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Caracterización de los saques de esquina en el Campeonato Brasileño de Fútbol

Characterization of corner kicks in the Brazilian Soccer Championship

Caracterização dos escanteios no Campeonato Brasileiro de Futebol

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RESUMEN

Este estudio caracterizó los saques de esquina realizados en los juegos del Campeonato Brasileño de Fútbol. Se analizaron 1450 saques de esquina de 148 juegos de la edición del Campeonato celebrada en 2020. Las imágenes fueron obtenidas de la cobertura de transmisión de canales de televisión cerrados. El instrumento de observación utilizado se adaptó de diferentes estudios que investigaron los saques de esquina en competiciones internacionales. Los datos se analizaron descriptivamente, a partir de valores absolutos (N) y relativos (%) y mediante análisis de conglomerados utilizando el método de máxima distancia entre los valores de agrupamiento, basado en el método de Gower para variables mixtas. Además, se realizó un análisis bivariado con tablas de contingencia utilizando una prueba de chi-cuadrado para criterios categóricas, siendo la variable de criterio el resultado del saque de esquina (Gol x no Gol). Los resultados indicaron que, en promedio, se ejecutaron 9,81 tiros de esquina por partido, la mayoría de los cuales fueron dirigidos al área penal, realizados entre los minutos 60 y 75 del partido, con una trayectoria alta y un arco externo del balón, y finalizados principalmente con la cabeza. Por otro lado, solo treinta y dos tiros de esquina (2,58%) resultaron en gol. El análisis inferencial reveló que la superficie de contacto final estaba relacionada con el resultado del tiro de esquina ($X^2 = 16,878$, $p = 0,002$, Cramer's $V = 0,12$). Se concluye que los tiros de esquina realizados en el Campeonato Brasileño comparten características similares a los encontrados en otros países, y estas características pueden estar relacionadas con la necesidad de engañar al adversario para alcanzar el gol.

Palabras clave: Fútbol; Saque de Esquina; Campeonato Brasileño; Análisis de Rendimiento; Gol.

ABSTRACT

This study characterized the corner kicks performed in the Brazilian Football Championship games. 1450 corner kicks from 148 games of the Championship edition held in 2020 were analyzed, with all sampled games taken from the broadcast coverage of closed television channels. The observation instrument used was adapted from different studies that investigated corner kicks in international competitions. The data were analyzed descriptively, from absolute (N) and relative (%) values and through cluster analysis using the maximum distance method between

grouping values, based on the gower method for mixed variables. In addition, a bivariate analysis was performed with contingency tables using a chi-square test for categorical criteria, with the criterion variable being the result of the corner kick (Goal x no Goal). The results indicated that, on average, 9.81 corner kicks were taken per match, most of which were directed to the penalty area, executed between the 60th and 75th minutes of the game, and delivered with a high trajectory and external arc, and finalized mainly with the head. On the other hand, only thirty-two corner kicks (2.58%) resulted in goal. Inferential analysis revealed that the final contact surface was related to the result of the corner kick ($X^2 = 16.878$, $p = 0.002$, Cramer's $V = 0.12$). It is concluded that the corner kicks in the Brazilian Soccer Championship share similar characteristics to those found in other countries, and these characteristics may be aimed at deceiving the opponent to score.

Keywords: Soccer; Corner Kick; Brazilian championship; Performance Analysis; Goal.

RESUMO

Este estudo caracterizou os escanteios realizados nos jogos do Campeonato Brasileiro de Futebol. Foram analisados 1450 escanteios de 148 jogos da edição do Campeonato realizada em 2020. As imagens foram obtidas da cobertura de transmissão de canais de televisão fechados. O instrumento de observação utilizado foi adaptado de diferentes estudos que investigaram os escanteios em competições internacionais. Os dados foram analisados descritivamente, a partir de valores absolutos (N) e relativos (%) e através de análise de conglomerados usando o método de distância máxima entre os valores de agrupamento, com base no método de Gower para variáveis mistas. Além disso, foi realizada uma análise bivariada com tabelas de contingência usando um teste qui-quadrado para variáveis categóricas, sendo a variável de critério o resultado do escanteio (Gol x Sem Gol). Os resultados indicaram que, em média, 9,81 escanteios foram executados por partida, a maioria dos quais direcionados para a área penal, realizados entre os 60º e 75º minutos do jogo, com uma trajetória alta e arco externo da bola, e finalizados principalmente com a cabeça. Por outro lado, apenas trinta e dois escanteios (2,58%) resultaram em gol. A análise inferencial revelou que a superfície de contato final estava relacionada ao resultado do escanteio ($X^2 = 16,878$, $p = 0,002$, Cramer's $V = 0,12$). Conclui-se que os escanteios realizados no Campeonato Brasileiro compartilham características semelhantes aos encontrados em outros países, e essas características podem estar relacionadas à necessidade de enganar o adversário para alcançar o gol.

Palavras-chave: Futebol; Escanteio; Campeonato Brasileiro; Análise de Desempenho; Gol.

INTRODUCTION

Game analysis is an essential resource to enhance performance of soccer teams (Garganta, 2001; Glazier, 2010). Data collection and analysis of relevant information allow coaches to measure teams' performance and, subsequently, plan training sessions, develop specific strategies and tactics, make more efficient decisions during the game, know the game model of the opposing team, as well as identify the styles of opposing coaches (Bangsbo & Peitensen, 2000; Cordoba et al., 2020; Gómez-García et al., 2022; Forcher et al., 2023; Marín & Castellano, 2023; Ueda et al., 2023).

Over the last few decades, the use of game analysis in soccer has been increasingly highlighted in the context of high performance, since it can be used to help coaches to have more information about the individual and collective performance of athletes in different moments/phases of the game (Barbero et al., 2024; Pereira et al., 2024; Prieto et al., 2021; Roffé, 2016; James, 2006). One of the aspects to be analyzed in this context concerns the technical-tactical actions of teams with and without possession of the ball, called attack and defense phases respectively (Gréhaigne et al., 1997). These phases relate to the moments of the game when the ball is in motion, also known as open play. Additionally, the game features other moments when the game is stopped according to the rules of the game, also named set play situation (Li & Zhao, 2021; Pérez-Muñoz et al., 2024).

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A way of set play in the soccer game is the corner kick. Specifically, the corner kick corresponds to the 17th rule of the soccer game, being a way to restart the game. The corner kick is awarded to the team in an attacking situation when the ball completely crosses the goal line, either on the ground or in the air, after having last touched a player of the defending team (IFAB, 2023). Corner kicks can be classified according to different criteria, such as the distance traveled by the ball, the trajectory of the ball, the height of the ball, etc. (Casal et al., 2015; Maneiro et al., 2017).

Over the last few decades, several studies have been analyzing corner kicks in football, focusing mainly on the FIFA World Cup from 2002 to 2018 (Ardá et al., 2014; Borrás & Sainz de Baranda, 2005; Baranda & Lopez-Riquelme, 2012; Borrás & Sainz de Baranda, 2005; Casal et al., 2017; Casal et al., 2015; Kubayi & Larkin 2019; Maneiro et al., 2019; Maneiro et al., 2021), and also in continental and national championships on the European continent, for example, UEFA Champions League 2010-2011 (Casal et al., 2015), UEFA Euro 2012 (Maneiro et al., 2017), UEFA European Championships 2012 (Casal et al., 2015), Portugal Championship (Gouveia et al., 2022), Liga de Spanish First Division (Gallardo et al., 2022) and Premier League (Pulling, 2015).

Those studies advanced in the description of the frequency of different variables related to corner kicks, for example, the way the foot is used in the kicks, type of effect of the ball, kick distance, surface of the finalization, number of attacking and defending players, type of marking (Borrás & Sainz de Baranda, 2005; Casal et al., 2017), as well as the influence of these variables on the result of the corner kick (Sainz de Baranda & Lopez-Riquelme, 2012; Casal et al., 2015; Kubayi & Larkin, 2019) and how to compare teams according to their position in the league table (Strafford et al., 2019).

Out the European context, the Brazilian soccer championship is acknowledged because of the high-level performance. Also, it has been considered one of the most competitive soccer championships in the world (Gasparetto & Barajas, 2016). The differences between Brazil and European countries in terms of professionalism of the athletes, game models, culture, and economic investment, suggest different behaviors between the championships in these two places (Delani et al., 2005; Franco Júnior, 2013). However, performance analysis of corner kicks in the Brazilian context remains unexplored. Therefore, the purpose of the present study was to characterize the corner kicks that were taken in the Brazilian Football Championship games. Specifically, the study aims to (1) group and characterize corner kicks according to notational criteria for performance analysis; (2) identify the criteria with the greatest influence on the result of the corner kick.

MATERIAL AND METHODS

Research design

This work is based on the observational-descriptive research method, which refers to a technique in which the behaviors of participants are observed and described in a natural environment (Thomas et al., 2022). According to the categorization of observational designs proposed by Anguera et al. (2011), this study is classified as follows: 1) Nomothetic: The analysis of a large set of events allows the results to be generalized to a broader context; 2) Multidimensional: The study incorporates multiple dimensions related to corner kicks; and 3) Longitudinal: Data from an entire season was analyzed, enabling the temporal tracking of events over time.

Sample

A total of 1450 corner kicks were collected from 148 matches of the 2020 Brazilian Football Championship.

Materials and Procedures

All sampled matches were taken from the broadcast coverage of the closed television channels Premiere, SporTV and TNT sports. Initially, all matches were recorded and analyzed systematically post-event by an investigator with experience in soccer performance analysis. A single rater evaluated all videos. To guarantee reliability, a second rater evaluated 76 corner kicks from 14 matches randomly selected. Cohen's Kappa coefficient revealed perfect inter-rater agreement ($K = 1$, $z = 53.627$, $p = 0$). This study was conducted in accordance with the Declaration of Helsinki (WMA, 2001), which sets out the fundamental ethical principles for research involving human subjects. This is a non-invasive study, as it consisted in analysis of public domain videos, that considers the ethical aspects of quantitative and qualitative research with social or scientific value. Thus, according to Belmont report (U.S. Department of Health and Human Services, 1978), research with the previous described characteristics does not require participants consent form or the approval of an ethics committee.

The observation instrument used was adapted from different studies that investigated corner kicks in international competitions (Casal et al., 2015; Pulling, 2015; Pulling et al., 2018; Sainz de Baranda & Lopez- Riquelme, 2012) (Table 1).

Table 1

Field formats and levels of the observation tool.

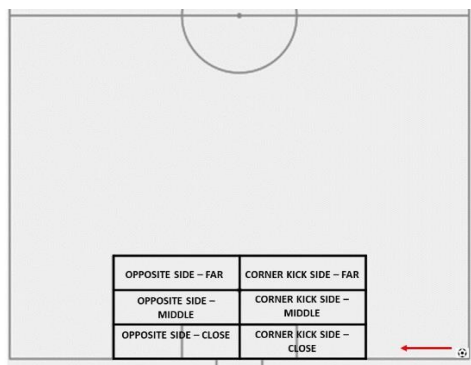
CRITERIA	LEVELS
Match time	<ul style="list-style-type: none"> • 0' - 15' • 15' - 30' • 30' - 45' • Extra Time 1º half • 45' - 60' • 60' - 75' • 75' - 90' • Extra Time 2º half
Score of the team that took the corner at the time of the kick	<ul style="list-style-type: none"> • Win • Draw • Lose
Ball distance	<ul style="list-style-type: none"> • In the penalty area • In the goal area • Short corner kick • Corner kick outside the penalty area
Number of players inside the penalty area	<ul style="list-style-type: none"> • Number of attackers • Number of defenders
Kick type	<ul style="list-style-type: none"> • Internal arch • External arch
Corner kick result	<ul style="list-style-type: none"> • Goal • No goal
Marking type	<ul style="list-style-type: none"> • Individual (each defender is responsible for marking a specific opponent) • Zone (Defenders are organized in specific spaces inside the area, without individual marking) • Mixed zonal marking (zone 2 to 3) (Use of two forms of marking, individual and by zone).
Ball trajectory	<ul style="list-style-type: none"> • High – When the ball was thrown in the air above

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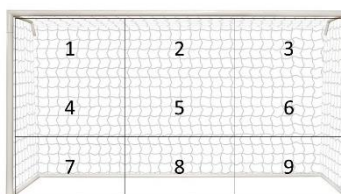
the height of the abdomen

- Medium - When the ball was thrown in the air to the height of the abdomen
- Ground – Ball thrown by the ground

Finalization zone *



Region where the ball entered the goal**



Finishing contact surface

- Head
- Foot
- Thigh
- Chest
- Others

Importance of the goal

- Put in front (when the goal puts a team ahead of the scoreboard)
- Tie (when the goal equalizes the score)
- Comeback (when a team that was losing passes in front of the scoreboard)
- Discount (when a team lowers the score)
- Increase the difference (when a team manages to increase the difference in the scoreboard)

Legend –

* The criterion “Finalization Zone” refers to the location where the ball is shot on goal following a corner kick. For evaluation purposes, the penalty area was divided into six zones, each approximately 8 meters wide and 2.7 meters long.

** The criterion “Region where the ball entered the goal” represents the specific area of the goal where the ball crossed the line in corner kicks that resulted in a goal. For evaluation purposes, the goal was divided into nine zones (1–9), each approximately 2.44 meters wide and 0.81 meters high.

Performance data were initially registered in a spreadsheet in Microsoft Office Excel software (Version 14.7.1, Microsoft Cooperation, United States) and subsequently organized according to the criteria and levels shown in Table 1.

Data Analyses

All analyzes were performed using RStudio software (version 4.3.1). First, a descriptive analysis of the absolute (N) and relative (%) values of the criteria cited in the 1450 corner kicks collected was conducted. Subsequently, from the 1450 corner kicks collected, were selected 1238 that did not present missing values in the criteria described in Table 1. Subsequently, a cluster analysis was performed for qualitative and quantitative data, in which the maximum distance method between the grouping values was used, based on the Gower method for mixed variables. The product of this analysis is a tree diagram (dendrogram) that shows the distance (similarity level) on the y-axis, and the cluster items (corner kicks) represented on the x-axis. After running the cluster analysis algorithm, a cutoff level was designated in which four clusters were established (Everitt et al., 2001). Daisy and hclust functions from the cluster and stats packages of the RStudio software were respectively used to perform the cluster analysis and creation of the dendrogram. Subsequently, a bivariate analysis was performed with contingency tables using a chi-square test for categorical variables. The criterion variable was the result of the corner kick (Goal x no Goal). For this purpose, 'CrossTable' and 'chi' functions from the 'gmodels' package were used. The Cramer's V effect size was calculated using the 'confintr' package.

RESULTS

Descriptive analysis of corner kicks

The total of 1450 corner kicks in 148 games represents an average of 9.80 corner kicks per game (Table 2). Of the 1238 corner kicks selected, 703 (56.79%) resulted in a direct kick in the penalty area, 449 (36.27%) in direct kicks in the goal area, 84 (6.79%) in short corner kicks, and 2 (0.16%) in corner kicks outside the penalty area. Regarding the type of the kick, 537 (43.38%) were executed with an internal ball arc and 701 (56.62%) with an external ball arc. Considering the playing time, 202 (16.32%) occurred between minutes 60'-75', followed by 198 (15.99%) between minutes 45'-60', 190 (15.35%) between minutes 30'-45', 188 (15.19%) between minutes 15'-30', 185 (14.94%) between minutes 75'-90', 154 (12.44%) between minutes 1'-15', 71 (5.74 %) in the additional time of the 2nd half, and 50 (4.04%) in the additional time of the 1st half.

About the result of the game at the time of the corner, 650 (52.50%) corner kicks occurred when the match was tied, 344 (27.79%) were taken by the team that was losing and, 244 (19.71%) were taken by the team that was winning. Regarding the ball trajectory, 1062 (85.78%) corner kicks had a high trajectory, 153 (12.36%) had medium trajectory, and 23 (1.86%) had ground trajectory.

Regarding the type of marking, in 1117 corner kicks (90.23%) the defending team used a mixed zonal marking (individual and zone), followed by 74 (5.98%) with one-to-one marking and 47 (3.80%) with zonal marking. Regarding the finalization zone after the corner kick is taken, 508 (41.03%) finalizations occurred on the side of the corner kick, close to the goal, 299 (24.15%) on the side of the corner kick, middle distance from the goal, 251 (20.27%) on the opposite side, middle distance from the goal, 111 (8.97%) on the opposite side, close to the goal, 51 (4.12%) on the opposite side, far from the goal, and 18 (1.45%) on the corner side, far from the goal.

Regarding to the contact surface used for finalization, 910 (73.51%) were finished with the head, 205 (16.56%), with the foot, 12 (0.97%) with the thigh, 10 (0.81%) with the chest, and 101 (8.16%) with others (e.g., shoulder, shin, back, belly). Regarding the results of corner kicks, 1206 (97.42%) did not result in a goal and 32 (2.58%) resulted in a goal. As for the region where the ball entered the goal, nine corner kicks (28.12%) entered through region 1, six (18.75%) at region 3, five (15.62%) at region 2, three (9.38%) at region 5, three (9.38%) in region 6, two (6.25%) in region 8, two (6.25%) in region 4, one (3.12%) in region 7, and one (3.12%) in region 9.

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Finally, regarding the importance of the goal, 15 (46.88%) goals occurred to put a team ahead in the score, five (15.62%) goals increased the difference in the score, five (15.62%) goals tied the game (when the goal equalizes the score), five (15.62%) goals discounted the difference (when a team reduces the score), and two (6.25%) comeback (when the team goes ahead of the score after having tied the game).

Table 2

Descriptive results of the observation criteria.

CRITERIA	LEVELS	N
Match time	• 0' - 15'	181
	• 15' - 30'	213
	• 30' - 45'	234
	• Extra Time 1º half	58
	• 45' - 60'	223
	• 60' - 75'	226
	• 75' - 90'	216
	• Extra Time 2º half	102
Score of the team that took the corner at the time of the kick	• Win	309
	• Draw	748
	• Lose	389
Ball distance	• In the penalty area	755
	• In the goal area	489
	• Short corner kick	177
	• Corner kick outside the penalty area	11
Kick type	• Internal arch	597
	• External arch	759
Corner kick result	• Goal	32
	• No goal	1415
Marking type	• Individual	91
	• Zone	81
	• Mixed zonal marking	1263
Ball trajectory	• High	1186
	• Medium	166
	• Ground	43
Finalization zone	• Opposite side - Far	154
	• Opposite side - Middle	279
	• Opposite side - Close	59
	• Corner Kick side - Far	539
	• Corner Kick side - Middle	324
	• Corner Kick side - Close	23
Region where the ball entered the goal	• Zone 1	9
	• Zone 2	5
	• Zone 3	7
	• Zone 4	2
	• Zone 5	3
	• Zone 6	3
	• Zone 7	1
	• Zone 8	3
	• Zone 9	1
Finishing contact surface	• Head	945
		230

	• Foot	13
	• Thigh	11
	• Chest	108
	• Others	
Importance of the goal	• Put in front	15
	• Tie	5
	• Comeback	2
	• Discount	5
	• Increase the difference	6

Cluster analysis

Cluster analysis identified four groups based on the characteristics of the corner kicks. Group 1 was formed by 420 corner kicks (33.93%), followed by group 2, was formed by 630 corner kicks (50.89%). Group 3 was formed by 125 corner kicks (10.10%) and group 4, by 63 corner kicks (5.09%). Based on the results of cluster analysis, the frequencies of occurrences were plotted for each of the criteria, in each of the groups (Figure 1). The characteristics of the groups found are characterized in Table 3.

Table 3

Description of groups identified by cluster analysis based on notational information from corner kicks.

Group	Characteristics
Group 1	<p>a) Corner Kicks finishing in headers, without resulting in a goal, involving between five and six attacking players and between eight and 10 defensive players using mixed zonal marking, one of which was positioned close to the goal.</p> <p>b) They were executed at different moments of the game, mainly when the game was tied.</p> <p>c) In these corner kicks, the ball had an internal curve with a high trajectory that ended in the goal area and, were finished on the side of the corner, close to the goal.</p>
Group 2	<p>a) Corner kicks finishing in headers, in which the majority did not result in a goal, however, the highest number of goals were made in corner kicks classified in this group (13).</p> <p>b) In these corner kicks, between five and six attacking players and between eight and 10 defensive players who used mixed zonal marking participated.</p> <p>c) These corner kicks occurred at different moments of the game, mainly when the game was tied, or the executing team was losing.</p> <p>d) In these corner kicks, the ball had an external curve with a high trajectory that ended in the penalty area and, were finished on the side of the corner kick.</p>
Group 3	<p>a) Corner kicks finished with the foot, most of which did not result in a goal.</p> <p>b) They had the participation of five and six attacking players and between eight and nine defensive players, who used mixed zonal marking.</p> <p>c) They were executed at various times of the game, mainly when the team was winning.</p> <p>d) In these corner kicks, the ball had an external curvature with a high trajectory and, were finished on both sides of the field, at a medium distance from the goal.</p>

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Group 4

- Corner kicks finishing with a header, most of which did not result in a goal.
- They had the participation of five attacking players. In these corner kicks, the marking was in zone and no defensive player was positioned near the goal.
- These corner kicks were taken in a tie or defeat situation.
- Had an external and internal curvature and were short. The finalization took place on both sides of the field, at a medium distance from the goal.

Figure 1

Frequency of occurrence of each level per criterion in the identified groups (1 to 4).

Goal characterization analysis.

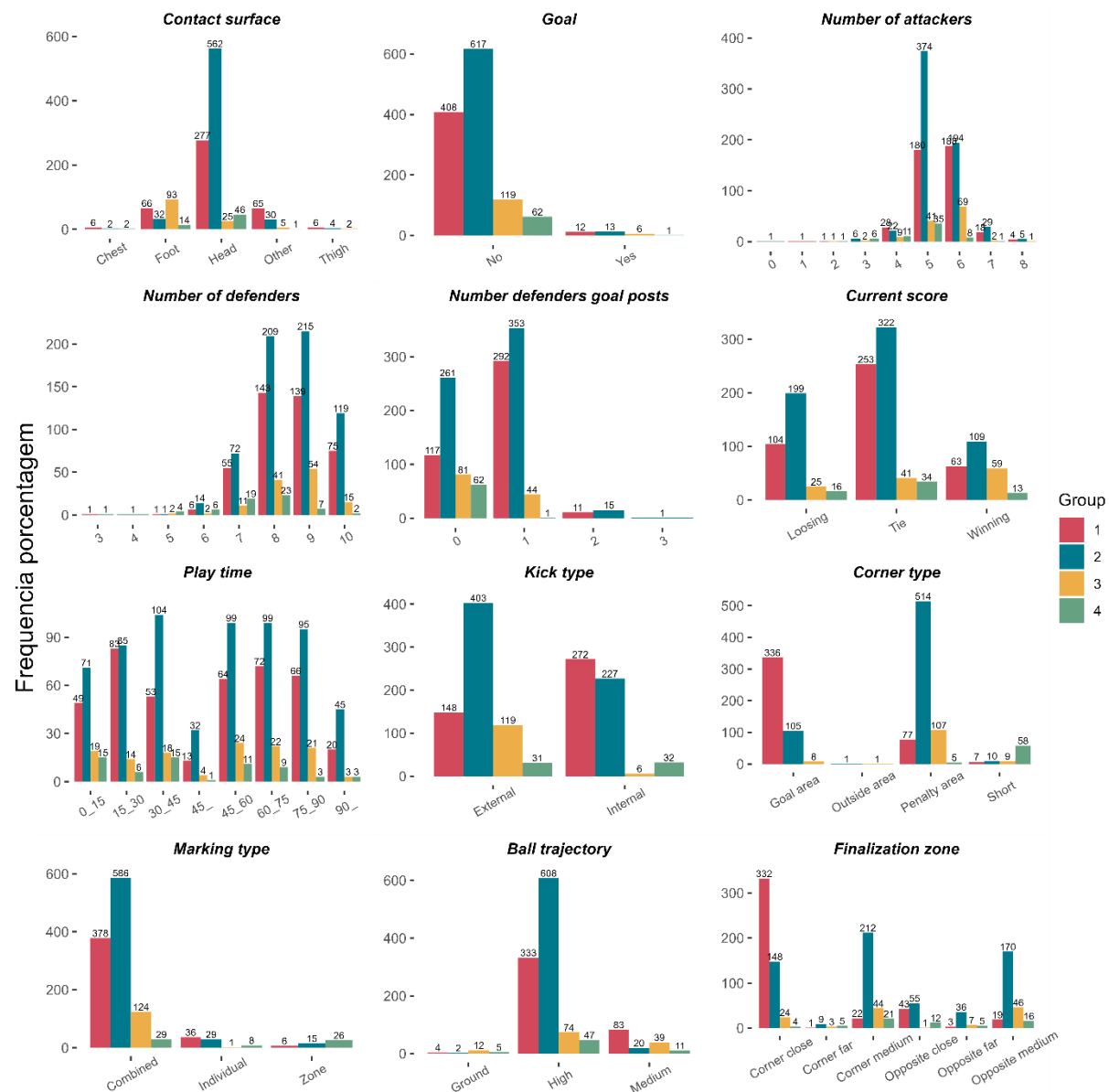
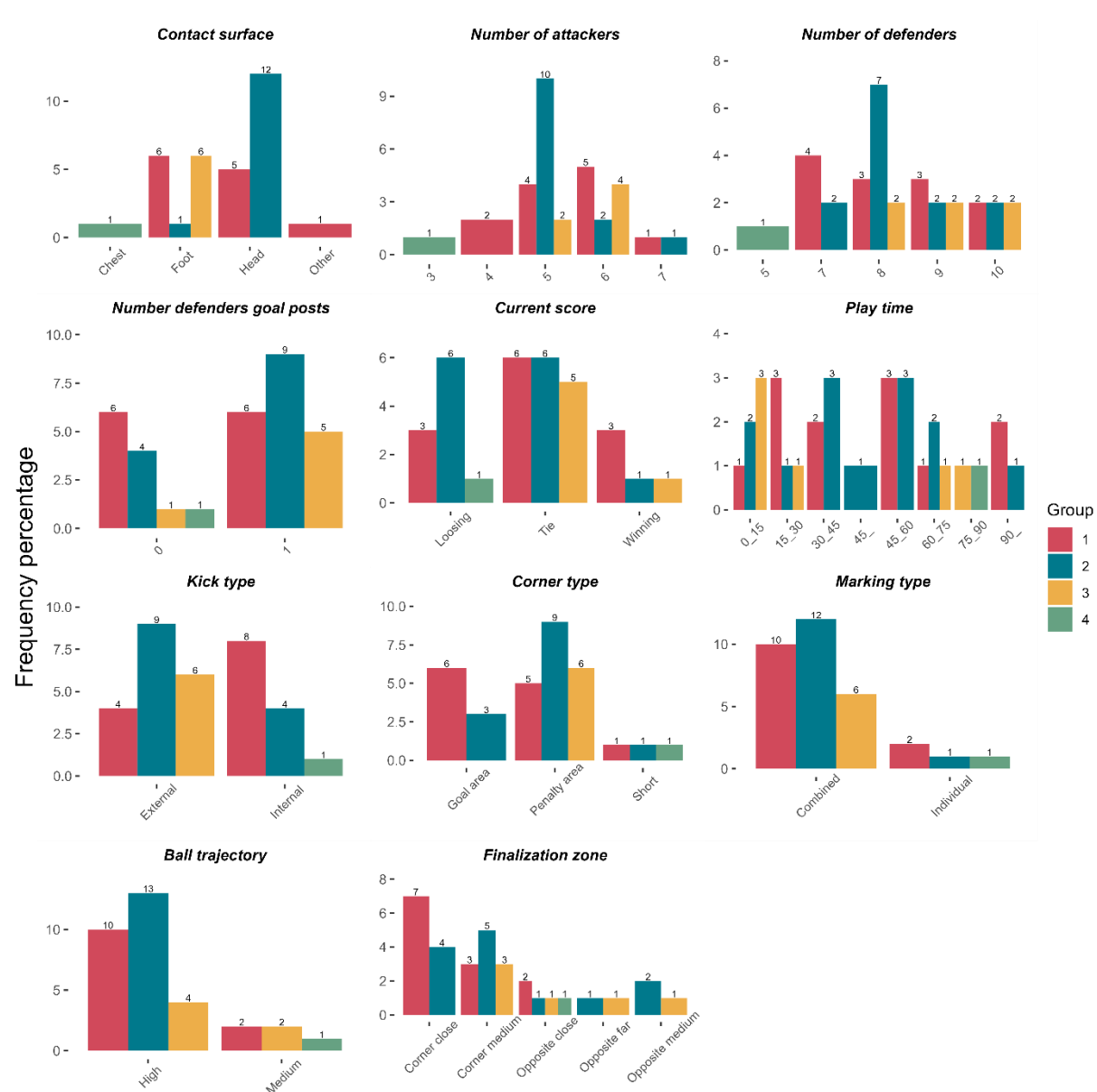


Figure 2 illustrates the frequency of occurrence of each of the criteria in the groups identified specifically in the corner kicks that resulted in a goal. Of the 1238 corner kicks analyzed, only 32 (2.58%) resulted in a goal. Of these corner kicks, in relation to the form of finalizing the play, head shots were used in 17 corner kicks (53.12%). Regarding the number of defensive players, eight players participated in 12 (37.5%) corner kicks. On the other hand, in 16 (50%) corner kicks, five attacking players participated. Still, 17 (53.12%) corner kicks were executed when the game was tied and 19 (59.38%) were executed with external curve of the ball; in 20 (62.5%) of them, the ball was sent in the penalty area; in 28 (87.5%) mixed zonal marking was used; and, in 27 (84.38%), the ball trajectory was high.

Figure 2

Frequencies of occurrence in each of the criteria in the identified groups (1 to 4) in corner kicks that ended in goal.



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Bivariate analysis with contingency tables

Regarding the bivariate analysis with contingency tables, the influence of different variables on the effectiveness of corner kicks was analyzed, classified into goals and non-goals. The chi-square test results, and the corresponding Cramer's V values revealed that the only variable associated with the corner result was the finalization contact surface ($X^2 = 16.878$, $p = 0.002$, *Cramer's V* = 0.12). The results are shown in Table 4.

Table 4

Chi-square test results for each of the criteria in relation to corner success.

CRITERION: GOAL						
Criteria	Levels	Percentage no (%)	Percentage yes (%)	X^2	<i>sig</i>	<i>Cramer's V</i>
Finishing contact surface	Head	98.13	1.87	16.87	0.002*	0.12
	Thigh	100	0			
	Others	99.01	0.99			
	Foot	93.66	6.34			
	Chest	90	10			
Number of attacking players	0	100	0	2.04	0.98	0.04
	1	100	0			
	2	100	0			
	3	92.86	7.14			
	4	97.14	2.86			
	5	97.46	2.54			
	6	97.6	2.4			
	7	96	4			
	8	100	0			
Number of defensive players	3	100	0	6.43	0.49	0.07
	4	100	0			
	5	87.5	12.5			
	6	100	0			
	7	96.18	3.82			
	8	97.12	2.88			
	9	98.31	1.69			
	10	97.16	2.84			
	0	97.7	2.3			

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Number of players positioned close to the goal	1	97.1	2.9	1.15	0,765	0.03
	2	100	0			
	3	100	0			
Game score at the time of the corner kick	Win	97.09	2.91	0.42	0.81	0.02
	Tie	97.38	2.62			
	Lose	97.95	2.05			
Play time (min)	0-15	96.1	3.9	3.99	0.78	0.06
	15-30	97.34	2.66			
	30-45	97.37	2.63			
	Extra Time 1 st H	98	2			
	45-60	96.97	3.03			
	60-75	98.02	1.98			
	75-90	98.92	1.08			
	Extra Time 2 nd H	95.77	4.23			
Type of kick	External	97.29	2.71	0.1	0.75	0
	Internal	97.58	2.42			
Type of corner kick	Short	96.43	3.57	1.17	0.76	0.03
	Outside the area	100	0			
	Penalty area	97.16	2.84			
	Goal area	98	2			
Type of marking	Mixed Zonal	97.49	2.51	3.61	0.16	0.05
	Individual	94.59	5.41			
	Zone	100	0			
Ball trajectory	High	97.46	2.54	0.9	0.637	0.03
	Medium	96.73	3.27			
	Ground	100	0			
Finishing zone	Corner side far	100	0	6.17	0.29	0.07
	Corner side middle	96.32	3.68			
	Corner side close	97.83	2.17			
	Opposite side	96.08	3.92			

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close			
Opposite side	98.8	1.2	
middle			
Opposite side	95.5	4.5	
far			

Legend – H: Play time

* Significant values ($p < 0.05$)

DISCUSSION

Collecting and analyzing performance data in soccer teams in competition has become essential in the sports coaching process. This study aimed to expand the existing knowledge about performance analysis of soccer teams in corner kick situations in the Brazilian soccer championship. Specifically, performance criteria were grouped to characterize the corner kicks and associate the characteristics with the outcome of these set pieces.

The descriptive results of the present study revealed that, on average, 9.80 corner kicks were taken per match. This value is like the results of other studies in which national and international championships of European clubs and professional teams were analyzed (Casal et al., 2015; Pulling et al., 2013; Sainz de Baranda & Lopez-Riquelme, 2012). In this sense, it can be seen that 10 corner kicks per game is the average value in professional team games, which is equivalent to a corner every nine/ten minutes of the game.

Most of the corner kicks found were sent to the penalty area, played between the 60th and 75th minutes of the game, with a high trajectory, with an external arc of the ball, when the game was tied, and defended with mixed type of marking. In addition, they were mainly finished with the head, from the corner kick side and close to the goal, with 2.58% resulting in a goal, and the goals left the team ahead on the score. These results match with those found in studies conducted in European national team and club championships (Casal et al., 2015; Kubayi & Larkin, 2019; Strafford et al., 2019). In this way, it can be stated that the general statistics on corner kicks executed in the Brazilian championship have similar characteristics with other international competitions. However, regarding the arc of the ball, some studies analyzing the 2002 and 2006 World Cups have found that most corner kicks are taken with an internal arc of the ball (Borrás & Sainz de Baranda, 2005; Sainz de Baranda & Lopez-Riquelme, 2012), which differs from the results found in this study.

The fact that most corner kicks occur in tied game situations can be explained in two ways: 1) in a tie situation, both teams try to score in order to have the advantage in the game result, which results in more corner kicks; 2) tie situations are more common in the game compared to situations which one of the teams is winning (Casal et al., 2017; Sainz de Baranda & Lopez-Riquelme, 2012). Additionally, regarding the type of marking, other investigations have also found that more than 80% of corner kicks are defended by mixed zonal marking (in zone and individual) (Kubayi & Larkin 2019; Sainz de Baranda & Lopez-Riquelme, 2012).

Regarding the cluster analysis, results revealed that corner kicks have distinctive characteristics that allow their classification in separate groups. Within the four groups found, corner kicks varied in terms of the curvature of the ball trajectory, the score at the time of the corner kick, the number of attacking and defending players participating, the type of marking and, the region of finishing the play. In general, the results showed a wide variation in the characteristics of the corner kicks between the groups.

The variation of the characteristics of corner kicks can be linked to the fact that they are close to the opponent's goal, which can lead teams to modify their behavior to become unpredictable for the opposing team, aiming to deceive the defending team and score. The variation in the execution of these situations reflects the redundancy (abundance) of options that teams use to deal with different forms of defense that teams can use (Clavijo et al., 2022). The fact that the present study analyzed professional teams may have led to this variation due to the amount

of practice and experience of the players, as they have the capacity to modify their behavior, compared to beginners. Studies in collective sports of invasion have highlighted the importance of the variability of visual search in the execution of the kick in soccer (Corrêa et al., 2020), interpersonal distance in the decision of the contact surface for the execution of the kick (Clavijo et al., 2016), and interpersonal coordination in the decision-making of the futsal pass (Correa et al., 2020).

Out of the 1238 corner kicks analyzed, only 32 (2.58%) ended in a goal. This percentage is within the range of values found by other studies conducted in the European continent (Casal et al., 2015; Pulling, 2015; Sainz de Baranda & Lopez-Riquelme, 2012). Out of the total number of goals scored, 40.62% and 37.5% came from corner kicks in groups two and one, respectively. Therefore, those results support the idea that corner kicks that present the characteristics found in groups one and two were more successful. Of the total number of corner kicks that ended in a goal, most were finished with the head and foot, with the participation of eight defensive players and five attacking players and executed when the game was tied. In addition, they presented external curvature and high ball trajectory, with the ball sent to the penalty area and while the defending team used mixed marking. These results partially corroborate the findings of Casal et al. (2015), who found that variables associated with scoring in corner kick situations were game time, number of attacking players and type of defensive organization in UEFA Euro 2012 and in the final stages of the 2010 World Cup.

The bivariate analysis revealed that the finalization contact surface was related to the result of the corner kick. It was found that out of the total number, 1.87%, 6.34% and 10% (percentage obtained in relation to the number of shots with the respective contact surface) were finished with the head, foot, and chest, respectively, and ended with a goal. Although the highest value was obtained with the chest, this value represents only one goal. While with the head and the foot, 17 and 13 goals were scored, respectively. On the other hand, when analyzing the percentages of goals scored with each of the contact surfaces in relation to the total number of goals, descriptive analysis revealed that 50% of all goals were scored with the head and 40.62% with the foot, and 3.12% with the chest. These results are in the same direction as the findings of Sainz de Baranda & Lopez-Riquelme (2012), who found that two thirds of the goals from corner kicks occurred with the head and one third were with the foot in the analysis of the 2006 World Cup. In this manner, it is worth highlighting the importance of analyzing values related to total frequency, to better interpret the results, since classic studies of performance analysis in soccer have found divergent results when analyzing absolute and relative values (Hughes & Franks, 2005; Reep & Benjamin, 1968).

In summary, this study concludes that corner kicks performed in the Brazilian soccer championship have similar characteristics to those found in other countries, and these characteristics may be related to the need to deceive the opponent to reach the goal. Regarding corner kicks that ended in a goal, most were finishing with the head and with the feet, and that corner kicks in groups one and two were the ones that most resulted in a goal. These results can be used in practice to improve the performance of teams in corner kick situations, both in the attack and defense phases. Additionally, this type of analysis can be used in training contexts to characterize the ways in which teams behave in different moments of the game, without being restricted only to corner kicks situations.

However, the results of the chi-square test must be interpreted carefully, as they differ from the descriptive analysis in relation to the contact surface with which most goals were scored. Finally, to better understand performance analysis variables in corner kicks and their respective results, future studies should perform clustering analysis considering separately each team, type of championship, the home field advantage, and the relative position with the opponent in the table of championship positions.

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