Research Article

FIFA World Cup 2022 Qatar Corner Kicks: An Analysis on Effectiveness and Match Context

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This study presents an analysis of the tactical and technical characteristics of corner kicks during the 2022 FIFA World Cup, focusing on their effectiveness and influence on match dynamics. A total of 570 corner kicks were examined using a sequential notational approach, followed by descriptive statistical analysis. The goal conversion rate was 2.6%, with corner kicks influencing the match status in 73.3% of cases. Delivery into the Penalty Area 1 and 2 (PA1/2), the central zones in front of the goal, was associated with the highest number of goal attempts and goals. Direct out-swinging deliveries generated more goal-scoring opportunities than other types of delivery. Defensively, a mixed zonal dominance structure was linked to fewer goals conceded, while mixed individual dominance was associated with fewer goal attempts, though it required more defensive involvement. Common actions during corner sequences included defender interventions and short passes. Action development most frequently occurred in Wing Zones 1 and 2 (W1/2) and PA1/2, while successful teams often used the Wide Forward and Midfield Zones (AFGM). These findings describe patterns in corner kick execution and defensive strategies observed during the tournament.

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Introduction

Traditionally, football has been analysed through notation of events, and much of the literature reflects this through game actions being the most common research approach in performance analysis[1]. Despite how extensively game actions have been investigated, there has been limited success in

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understanding the nuances of the sport, either due to high variability in performance or an inability of these methods to adequately quantify performance[2]. Considering the fluid nature of football, providing insight into the being modelled as a dynamic and complex system has led analysts to investigate novel approaches such as spatial temporal analysis[3][4]. These approaches might offer insight into the self-organisation of teams during open play; however, football can be broken down into two phases. The first is the dynamic phase, which occurs when the ball is in play; and the second is the static phase, when the game is paused or when it resumes after a regulatory break[5]. This static phase, comprised of set pieces including goal kicks, free kicks, penalties, throw-ins, and corner kicks, offers teams the opportunity for planning and strategic organisation. Due to this shift in dynamics, evaluation of set pieces through notational analysis of game actions shows greater promise in identifying valuable observations. This is highlighted by Sarmento et al,[6] who emphasised the relevance of set pieces as a trend in contemporary performance analysis.

Interruptions account for 38% of match time in elite domestic and international competitions[7]. These authors referred to the most common stoppage as a throw-in, which accounted for 37% of stoppages, with corners taking up 9% of stoppages. Although only accounting for 9% of stoppages, corners can be an important prong in a team's gameplay. A corner kick is a set piece that is awarded to the attacking team after the defending team makes the last contact with the ball before it goes over the defending team's goal line on either side of the goalposts[8]. The investigation of corner kicks has become an increasingly relevant area in performance analysis, offering insights into the nuanced strategies and outcomes prevalent in elite football. Remarkably, Casal et al.[9] undertook a comprehensive observational study encompassing three prestigious competitions: the 2010 FIFA World Cup, UEFA Euro 2012, and the UEFA Champions League 2010-2011. Their research shed light on the multifaceted dynamics of corner kicks, revealing intriguing patterns in player performance metrics across different matches and tournament stages. Similarly, Sainz De Baranda's[10] contributions, particularly his examinations of corner kick dynamics in the 2002 and 2006 FIFA World Cups, offer valuable insights into how corner kicks influence match status across diverse competitions. These studies underscore the significance of contextual analysis in understanding the effectiveness of corner kicks within the dynamic landscape of elite football.

While previous research has primarily focused on corner kicks in domestic leagues such as the English Premier League, the dearth of literature examining corner kick dynamics in international tournaments presents an opportunity for further exploration. Pulling's seminal works on corner kicks within the

Premier League, although not specific to international competitions, introduce innovative methodologies such as zoning techniques to track delivery and first-contact points[11]. Likewise, Gouveia et al. [12] explored corner kick dynamics in Portuguese domestic football, utilising zone-based analyses within the penalty area to discern performance trends. These studies highlight the evolving methodologies employed in corner kick analysis, laying the groundwork for more nuanced investigations into corner kick dynamics on the international stage.

An emerging area of inquiry lies in the examination of defensive strategies employed during corner kicks and their implications for match outcomes. Studies by Kubayi and Larkin[13] and Pulling, Robins, and Rixon[14] offer valuable insights into the effectiveness of different marking systems in thwarting corner kick threats. However, further research is warranted to explore nuanced variations within mixed marking systems and their differential impact on defensive outcomes. Additionally, a comparative analysis of defensive strategies deployed by successful versus unsuccessful teams could provide invaluable insights into the tactical nuances that contribute to match success. By delving into these unexplored dimensions of corner kick analysis, researchers can advance their understanding of the tactical and technical intricacies that underpin success in elite football.

These intricacies extend beyond defensive organisation, with a range of factors having been identified as relevant to the dynamics of a corner kick. Several articles have applied similar zoning systems to evaluate effective locations for corner delivery[15][16][17][12]. These commonly highlight that the most effective area of delivery is 6-9 yards from the goal line and within the width of the goal. Alternative strategies, such as playing the ball short to a teammate, have been explored; however, Prieto Lage et al[15] highlight that more goals came from direct corners, especially targeting the aforementioned area of delivery. Delivery type has also been investigated, with a recent article by Goodman[16] identifying that in-swinging corners (75.1%) are more common than out-swinging (20.3%) or other (4.6%) types of corner delivery when investigating the Northern Ireland Football league. This finding is similar to Prieto Lage et al, [15] who found that English teams had a similarly high frequency of in-swinging corners (68.8%); however, other European countries ranged from 41.9-53.2%. This suggests there might be cultural differences between corner-taking strategies. Other articles have also found differences in corner outcomes based on situational variables such as match location[18] and match status[16][17]. To combat the broad variation and tactical nuances of corners, current approaches for measuring them include extensive tools for recording as much detail from each corner as possible, including other strategies such

as players on the posts and the defensive strategy selected[19][16]. These approaches have only had some success in understanding the dynamics of a corner despite the constrained nature of the skill[16].

A critical gap in existing literature pertains to the holistic analysis of corner kick phases, extending beyond the initial delivery to encompass subsequent actions and interactions within the corner phase. While previous studies have provided valuable insights into the effectiveness of corner kick delivery types and target zones, there remains a need to elucidate the intricate build-up phases preceding successful corner kicks. By collecting granular data on actions throughout the entirety of the corner phase, including specific pitch zones and match contexts, researchers can unravel the tactical and technical intricacies underlying successful corner kick execution. This holistic approach promises to enrich our understanding of corner kick dynamics and their influence on match outcomes, bridging the gap between theoretical analysis and practical application in elite football.

This study embarks on a novel exploration within football analytics, particularly focusing on the corner kick dynamics in the distinctive setting of the FIFA Qatar World Cup. Notably, factors such as the tournament's unique environment, the record-high duration of matches, and its scheduling within the European domestic season underscore a significant gap in the existing literature. Moreover, given the recency of the event, there is a conspicuous absence of academic discourse pertaining to corner kick analysis specific to the 2022 World Cup. Against this backdrop, this paper seeks to introduce pioneering insights and methodologies to address this research gap. The primary objectives of this study are twofold: firstly, to meticulously gather and analyse tactical and technical performance variables associated with corner kicks to delineate the most effective characteristics; and secondly, to delve into how corner kicks influence match status and to ascertain the divergent technical and tactical attributes of corner kicks between successful and unsuccessful teams. Through these multifaceted objectives, this research endeavours to enrich the understanding of corner kick strategies and their impact on match outcomes within the context of elite football tournaments, ultimately contributing to the advancement of football performance analysis.

Methods and materials

Procedures

The data collection tool for this research study has been adapted and developed from Gouveia et al.[12]. Data were collected in Microsoft Excel in real-time using video footage of the match accompanied by

slow-motion and replay features[20]. The components of performance collected with the data collection tool used for this research were broken down into four sections: 1) contextual description, 2) defensive and attacking organisation, 3) corner kick action, and 4) duration of the action. Contextual data comprise the competition stage and the time within the match. The second section focuses on the defensive and attacking organisation. This section solely focuses on the defensive and attacking tactical strategies inside the box. It consists of the number of attackers and defenders in the box, the defensive method used, and the appearance or lack of players in each goalpost area. Corner kick action identifies components varying from the type of corner to the last action in the corner phase. The final section solely includes the duration of the action that was collected, which is simply the time elapsed from the contact with the ball to the end of the corner kick phase. Tables 1, 2, 3, and 4 show a breakdown of the performance components, the variables for said performance components, and the description. Using this level of detail for this data collection tool meant that an outcome that was not anticipated before the analysis was able to be seen in the data analysis section, allowing important new lines of enquiry to be followed if they emerge[21]. Additionally, to add more context and detail to the data, location data were collected by dividing the pitch into sixteen sections (Figure 1). This zoning system was adapted from previous work by Gouveia et al.[12] and designed to allow for more precise identification of delivery and action zones commonly used in elite football contexts. Collecting location data for specific actions allowed for more specific conclusions to be drawn.

Performance Component	Variables	Code	Description
Stage of the competition 002 The phase of the competition where the match belongs	Group Stage	Group Stage	
	Round of Sixteen	R16	
	Quarterfinals	Quarterfinals	
	Semi-Finals Third v Forth Place Playoff	Semi-Finals 3^{rd} v 4^{th} Place Playoff	
	Final	Final	
Match 003	Teams Playing	Name of the teams	Format: Home Team vs Away Team
Time of play 004 Time in which the corner was taken	Zero - Fifteen minutes	0-15	The corner kick was taken between the 1st and the 15th minute
	Sixteen - Thirty minutes	16-30	The corner kick was taken between the 16th and the 30th minute
	Thirty-First Minute - Half Time	31-HT	The corner kick was taken between the 31st and the half-time
	Forty-Six - Sixty minutes	46-60	The corner kick was taken between the 46th and the 60th minute
	Sixty-One -Seventy-Five minutes	61-75	The corner kick was taken between the 61st and the 75th minute
	Seventy-Six-Ninetieth minutes	76-90	The corner kick was taken between the 76th and the 90th minute
	Stoppage time	ST	The corner kick was taken during stoppage time
	Extra Time	ET	Extra time is played during knock-out stages.
Location of match 005	Home	Home	The corner kick was taken by the home team

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Performance Component	Variables	Code	Description
Pitch where the match was played	Away	Away	The corner kick was taken by the away team
	Neutral	Neutral	The game takes place in a neutral stadium
Match Result 006 Partial result of the match	Winning by more than one goal	Winning by +1	The attacking team is winning by at least 2 goals
	Winning by one goal	Winning by 1	The attacking team is winning by 1 goal
	Tying	Tying	The match is tied
	Losing by one goal	Losing by 1	The attacking team is losing by 1 goal
	Losing by more than one goal	Losing by +1	The attacking team is losing by at least 2 goals
Level of the opponent 007 Evaluation of the capacity of the attacking team	Higher level competition	Higher competitive level	The competitive level of the defending team is higher in comparison to the attacking team.
	Low-level competition	Low-level competition	The competitive level of the defending team is lower in comparison to the attacking team.
	Same level competition	Same level competition	The competitive level of the defending team is similar comparison to the attacking team.

Table 1. Contextual description: relevant features related to the competition and match status.

In national teams' classifications, the FIFA ranking is used at the beginning of the competition, and a difference superior to 10 places in the rank determines a higher or lower competitive level. Equal to or less than 10 places, the teams are considered from the same competitive level.

Performance Component	Variables	Code	Description
Number of defenders in the box 008a Defenders inside the box	Seven or Less	7 Or Less	7 defenders or less
	Between Eight and Nine	8-9	Between 8 and 9 defenders
	Ten	10	10 defenders
Defensive method 008b Defensive style adopted	Individual marking	Individual marking	Individual marking/ 1-1 defending
	Zonal defending	Zonal defending	Zonal defense
	Mixt individual dominance	Mixt individual dominance	Both methods are present, with individual marking dominant
	Mixt zonal dominance	Mixt zonal dominance	Both methods are present, with zonal marking dominant
Defenders in the posts 008c Protection of the posts	First post	1st post	Defender in the 1st post area
	Second post	2nd post	Defender in the 2nd post area
	Both posts	Both posts	Defenders in both posts' areas
	Neither	Neither	No defenders on the goalposts
Number of attackers in the box 009	Less than four attackers	4 or less	Players who intend to attack the ball or to intervene in the action (players placed to provide shorts corner solution, to finalize or to win rebounds)
	Five attackers	5	
	Six attackers	6	
	Seven or more attackers	7+	

Table 2. Defensive and attacking organization: Aspects regarding the tactical context of the corner kick.

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Performance Component	Variables	Code	Description
Corner side 010 The side where the corner is awarded	Right side and foot	Right side and foot	A Corner was awarded on the right side of the attacking team and taken with the right foot.
	Right side, left foot	Right side, left foot	A Corner was awarded on the right side of the attacking team and taken with the left foot.
	Left side, right foot	Left side, right foot	A Corner was awarded on the left side of the attacking team and taken with the right foot.
	Left side and foot	Left side and foot	A Corner was awarded on the left side of the attacking team and taken with the left foot.
Number of attackers providing short solutions 011 Players placed or appearing near the corner marker	Zero	0	No players providing a short corner option
	One	1	1 player is near or appears to provide a short corner option
	Two	2	2 players are near or appear to provide a short corner option
	Three or more	3+	3 or more players are near or appear to provide a short corner option
Type 012 The trajectory that the ball describes	Direct outswing	Direct outswing	Ball enters/crosses the box directly with an open trajectory (spinning away from the goal)
	Direct inswing	Direct inswing	Ball enters/crosses the box directly with a closed trajectory (spinning towards the goal)
	Direct flat	Direct flat	Ball enters/crosses the box directly with a flat trajectory
	Direct ground pass	Direct ground pass	Ball enters/crosses the box directly with a ground pass
	Short corner penetration	Short corner penetration	The attacking team touches the ball more than one time after it enters (or aims to) or crosses the box or aims to enter the box with the ball controlled. Situations in which a shot occurs from out of the box after a short corner also enter here.

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Performance Component	Variables	Code	Description
	Short corner back pass	Short corner back pass	Short corner aiming a ground pass to the outside of the goal area (OBM and OBS1/2).
	Short corner medium pass	Short corner medium pass	Short corner aiming an air pass which enters before the imaginary line from the middle of the goal to the middle of the pitch.
	Short corner long pass	Short corner long pass	Short corner aiming an air pass which enters after the imaginary line from the middle of the goal to the middle of the pitch.
	Others	Others	Any other delivery trajectory which doesn't fit in any other category.
Zone of the first touch 013a Where the first contact on the ball took place	Zones defined in the pitch	W1/2	Wings; between the attacking quarter imaginary line, the sideline of the box, the sideline, and the goal line
		AFGW1/2	Away from the goal in the wings; between the projection of the sideline of the box, the attacking quarter imaginary line, the sideline, and the midfield line
		AFGM	Away from the goal in the middle; between the projection of the sidelines of the box, the attacking quarter imaginary line, and the midfield line.
		OBS1/2	Out of the box on the sides; between the imaginary line of the attacking quarter, the box, the projection of the sideline of the goal area and the projection of the sideline of the box
		OBM	Out of the box in the middle; between the imaginary line of the attacking quarter, the box, the projection of the sideline of the goal area and the imaginary line from the middle of the goal to the middle of the pitch.

Performance Component		Variables	Code	Description
			LZ1/2	Lateral zone; between the box, the lateral sideline of the box, the projection of the line of the goal area and the sideline of the goal area
			DLZ1/2	Deep lateral zone; between the goal line, sideline of the box, and goal area. lines
			PA1/2	Penalty area; between the goal and box lines, the projection of the lateral line of the goal area and the imaginary line from the middle of the goal to the middle of the pitch
			GA 1/2	Goal area: between the goal area lines, the goal line and the imaginary line from the middle of the goal to the middle of the pitch.
			Out/Fault	The ball NN enter the pitch.
Player of the first touch 013b A player that touches the ball after being played with the intention to search for finalization		Attacker	Attacker	The ball is touched by an attacker in the first place
		Defender	Defender	The ball is touched by a defender in the first place
		Goalkeeper	Goalkeeper	The ball is touched by the GK in the first place
		None	None	No one touches the ball: direct goal or the ball goes out, or a fault is committed
Action development 014a All the interventions on the ball by the player/team to keep the ball in control[6]	AT	Short passing	Short passing	The ball carrier performs a short pass (within the same zone or within two nearby zones)
		Long passing	Long passing	The ball carrier performs a long pass (jumps at least one zone) or surpasses at least two opponents in an air trajectory even in two nearby zones.
		Ball conduction	Ball conduction	The ball carrier contacts the ball at least 3 consecutive times with displacement.

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Performance Component		Variables	Code	Description
		Control of the ball	Control of the ball	The ball carrier receives the ball from a colleague, keeping it
		Dribble	Dribble	The ball carrier dribbles his opponent(s) to keep the ball or manage space or win position
		Duel	Duel	The player from the attacking team fights for the ball with an opponent in the air or on the floor, trying to keep it in possession
		Goalkeeper action	GK action	The Intervention of the GK from the attacking team in the attack
		Shot	Shot	The attacking team makes a shot that doesn't end the action.
		Crossing	Crossing	The ball carrier is in one wing (W1/2, AFGW1/2) and sends the ball to the central corridor with a ground or aerial pass
	DT	Defender intervention	Defender intervention	An opponent touches the ball, but it doesn't control it, i.e., breaking the attacking process of the attacking team
	DT	Opponent attacking action	Opponent attacking action	Any player from the team which defended the corner performs an attacking action to counterattack the corner.
	DT	Action from the other team's Goalkeeper	OGKE action	The Intervention of the GK from the defending team
	Both	Other	Other	Other development not described above
Action development zone 014b Where the previous actions took place		Zones defined in the pitch	Described above	Described above
Last action 015a	AT	Heading	Heading	Shot with the head.

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Performance Component		Variables	Code	Description
The immediate action before the end of the corner kick situation		Foot	Foot	Shot with the foot.
		Attacking team technical action	Attacking team technical action	Technical actions of the attacking team led to keeping ball possession and ending the corner kick situation by entering into their attacking organisation.
		Lost ball	Lost ball	Ball is lost after a cross, pass or any technical action without finalization.
		Attacking team GK intervention	Attacking team GK intervention	The GK of the attacking team receives a back pass or makes a safe, ending the action.
		Another attacking team action	Another attacking team action	Another unmentioned action by the attacking team (fault, off-side, defensive action, etc.)
	DT	Defending GK block	Defending GK block	The GK from the defending team blocks the ball and it doesn´t explore attacking transition possibilities.
		Defending GK safe	Defending GK safe	The GK of the defending team makes a save and the action ends after it with the ball leaving the pitch after.
		Defender action	Defender action	Any defensive technical action from the defending team which ended the corner kick situation (cut, clearance, interception, fault).
		Defending team technical action	Defending team technical action	The last action is an attacking technical action performed by a player of the defending team allowing to upkeep ball possession or to counterattack.
		Another defending team action	Another defending team action	Another unmentioned action by the defending team.

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Performance Component		Variables	Code	Description
Corner kick outcome 016 What happened in the sequence of the corner kick?	AT	Goal	Goal	A goal is scored in the sequence of the corner kick.
		Goal attempt on target	Goal attempt on target	No goal, but an attempt with finalization on target was made (excluding goalposts)
		Goal attempts off target	Goal attempt off target	No goal, but an attempt with finalization off-target was made
		Shot without danger	Shot without danger	A shot is made, but it happens: i) from a difficult position; and/or ii) goes wide or the GK defends without difficulty.
		Penalty	Penalty	In the sequence of the action, a penalty kick is given to the attacking team
		Free kick	Free kick	The action ends with a fault committed by the defending team resulting in a free kick.
		Corner Kick	Corner Kick	A corner kick is awarded to the attacking team
		Attacking team Possession	Attacking team Possession	The action ends with other technical actions not described above and the attacking team enters their attacking organization and the specific formations of the teams related to corner kicks completely disappear.
		Ball out	Ball out	The ball goes out directly with no one touching it.
		Another attacking team	Another attacking team	Another different outcome results from an attacking team action (goal kick, throw-in...)
	DT	Attacking transition	Attacking transition	The defending team gets the ball and takes it controlled to ANOTHER zone.
		Attacking transition in the box	Attacking transition in the box	The defending team enters the box with the ball controlled or tries a pass with criteria.

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Performance Component		Variables	Code	Description
		Attacking transition shot	Attacking transition shot	The defending team gets a shot without scoring
		Attacking transition goal	Attacking transition goal	The opponent team gets a goal.
		Fault	Fault	The action ends with a fault committed by the attacking team
		Defending team possession	Defending team possession	The action ends with ball possession to the defending team and the specific formations of the teams related to corner kicks completely disappear.
		Another defending team	Another defending team	Another different situation results from a defensive team action, e.g. a Throw-in

Table 3. Corner kick action: Zones and consequent actions of the corner kick.

Performance Component	Variables	Code	Description
Duration of the action 017	Time	Seconds	The time is measured from the 1st touch on the ball until the action ends: 1) with a goal; 2) leaving the pitch; 3) with a fault; and/or 4) with one team retaining ball possession and the specific corner kick organization disappears; 5) With a backwards pass to the GK of the attacking team; 6) With a block from the defending team GK, retaining the ball allowing the organization of the team that beaten the corner kick.

Table 4. Duration of the action: Time elapsed from the contact with the ball to the end of the corner kick-specific action.

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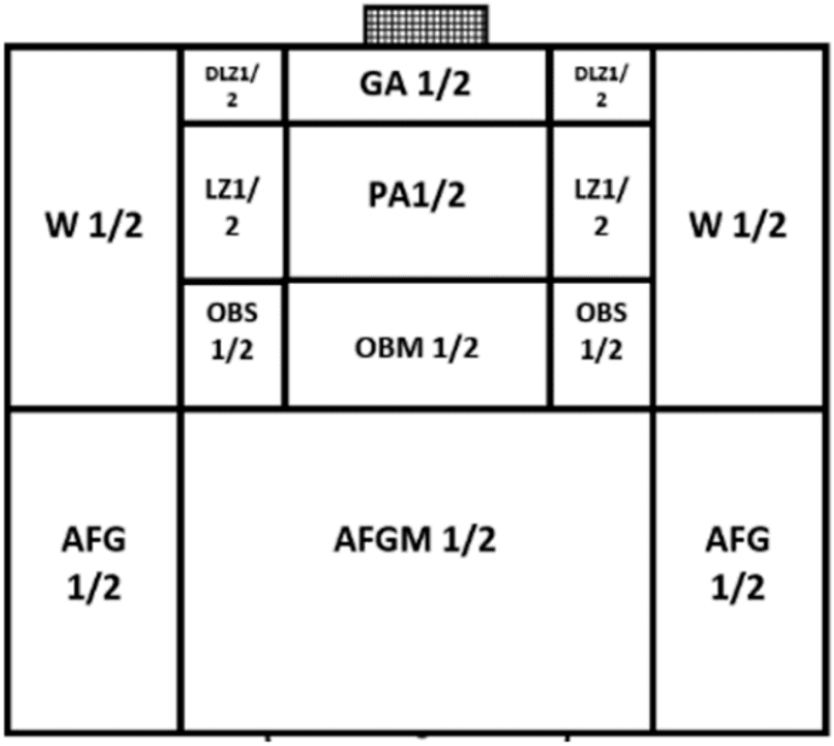

Figure 1. A visualization of the zones used for the data collection.

Data collection

Corner data from 64 World Cup matches were collected through notation from video broadcasts of the football matches. To facilitate accuracy, matches were recorded and notated post-event remotely, allowing for replay and slow-motion features. A total of 570 corner kicks, with 21 different performance components, were gathered, with each respective performance component having multiple different variables.

These games took place over 29 days, from the 20th of November 2022 to the 18th of December 2022[22]. To collect the required data for all 64 games of the 2022 World Cup, every game was observed. To decrease the chance of inaccurate data collection, data were collected remotely, post-event, which means that the planned period of data collection was 31 days. The experimental protocol and investigation were approved by the local University Research Ethics Committee and performed according to the Helsinki Declaration's ethical standards.

Statistical analysis

The dataset comprised 570 corner kicks recorded during the 2022 FIFA World Cup, encompassing 21 distinct performance components, each with multiple categorical variables. A rigorous data cleaning and verification process was undertaken the day after initial collection, involving cross-referencing each entry with match footage to identify and resolve discrepancies.

Following verification, the data were analysed using Microsoft Excel, with descriptive statistics employed to summarise frequencies and distributions. Percentages were calculated by dividing the count of each category by the total number of observations for that variable. The "Per 90" metric refers to the average number of occurrences per 90 minutes (i.e., per match), derived by dividing the total occurrences by the number of matches (n = 64). This approach enabled clear representation of performance trends across teams and match contexts.

Intra-rater reliability was assessed using Cohen's Kappa across all coding categories. A sub-sample of 57 corner kicks (10% of the dataset) was independently re-coded more than three months after initial analysis to assess coding consistency and minimise memory bias[23].

Given the exploratory focus of the study and the categorical nature of most variables, the analysis was limited to descriptive statistics. Although inferential methods (e.g., chi-square tests or logistic regression) could offer deeper insights into the relationships between variables, such analyses were beyond the scope of this initial investigation and are recommended for future research.

Results

Analysis of corner kicks during the 2022 World Cup revealed several noteworthy findings (tables 5, 6, and 7). Over the 64 matches, 570 corner kicks were taken, with a mean of 8.91 ± 3.44 per match. Of the 570 corner kicks observed, only 2.6% resulted in goals, with an additional 3.2% leading to shots on target. The most effective areas of delivery were identified as PA 1/2, with direct out-swinging corner kicks proving to be the most successful delivery type in terms of generating goal-scoring opportunities. Defensive strategies varied, with a mixed zonal dominance approach proving effective in limiting goals conceded, while mixed individual dominance was optimal for reducing goal attempts. Notable actions following corner kicks included defender interventions and short passes, consistent across both successful and unsuccessful teams. The most prevalent zones for action development were W1/2 and PA1/2, with a majority of first touches occurring in these areas.

The corner kick analysis tool demonstrated high levels of intra-rater reliability. Over the thirteen aspects observed, excellent Cohen's Kappa values ($\kappa > 0.85$) were found for 7 aspects, including No. Defenders in the box, Defensive method, No. Attackers in the box, No. Attackers providing short options, Zone of first touch, Last Action, and Corner kick outcome. Other aspects, including Defenders in the posts, Corner side, type, Player of first touch, and Action Development, were found to have good Cohen's Kappa ($\kappa > 0.7$), and only the Action development zone was found to have moderate Cohen's Kappa ($\kappa > 0.55$) (table 8).

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Description	Variables	Total
Stage of Competition	Group Stage	431
	R16	69
	Quater Finals	39
	Semi Finals	11
	3rd v 4th Playoff	9
	Final	11
Time of Play	0-15	75
	16-30	72
	31-HT	106
	46-60	88
	61-75	77
	76-90	75
	ST	55
	ET	22
Location	Neutral	570
	Home	0
	Away	0
Result	Winning by +1	52
	Winning by 1	67
	Tying	314
	Losing by 1	106
	Losing by 1+	31
Level of the opponent	Higher level competition	144
	Low level competition	262
	Same level competition	164

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Table 5. Match details.

Description	Variables	Total	%	Per 90
No. Defenders in the box	7 or Less	70	12.3%	1.09
	8-9	306	53.7%	4.78
	10	194	34.0%	3.03
Defensive Method	Individual Marking	1	0.2%	0.02
	Zonal Defending	18	3.2%	0.28
	Mix Individual dominance	283	49.6%	4.42
	Mix zonal dominance	268	47.0%	4.19
Defenders in the posts	1st Post	376	66.0%	5.88
	2nd Post	12	2.1%	0.19
	Both Posts	51	8.9%	0.80
	Neither	131	23.0%	2.05
No. attackers in the box	4 or less	53	9.3%	0.83
	5	294	51.6%	4.59
	6	196	34.4%	3.06
	7+	27	4.7%	0.42

Table 6. Defensive and Offensive Organisation: Distribution of defensive methods, player positioning, and attacking numbers recorded during corner kicks. “Per 90” refers to the average number of occurrences per 90 minutes (i.e., per match).

Description	Variables	Total	%	Per 90
Corner Side	Right Side and foot	160	28.1%	2.50
	Right side, left foot	136	23.9%	2.13
	Left side, right foot	177	31.1%	2.77
	Left side and foot	97	17.0%	1.52
No. Attackers providing short options	0	311	54.6%	4.86
	1	247	43.3%	3.86
	2	12	2.1%	0.19
	3+	0	0.0%	0.00
Type	Direct outswing	206	36.1%	3.22
	Direct inswing	230	40.4%	3.59
	Direct flat	22	3.9%	0.34
	Direct ground pass	9	1.6%	0.14
	Short corner penetration	97	17.0%	1.52
	Short corner back pass	3	0.5%	0.05
	Short corner medium pass	3	0.5%	0.05
	Short corner long pass	0	0.0%	0.00
	Others	0	0.0%	0.00
Zone of first touch	W1/2	101	17.7%	1.58
	AFGW1/2	2	0.4%	0.03
	AFGM	8	1.4%	0.13
	OBS1/2	3	0.5%	0.05
	OBM	1	0.2%	0.02
	LZ1/2	18	3.2%	0.28
	DLZ1/2	39	6.8%	0.61
	PA1/2	210	36.8%	3.28

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Description	Variables	Total	%	Per 90
	GA 1/2	178	31.2%	2.78
	Out/Fault	10	1.8%	0.16
Player of first touch	Attacker	243	42.6%	3.80
	Defender	268	47.0%	4.19
	Goalkeeper	50	8.8%	0.78
	None	9	1.6%	0.14
Action Development	Short passing	453	21.0%	7.08
	Long passing	66	3.1%	1.03
	Ball conduction	47	2.2%	0.73
	Control of the ball	402	18.6%	6.28
	Dribble	57	2.6%	0.89
	Duel	71	3.3%	1.11
	GK action	2	0.1%	0.03
	Shot	222	10.3%	3.47
	Crossing	95	4.4%	1.48
	Defender intervention	507	23.5%	7.92
	Opponent offensive action	135	6.3%	2.11
	OGKE action	76	3.5%	1.19
	Other	27	1.3%	0.42
Action Development Zone	W1/2	580	26.9%	9.06
	AFGW1/2	119	5.5%	1.86
	AFGM	400	18.5%	6.25
	OBS1/2	89	4.1%	1.39
	OBM	64	3.0%	1.00
	LZ1/2	121	5.6%	1.89

doi.org/10.32388/N1JU5G.3

Description	Variables	Total	%	Per 90
	DLZ1/2	97	4.5%	1.52
	PA1/2	420	19.4%	6.56
	GA 1/2	262	12.1%	4.09
	Out/Fault	8	0.4%	0.13
Last Action	Heading	73	12.8%	1.14
	Foot	57	10.0%	0.89
	Attacking team technical action	92	16.1%	1.44
	Lost ball	37	6.5%	0.58
	Attacking team GK intervention	1	0.2%	0.02
	Another attacking team action	18	3.2%	0.28
	Defending GK block	22	3.9%	0.34
	Defending GK safe	14	2.5%	0.22
	Defender action	192	33.7%	3.00
	Defending team technical action	61	10.7%	0.95
	Another defending team action	3	0.5%	0.05
Corner kick outcome	Goal	15	2.6%	0.23
	Goal attempt on target	18	3.2%	0.28
	Goal attempt off target	89	15.6%	1.39
	Shot without danger	5	0.9%	0.08
	Penalty	2	0.4%	0.03
	Free kick	7	1.2%	0.11
	Corner Kick	61	10.7%	0.95
	Attacking team Possession	129	22.6%	2.02
	Ball out	117	20.5%	1.83
	Another attacking team	0	0.0%	0.00

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Description	Variables	Total	%	Per 90
	Offensive transition	23	4.0%	0.36
	Offensive transition in the box	5	0.9%	0.08
	Offensive transition shot	3	0.5%	0.05
	Offensive transition goal	2	0.4%	0.03
	Fault	54	9.5%	0.84
	Defending team possession	40	7.0%	0.63
	Another defending team	0	0.0%	0.00
Duration of action (seconds)		0.6276897		

Table 7. Corner Kick Action.

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Group	Aspect	Cohen's Kappa (κ)
Defensive and Offensive Organisation	No. Defenders in the box	0.921
	Defensive Method	0.896
	Defenders in the posts	0.807
	No. Attackers in the box	0.871
Corner Kick Action	Corner Side	0.826
	No. Attackers providing short option	0.862
	Type	0.812
	Zone of first touch	0.918
	Player of first touch	0.712
	Action Development	0.721
	Action Development Zone	0.684
	Last Action	0.869
	Corner Kick Outcome	0.897

Table 8. Reliability scores for aspects recorded on each corner.

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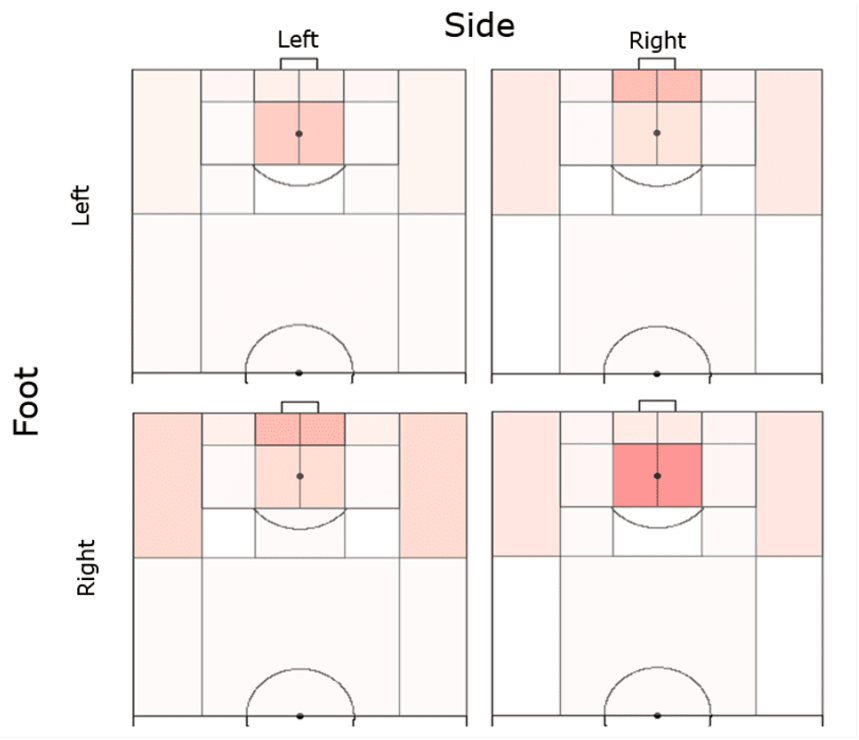

Figure 2. Heat map showing the frequency of first-touch zones, categorized by the foot used for the corner kick and the side from which the corner is taken.

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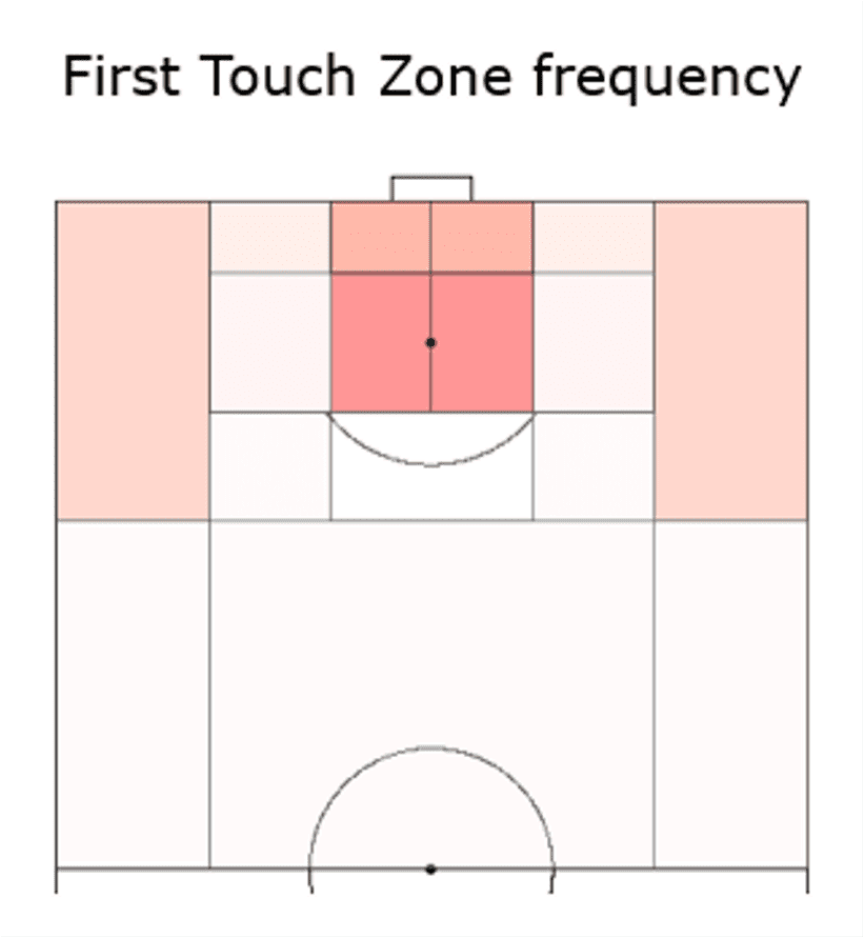

Figure 3. Heat map showing the locations of players' first touches following a corner kick.

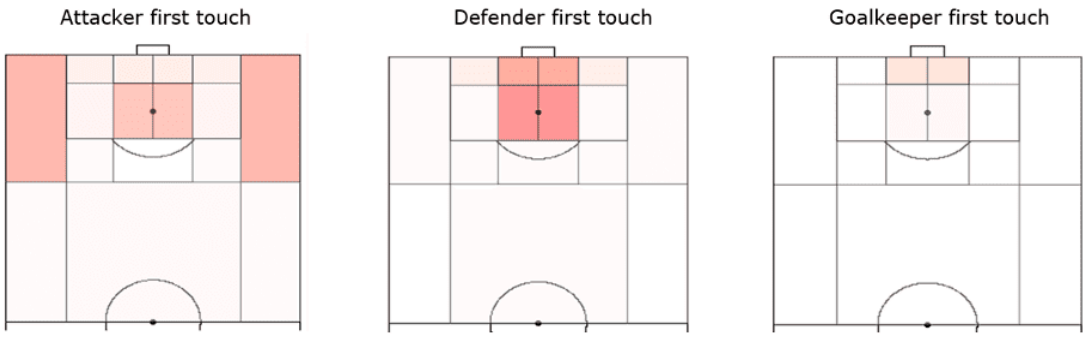

Figure 4. Heat map of first touch locations categorized by the player who reached the ball first: attacker, defender, or goalkeeper.

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Discussion

This study aimed to describe the technical and tactical characteristics of corner kicks observed during the 2022 FIFA World Cup. Patterns in delivery type, zone of first contact, and defensive setup were identified through descriptive analysis of 570 corners across 64 matches. The central hypothesis posits that by dissecting corner kick sequences and analysing the spatial-temporal dynamics of these set-piece scenarios, valuable insights can be gleaned regarding the strategic decision-making and execution prowess of teams, ultimately influencing match outcomes from the FIFA Qatar World Cup.

The mean number of corners and how they differed from previous tournaments

The analysis of corner kicks conducted over 64 observed games during the 2022 World Cup revealed a per-match mean of approximately nine corner kicks (8.91 ± 3.44). This finding contrasts marginally with previous investigations of men's World Cup tournaments. For instance, Sainz de Baranda and Lopez-Riquelme[10] reported 653 corner kicks over 64 matches during the 2006 World Cup. Similarly, other studies have documented varying corner kick counts in recent World Cup tournaments, such as 577 in 2010[9] and 600 in 2018[13]. The slightly lower mean per game observed during the 2022 World Cup may be attributed to the tournament's unique context and factors influencing performance. The event's timing within the season differs from typical domestic league schedules, necessitating adjustments in coaching and training regimens. Such alterations could render players more susceptible to fatigue and injury, potentially influencing tactical decision-making and prompting teams to adopt styles of play characterised by lower tempos and an emphasis on ball possession to mitigate the unfamiliar conditions.

The effectiveness of corners and how they affect match status

From the 577 corner kicks observed during the 2022 World Cup, a mere 15 resulted in goals, representing a goal success rate of 2.6%. This translates to a goal scored approximately every 38.5 corner kicks, indicating the limited efficacy of this set-piece strategy. Comparable success rates have been reported in previous research, with Kubayi and Larkin[13] documenting a slightly higher goal success rate of 3.7% in the 2018 World Cup. Consistent with prior findings, our results align with the assertion by Casal et al. [9] that corner kicks are generally ineffective, a widely acknowledged notion in the field of football research. Nevertheless, despite their low success rate, corners remain pivotal in determining match outcomes, as evidenced by our observation that 73.3% of goals resulting from corner kicks led to a team

either drawing or winning. Although this figure is slightly lower than the 76% reported by Casal et al.[9], it reinforces the critical role of corner kick strategies for both offensive and defensive purposes. Notably, successful teams (those securing wins or draws) attempted 91% more corners than unsuccessful teams (those experiencing losses), underscoring a significant disparity in corner kick frequency. However, despite taking more corners, successful teams had 3.2% fewer attempts at goal, indicating a nuanced relationship between corner kick frequency and overall offensive efficacy. The limited effectiveness of corner kicks can be attributed to the defensive organization employed by teams to mitigate the risk of conceding goals. During the tournament, 77% of defending teams positioned at least one player on a post during corner kicks, with 87.7% of teams deploying 8 or more players within the 16-yard box. In contrast, attacking teams predominantly featured 5 attackers in the box (51.6%), and 95.3% of the time, 6 or fewer attackers were present in the box. This numerical discrepancy underscores the inherent advantage held by defending teams during corner situations. However, despite the defensive posture, our analysis revealed that 68.8% of goals scored from corners were against opponents of either similar or higher competitive levels. This suggests that teams capitalising on corner kicks often do so against opponents of comparable or superior quality, possibly prompting a shift to a more defensive approach by the scoring team after securing a lead.

The most common and effective area of delivery/first contact

The analysis of 570 corner kicks revealed distinct patterns in the areas of delivery, with PA 1/2 and W 1/2 emerging as the most frequently targeted zones, followed by GA 1/2. This observation corroborates the findings of Gouveia et al.[12], highlighting the consistency of PA 1/2 as a preferred area for corner kick delivery. Notably, when the first contact occurred in PA 1/2, the highest number of goal attempts (57) and goals scored (10) were recorded, underscoring the effectiveness of this zone in generating scoring opportunities. This finding diverges from Pulling's[11] research, which identified the GA3 area as the most conducive to goal attempts but noted its underutilisation, potentially compromising its significance. Conversely, the alignment between the PA 1/2 area and CA3 in Pulling's study parallels the efficacy observed in this investigation. The subsequent analysis revealed W 1/2 as the second most effective area, yielding 2 goals (2%) and 17 goal attempts (16.8%), albeit with fewer instances of first contact compared to PA 1/2. Meanwhile, GA 1/2 ranked third in effectiveness, yielding 3 goals (1.7%) and 30 goal attempts (14.6%). Examining successful and unsuccessful teams, PA 1/2 emerged as the most effective zone of first contact for both categories. Successful teams demonstrated a 5.1% likelihood of scoring and a 26.3%

chance of attempting a goal when the first contact occurred in PA 1/2, with slight deviations observed for unsuccessful teams (4.1% chance of scoring and 28.8% chance of attempting a goal). Notably, successful teams exhibited a scoring rate of 1.8% from corners with first contact in GA 1/2, coupled with an attempt on goal rate of 18.4%, whereas unsuccessful teams scored at a rate of 1.6% and attempted a goal 12.5% of the time under similar conditions. Similarly, when the first contact was in W 1/2, successful teams recorded a scoring rate of 2.6% and a 17.1% chance of attempting a goal, while unsuccessful teams did not score but had a 16% chance of attempting a goal. These findings underscore the nuanced relationship between corner kick execution and team success, shedding light on the strategic importance of targeting specific areas for delivery to maximise scoring opportunities.

The most common type of delivery and the most effective for creating goal attempts and goals

The analysis of corner deliveries during the 2022 World Cup identified three predominant types: direct in-swinging corners, accounting for 40.4% (230 corners), followed by direct out-swinging corners at 36.1% (206 corners), and short corner penetration at 17% (97 corners). Evaluating the effectiveness of these delivery types in generating goal attempts and goals revealed that direct out-swinging corners were the most productive, resulting in 8 goals (3.9%) and 52 goal attempts (25.2%). This finding aligns with previous research by Casal et al.[9], who observed a higher likelihood of shots originating from out-swinging corners due to their trajectory away from the goal. However, contrary to the preference for in-swinging kicks reported by Sainz De Baranda and Lopez-Riquelme[10], direct in-swinging corners also demonstrated effectiveness, yielding 5 goals (2.2%) and 40 goal attempts (17.4%). Pulling's assertion regarding the increased scoring probability from in-swinging deliveries within the critical area was not supported by the data, with an equal distribution of goals resulting from both in-swinging and out-swinging corners. A potential explanation for the efficacy of out-swinging corners lies in the ball's trajectory away from defenders and the goalkeeper, potentially necessitating positional adjustments and creating opportunities for attacking players to exploit space. Moreover, out-swinging corners facilitate uninterrupted attacking runs, enabling players to meet the ball in motion without disrupting their momentum. These insights underscore the strategic implications of corner delivery types in maximising goal-scoring opportunities during set-piece scenarios.

The most common and effective defensive tactical structures used on defensive corners

In examining the defensive strategies deployed during corner kicks at the 2022 World Cup, mixed individual dominance emerged as the most prevalent approach, utilized in 49.6% (283 instances) of corners, followed closely by mixed zonal dominance at 47% (268 instances). Comparatively, zonal defending was employed in only 3.2% of cases (18 instances), while individual marking was rare, observed just once (0.2%). Analysis of defensive tactics among successful and unsuccessful teams revealed nuanced differences. Successful teams exhibited a near-equal utilization of mixed zonal dominance (48.7%) and mixed individual dominance (47.3%), whereas unsuccessful teams leaned more toward mixed individual dominance (54.1%) over mixed zonal dominance (43.9%). Evaluating the effectiveness of these defensive structures in limiting goal attempts and goals, as well as prioritising defender involvement, revealed that mixed zonal dominance was the most effective in terms of goals conceded, with only 6 goals allowed (2.2% of all corners). Following closely, mixed individual dominance conceded 7 goals (2.5% of all corners). However, when considering goal attempts conceded, mixed individual dominance emerged as the most effective, with 43 goal attempts (15.2%), followed by zonal marking with 3 goal attempts (16.7%), and mixed zonal dominance with 61 goal attempts (22.8%). Notably, the defensive structure most conducive to ensuring defender first contact with the ball was a mixed individual dominance approach (52.3%), followed by zonal marking (50%), and mixed zonal marking (41.4%). These findings underscore the importance of strategic defensive organisation in effectively mitigating goal-scoring opportunities from corner kicks. As a recommendation, employing a mixed individual dominance defensive structure may offer a balanced approach, maximising defensive solidity while facilitating proactive defender involvement in set-piece situations.

The most common actions and zones used within the action development of a corner

In examining the action development during corner kicks, two primary components were analysed: the actions occurring throughout the entire duration of the corner phase and the specific zones in which these actions took place. Among the actions observed, Defender Intervention emerged as the most frequent (507 instances – 23.5%), followed by Short Passing (453 instances – 21%), Control of the Ball (402 instances – 18.6%), and Shots (222 instances – 10.3%). This trend remained consistent across both successful and unsuccessful teams, with Defender Intervention being the predominant action followed by Short Passing. Delving into the spatial distribution of these actions, the most common zone for executed actions was W1/2 (580 instances – 26.9%), succeeded by PA1/2 (420 instances – 19.4%), AFGM

(400 instances – 18.5%), and GA1/2 (262 instances – 12.1%). Successful teams exhibited a slightly different pattern, with W1/2 (403 instances – 28.3%) being the most common, followed by AFGM (270 instances – 19%), and then PA1/2 (260 instances – 18.3%). However, unsuccessful teams mirrored the overall trend, with W1/2 (177 instances – 24%) as the most common, followed by PA1/2 (260 instances – 21.7%) and AFGM (130 instances – 17.6%). The prevalence of Defender Intervention underscores the defensive advantage typically enjoyed during corner situations, with teams frequently deploying multiple defenders to thwart attacking opportunities. Additionally, the prominence of Short Passing suggests a deliberate approach to ball circulation following corner clearances or during short corner routines. The alignment between the most common delivery areas (PA1/2 and W1/2) and the zone of action further emphasises the strategic importance of these regions during corner kicks. Specifically, the effectiveness of PA1/2 in generating goal-scoring opportunities underscores its significance in corner kick strategies. Similarly, the utilisation of W1/2 for short corners and secondary crosses highlights its tactical relevance in maximising offensive options. As teams navigate corner kick scenarios, these insights into action development and spatial dynamics provide valuable guidance for optimising both offensive and defensive strategies in football matches.

Limitations

While this study provides detailed insights into corner kick dynamics during the 2022 FIFA World Cup, some limitations should be acknowledged. First, the analysis was restricted to descriptive statistics, and no inferential statistical tests were conducted. As a result, the relationships observed between variables (e.g., delivery type and outcome, or defensive structure and goal attempts) should be interpreted as patterns rather than statistically validated effects. Future studies are encouraged to incorporate inferential methods such as chi-square tests or logistic regression to test the significance and strength of these associations.

Second, the dataset is limited to a single international tournament, which constrains the generalisability of the findings. The tactical approaches and player behaviours observed may not reflect trends across other competitions or levels of play. Additionally, some variables, such as purely zonal marking (n = 18) or individual marking (n = 1), had low representation, reducing the reliability of conclusions drawn for these categories.

Third, the classification of teams as “successful” or “unsuccessful” was based solely on match outcomes (e.g., winning or losing), which may not accurately reflect their set-piece proficiency. A team could

perform effectively at corners while still losing the match due to other factors. Future research could adopt classification criteria based on corner kick efficiency or success in set-piece execution.

Fourth, the zoning system used to record location data, while grounded in existing literature, involved some spatial grouping (e.g., DLZ1/2), which may have reduced the precision of spatial analyses. Refining this system to separate zones more distinctly (e.g., DLZ1 and DLZ2) could improve the granularity of future analyses.

Finally, the study did not track counterattacks initiated after corner kicks, an important tactical dimension that may influence risk-reward considerations for attacking and defending teams. Incorporating counterattack analysis would provide a more complete understanding of corner kick phases and their broader impact on match play.

Conclusion

This study provides a detailed account of the technical and tactical patterns associated with corner kicks during the 2022 FIFA World Cup. While the overall goal conversion rate was low (2.6%), the analysis identified consistent trends in delivery zones, defensive structures, and subsequent actions. Central delivery zones, particularly PA1/2, were most frequently associated with goal attempts and successful outcomes. Direct out-swinging deliveries also appeared more productive than other delivery types. In defending, mixed zonal and mixed individual dominance structures were the most common and showed differing associations with goal attempts and goals conceded. Defender interventions and short passing actions dominated post-delivery phases across all teams, with action development concentrated primarily in W1/2 and PA1/2.

The observed patterns suggest several practical applications for coaches and analysts. Training should emphasise delivering into PA1/2 and preparing defensive units for the tactical demands of this zone. The use of out-swinging deliveries, which were linked to increased attacking output, may offer tactical benefits. Defensive rehearsals could prioritise mixed marking systems, which were widely used and showed effectiveness in limiting different types of outcomes. Match context should also guide set-piece strategy, with tactical choices adjusted depending on whether teams are leading, trailing, or facing higher-ranked opponents.

While these findings offer relevant insights, they are based on a single tournament and should be interpreted accordingly. Future research would benefit from more granular zoning systems and a broader

dataset spanning multiple competitions and playing styles. The inclusion of inferential statistics and predictive models could further enhance the interpretation of corner kick effectiveness. By extending the analysis to different levels of competition and geographic contexts, researchers can build a more comprehensive understanding of set-piece dynamics in modern football.

Statements and Declarations

Conflicts of interest

The authors report there are no competing interests to declare.

Data Availability

The data presented in this study are available on reasonable request from the corresponding author.

Author Contributions

Conceptualization, A.C., M.C., V.G., and N.A.N.; methodology, A.C., V.G., and N.A.N.; software, A.C. and M.C.; validation, M.C. and N.A.N.; formal analysis, A.C.; investigation, A.C.; resources, V.G.; data curation, A.C.; writing—original draft preparation, A.C.; writing—review and editing, M.C., V.G., and N.A.N.; visualization, A.C. and M.C.; supervision, M.C. and N.A.N.; project administration, N.A.N.

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Declarations

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