookmakers' mispricing of the disappeared home advantage in the German Bundesliga after the COVID-19 break. Applied Economics, 53(26), 3054-3064. https://doi.org/10.1080/00036846.2021.1873234

Wolfson, S., Wakelin, D., & Lewis, M. (2005). Football supporters' perceptions of their role in the home advantage. Journal of Sports Sciences, 23(4), 365-374. https://doi.org/10.1080/02640410400021567

Wunderlich, F., Weigelt, M., Rein, R., & Memmert, D. (2021). How does spectator presence affect football? Home advantage remains in European top-class football matches played without spectators during the COVID-19 pandemic. PLoS ONE, 16(3): e0248590. https://doi.org/10.1371/journal.pone.0248590

Yi, Q., Gómez, M. A., Liu, H., Gao, B., Wunderlich, F., & Memmert, D. (2020). Situational and positional effects on the technical variation of players in the UEFA Champions League. Frontiers in Psychology, 11, Article 1201. https://doi.org/10.3389/fpsyg.2020.01201

Zeller, R. A., & Jurkovac, T. (1989). A dome stadium: Does it help the home team in the national football league? Sport Place, 3(3), 36-39.

Zimmer, T. E., Snyder, A., & Bukenya, L. (2021). American baseball fans do not influence game outcomes. Economics Bulletin, 41(2), 741-750.