Kronos 2025: 24(2)
ISSN: 1579-5225 - e-ISSN: 2603-9052
Niu, Z., Ardá, A., Maneiro, R., Iván-Baragaño, I.
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Performance in sports

Identification of optimal corner kick offensive strategy in the Chinese Super League based on decision tree analysis

Identificación de las estrategias ofensivas en córners en la Superliga China mediante árbol de decisión

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Date received: 26 November 2025
Date of acceptance: 22 December 2025

ABSTRACT

Although scientific knowledge about technical–tactical performance indicators in the Chinese Super League has advanced in recent years, there is still a knowledge gap regarding set-piece actions. Therefore, the aims of this study were: (1) to describe corner kicks in the 2020 Chinese Super League and (2) to identify which criteria influence the outcome of corner kicks, as well as to uncover the interactions between criteria that provide a higher probability of success in these actions. Using a nomothetic, punctual, and multidimensional observational design, 1,272 corner kicks from the 2020 Chinese Super League were analyzed, along with their association with success in these actions, defined as the achievement of a goal or a shot. The criteria that showed a statistically significant influence on the outcome of corner kicks were the timing of the action, the position of the corner kick,

the number of attacking players, the number of attackers involved, the zone to which the pass was directed, and the final zone of the play. Furthermore, according to the results obtained from the decision tree model, the involvement of 3–4 players and the use of aerial connections in attacks originating from corner kicks can achieve a higher success rate. These results may be useful for the implementation of specific training tasks for set-piece actions.

Keywords: high performance football, set pieces, multivariate analysis, bivariate analysis, football training.

RESUMEN

Aunque el conocimiento científico sobre los indicadores de rendimiento técnico-tácticos en la Superliga China ha avanzado en los últimos años, todavía existe una brecha de conocimiento sobre el conocimiento de las acciones a balón parado. Por ello, los objetivos de este estudio fueron: (1) describir los saques de esquina en la Superliga China de 2020 y (2) identificar qué criterios modifican el resultado de los saques de esquina, así como descubrir las interacciones entre criterios que proporcionan una mayor probabilidad de éxito en estas acciones. Mediante un diseño observacional nomotético, puntual, y multidimensional, se analizaron 1272 saques de esquina de la Superliga China 2020 y su asociación con el éxito en estas acciones, considerado como la consecución de gol o tiro. Los criterios que mostraron una influencia estadísticamente significativa en el resultado de los saques de esquina fueron la temporalidad de la acción, la posición del saque de esquina, el número de jugadores en ataque, el número de atacantes implicados, la zona a la que se dirige el pase y la zona final de la jugada. Por otro lado, según los resultados obtenidos del modelo de árbol de decisión, la intervención de 3-4 jugadores y el uso de conexiones aéreas en los ataques procedentes de saques de esquina pueden alcanzar un mayor porcentaje de éxito. Estos resultados pueden ser útiles en la implementación de tareas de entrenamiento específicas para las acciones a balón parado.

Palabras clave: fútbol de alto rendimiento, acciones a balón parado, análisis multivariado, análisis bivariado, entrenamiento en fútbol.

INTRODUCTION

Chinese football has experienced remarkable growth in the last two decades due to government efforts (Hong et al., 2005; Hong & Zhouxiang, 2013), enabling the creation of an institutionalized system of sports clubs (Tan & Bairner, 2010). Despite these efforts, Chinese football has not yet reached its intended sporting potential. The Chinese men's national team has never surpassed the 37th position in the FIFA rankings and has only qualified for the final stage of the World Cup in 2002. In the realm of research, several authors have analyzed different aspects of the Chinese football context (Cockayne et al., 2021; Qian et al., 2017). In aspects of team technical style, Lago-Peñas et al. (2018) selected 240 matches from the 2016 Chinese Super League season to understand the playing style of participating teams. In terms of physical and technical aspects, on the one hand, Zhou et al. (2018) examined the seasons from 2012 to 2017 in the Chinese Super League, assessing the impact of technical and physical indicators on the game, as well as the influence of player age in the Chinese league (Zhou et al., 2021; Zhou et al., 2020; Zhou et al., 2018). On the other hand, Yang et al. (2018) analyzed 240 matches from the 2014 season to determine the impact of physical and technical aspects throughout the championship

on the final standings of teams. In a similar vein, Gong et al. (2021) measured different physical and technical aspects to analyze their impact on ball possession in 237 matches from the 2019 Chinese Super League. Despite these studies, however, only Niu et al. (2023) have conducted research on the indirect free kicks in the Chinese Super League, there is still a knowledge gap regarding performance indicators in Chinese football compared to other European leagues or international teams. One of these gaps lies in the analysis of technical-tactical indicators, crucial in football performance (Iván-Baragaño et al., 2021), and in the analysis of set-piece actions.

Set-piece actions constitute the only moment in football when the ball is not in motion before play begins. For this reason, this phase can be a key factor during high-performance matches (Maneiro, 2014). In relation to these actions, some studies have provided information on their characteristics and influence on team performance. Yiannakos and Armatas (2006) analyzed goals scored in the 2004 Euro Cup in Portugal and found that 35.6% of goals originated from set-piece actions. These results were similar to other published studies (Acar et al., 2008; Maneiro, 2014; Silva Puig, 2011).

Shortly after, Casal et al. (2014) expanded the sample size and demonstrated that 76% of them resulted in a modification of the final match outcome, an aspect that was confirmed six years later in a study conducted on more than 750 matches in the Brazilian League by Souza et al. (2021). Furthermore, a novel and significant aspect of this study was to show that there was a higher probability of success when the corner kick was executed in the last 30 minutes of the match, a finding confirmed by Prieto-Lage et al. (2021). In the same year, the longitudinal study published by (Pulling et al., 2013) confirmed the likelihood of successfully completing a corner kick when more than two players were involved, and the ball was delivered to the far post. Continuing in the same line of research, Strafford et al. (2019) found that the level of the opponent appears to be a criterion that conditions the outcome of these actions. Similarly, in the first and second divisions of the Spanish league, a higher efficacy was observed for teams executing corner kicks as the home team (Fernández-Hermógenes et al., 2017).

In the longitudinal study, it is noteworthy to mention the research conducted by Maneiro et al. (2021), analyzing 1704 corner kicks that took place in the 2010, 2014, and 2018 World Cups. It was observed that the criterion with the most influence on the probability of success in this type of action was the number of participating players. In the study conducted by Mitrotasios et al. (2021), analyzing 3620 corner kicks corresponding to the Spanish League, it was observed that a direct delivery into the penalty area increased the probability of success.

Based on all the foregoing, these investigations highlight the differences between different leagues and seasons, however, in our opinion, there is still a knowledge gap regarding this type of action in the Chinese Super League. Consequently, the objectives of this study were: (1) to analyze and describe corner kicks in the Chinese Super League in 2020, and (2) to identify the indicators that influence the outcome of corner kicks, as well as to discover the interaction of criteria that provide a higher probability of success in corner kicks.

METHOD

Research Design

This study was conducted using observational methodology (Anguera et al., 2000). Our observations on corner kicks in the 2020 Chinese Super League fall within the third quadrant, considering the type of design and the type of data we recorded. It involves an observational design that is nomothetic, punctual, and multidimensional. The type of data was collected based on the duration parameter, which entails the temporal recording of actions according to the time elapsed between one action and another within the same match.

Participants

A total of 1272 corner kicks were analyzed, corresponding to the 160 matches of the 2020 Chinese Super League. All corner kicks meeting the following inclusion criteria were coded: (1) the executing team played the ball (either directly or indirectly) into the penalty area with the intention of concluding the action (i.e., set-piece actions in which there was no clear intention to deliver the ball into the penalty area were excluded), and (2) the duration of the play was equal to or less than five seconds ((Dufour, 1993; Olsen, 2013; Silva Puig, 2011). All matches were recorded from public television broadcasts and analyzed post-event. Following the Belmont Report (1979), the use of public images for research purposes does not require consent for the participants.

Observation and recording instrument

The observation instrument utilized in this study was adapted from Maneiro (2014) and comprised 18 criteria and 40 categories (Table 1). The adaptation of the initial observation instrument was carried out by three of the study's authors (ZN, II-B, AA) following the procedure proposed by Anguera et al. (2007), based on: (1) a prior theoretical framework (in this case, the rules of football) and (2) criteria and categories empirically verified in other observational studies. Los autores encargados de la elaboración del instrumento de observación presentaban más de 20 años de experiencia en metodología observacional.

The recording of corner kick actions was conducted using LINCE PLUS V. 1.3.2® software (Soto et al., 2019).

Table 1
The observation instrument of corner kick

Criterion	Category
Temporal result	Win (RTG)
	Draw (RTE)
	Loss (RTP)
Time	1: 0'-30' (1)
	2: 31'-60' (2)
	3: 61'-90' (3)
Position of corner	Right (LSR)
	Left (LSL)
Laterality of corner	Natural: Taken with the right foot from the right side or taken with the left foot from the left side. (LGN)
	Switched: Taken with the left foot from the right side or taken with the right foot from the left side. (LGC)

Number of players in attack	2-3: 2 or 3 observed players are directly involved in the offensive phase of the corner kick. (JA2-3)
	4-5: 4 or 5 observed players are directly involved in the offensive phase of the corner kick. (JA4-5)
	6 or more: 6 or more observed players are directly involved in the offensive phase of the corner kick. (JAMAS6)
Number of players on defense	4-5: 4 or 5 opposing players are directly involved in the defensive phase of the corner kick. (JD4-5)
	6 or more: 6 or more opposing players are directly involved in the defensive phase of the corner kick. (JD6MAS)
Interaction context in end zone	Inferiority: The number of offensive players is lower than the number of defensive players. (COIIN)
	Equality: The number of offensive players is equal to the number of defensive players. (COIIG)
Delivery of ball	Direct delivery: The observed player sends the ball to the finishing zone with just one touch on the ball. (EBFED)
	Indirect delivery: Before sending the ball to the finishing zone, the observed player cooperates with teammates and uses more than one touch on the ball. (EDFEI)
Path of ball	Ground: The ball is sent to the finishing zone, always contacting the playing surface, without showing an aerial trajectory. (TBTRS)
	Air: The ball is sent to the finishing zone without contacting the ground. (TBTA)
Type of marking used by the defending team in the finishing zone	Individual: Each attacker is marked by one defender. (MARI)
	Zonal: Each opposing player is responsible for occupying a zone in the penalty area; each opposing player will defend in their designated zone. (MARZ)
	Combined: Some opposing players execute zonal marking, while another group of opposing players executes individual marking. (MARC)
Number of defenders on the posts	Zero (DPN)
	One (DPU)
	Two (DPD)
Number of attackers involved	1-2: 1 or 2 observed players are involved in the ball attack. (NAI1-2)
	3-4: 3 or 4 observed players are involved in the ball attack. (NAI3-4)
Zone to which pass is made	Near post (ZEPPPP)
	Far post (ZEPPSP)
End zone of the play	Near post (ZFJPP)
	Far post (ZFJSP)
Offensive organization	Static: During the offensive phase of the corner kick, more than 50% of the observed players maintain their initial attacking positions.
	Dynamic: The initial attacking positions of the more than 50% of observed players vary during the offensive phase of the corner kick. (MODD)
Result of corner	Goal (G)
	Shot (S)
	Not success (N)

Data Quality Control

Data quality control in this study followed the procedure outlined by Losada and Manolov (2015), aiming to verify the consistency of Cohen's Kappa coefficient (1960) among each observer. At the

moment of the registration, two of the observers held a Doctorate in Sport Sciences and the third observer was enrolled in the PhD programme. To train the observers, five two-hour training sessions were conducted, analyzing a total of 100 randomly selected records.
The average value of Cohen's Kappa coefficient was .848 [Range: .878-.802], which can be considered excellent according to the Landis and Koch (1977) scale, an aspect that allows the use of this instrument in similar studies (Table 2).

Table 2
Kappa values and average Kappa for corner kick

Observers	Kappa	Average Kappa
Observer 1- Observer 2	0.863	
Observer 1- Observer 3	0.878	
Observer 2- Observer 3	0.802	0.848

Data analysis
Three types of analyses were conducted in this study. First, absolute and relative frequencies were analyzed for each criterion of the observation instrument. Second, it was examined whether significant differences existed between the categories "Shot/No Shot" and "Goal/No Goal" for each criterion using contingency table procedures. The presence of differences was tested using the Chi-square statistic ($p<.05$), and the effect size was quantified using the contingency coefficient. Finally, a classification model was developed using the decision tree technique, previously successfully applied in football performance analysis (Casal et al., 2017; Iván-Baragaño et al., 2021; Maneiro et al., 2019). The tree-growing method employed was CHAID (Chi Squared Automatic Interaction Detection). The recoded variable "Shot (Goal, Shot) /No Shot" was introduced as the dependent variable. The maximum tree depth was set at three levels, with a minimum of 100 cases for the parent node and 50 for the child node.
All analyses were performed using the SPSS 25.0 software (IBM Corp. Released 2017. IBM SPSS Statistics for Windows, Version 25, IBM Corp., Armonk, NY, USA).

RESULTS

A total of 1272 corner kicks were analyzed across 160 matches, resulting in an average of 7.95 corner kicks executed per match.
Of these 1272 corner kicks, only 41 (3.2%) resulted in a goal, 254 (20.6%) ended with a shot, and the remaining 76.2% concluded unsuccessfully for the attacking team. Regarding the effectiveness of the attack, we observe the cumulative frequency of outcomes, and 303 (23.8%) of the corner kicks achieved success.
Table 3 presents the count of absolute and relative frequencies for each criterion included in the observation instrument. Teams tended to take more corner kicks when the score was tied (46.3%). Most corner kicks were executed with the involvement of 4-5 players in attack and 6 or more in

defense. In most instances, these corner kicks were executed through a direct aerial delivery into the penalty area (87.8%), and only one or two players from the attacking team were involved with the ball (89.9%). Combined defense was used by 80.7% of the teams, and there were more static ones (56.4%) than dynamic attacks (43.6%). The ball was predominantly delivered to the near post (70.6%), and the action predominantly concluded in that area (61.9%).

Table 3
Descriptive analysis of corner kicks

Criterion	Category	N	%
Match Status	Win	266	20.90%
	Draw	589	46.30%
	Loss	417	32.80%
Time	1	358	28.10%
	2	431	33.90%
	3	483	38.00%
Position of corner	Right	632	49.70%
	Left	640	50.30%
Laterality of corner	Natural	786	61.80%
	Switched	486	38.20%
Number of players in attack	2-3	20	1.60%
	4-5	815	64.10%
	6 or more	437	34.40%
Number of players on defense	4-5	12	0.90%
	6 or more	1260	99.10%
Interaction context in end zone	Inferiority	1264	99.40%
	Superiority	8	0.60%
Delivery of ball	Direct delivery	1139	89.50%
	Indirect delivery	133	10.50%
Path of ball	Ground	155	12.20%
	Air	1117	87.80%
Type of marking used by the defending team in the finishing zone	Individual	7	0.60%
	Zonal	238	18.70%
	Combined	1027	80.70%
Number of defenders on the posts	Zero	909	71.50%
	One	289	22.70%
	Two	74	5.80%
Number of attackers involved	1-2	1143	89.90%
	3-4	129	10.10%
Zone to which pass is made	Near post	898	70.60%
	Far post	374	29.40%
End zone of the play	Near post	787	61.90%
	Far post	485	38.10%
Offensive organization	Static	718	56.40%
	Dynamic	554	43.60%
Result of corner	Goal	41	3.20%
	Shot	262	20.60%
	Not success	969	76.20%

Note. N = number of observations for the categories, % = percentage of the total observed.

Table 3 presents the bivariate results based on the categories Shot/No Shot. The criteria that showed statistically significant differences were Time ($\chi2=6.16$, $p<.05$), Position of corner ($\chi2=5.28$, $p<.05$), Number of players in attack ($\chi2=6.79$, $p<.001$), Number of attackers involved ($\chi2=115.41$, $p<.001$), Zone to which pass is made ($\chi2=9.12$, $p<.001$), and End zone of the play ($\chi2=11.91$, $p<.001$).

Table 4
Bivariate results of corner kicks based on Shot/No shot.

Criterion	Category	E	E%	NE	NE%	χ^2	P	Cont. Coef
Match Status	Win	63	5.0	203	16.0	0.14	0.93	0.01
	Draw	143	11.2	446	35.1			
	Loss	97	7.6	320	25.2			
Time	1	72**	5.7	286*	22.5	6.16	<.05	0.07
	2	99	7.8	332	26.1			
	3	132*	10.4	351**	27.6			
Position of corner	Right	168*	13.2	464**	36.5	5.28	<.05	0.06
	Left	135**	10.6	505*	39.7			
Laterality of corner	Natural	128	10.1	358	28.1	2.75	0.09	0.04
	Switched	175	13.8	611	48.0			
Number of players in attack	2-3	7	0.6	13	1.0	6.79	<.001	0.07
	4-5	176**	13.8	639*	50.2			
	6 o more	120*	9.4	317**	24.9			
Number of players on defense	4-5	4	0.3	8	0.6	0.60	0.43	0.02
	6 o more	299	23.5	961	75.6			
Interaction context in end zone	Inferiority	300	23.6	964	75.8	0.83	0.36	0.02
	Equality	3	0.2	5	0.4			
Delivery of ball	Direct delivery	268	21.1	871	68.5	0.51	0.47	0.02
	Indirect delivery	35	2.8	98	7.7			
Path of ball	Ground	45	3.5	258	8.6	2.64	0.10	0.05
	Air	110	20.3	859	67.5			
Type of marking used by the defending team in the finishing zone	Individual	1	0.1	6	0.5	0.85	0.65	0.03
	Zonal	61	4.8	177	13.9			
	Combined	241	18.9	786	61.8			
Number of defenders on the posts	Zero	220	17.3	689	54.2	0.60	0.74	0.02
	One	68	5.3	221	17.4			
	Two	15	1.2	59	4.6			
Number of attackers involved	1-2	223**	17.5	920*	72.3	115.41	<.001	0.29
	3-4	80*	6.3	49**	3.9			
Zone to which pass is made	Near post	193**	15.2	705*	55.4	9.12	<.001	0.08
	Far post	110*	8.6	264**	20.8			
End zone of the play	Near post	162**	12.7	625*	49.1	11.91	<.001	0.1
	Far post	141*	11.1	344**	27.0			
Offensive organization	Static	184	14.5	534	42	2.96	0.09	0.05
	Dynamic	119	9.4	433	34.2			

*Note. E% = percentage of success, NE% = percentage of non-success. * = More observed values than expected obtained from adjusted residuals (p<.05) for each category, ** = Less observed values than expected.*

Table 4 displays the bivariate results based on the criterion Goal/No Goal. The criteria that exhibited a statistically significant influence with this criterion were: Time ($\chi2=6.99$, $p<.05$), Number of

attackers involved ($\chi2$=43.86, p<.001), Zone to which pass is made ($\chi2$=5.25, p<0.05), and End zone of the play ($\chi2$=12.60, p<.001).

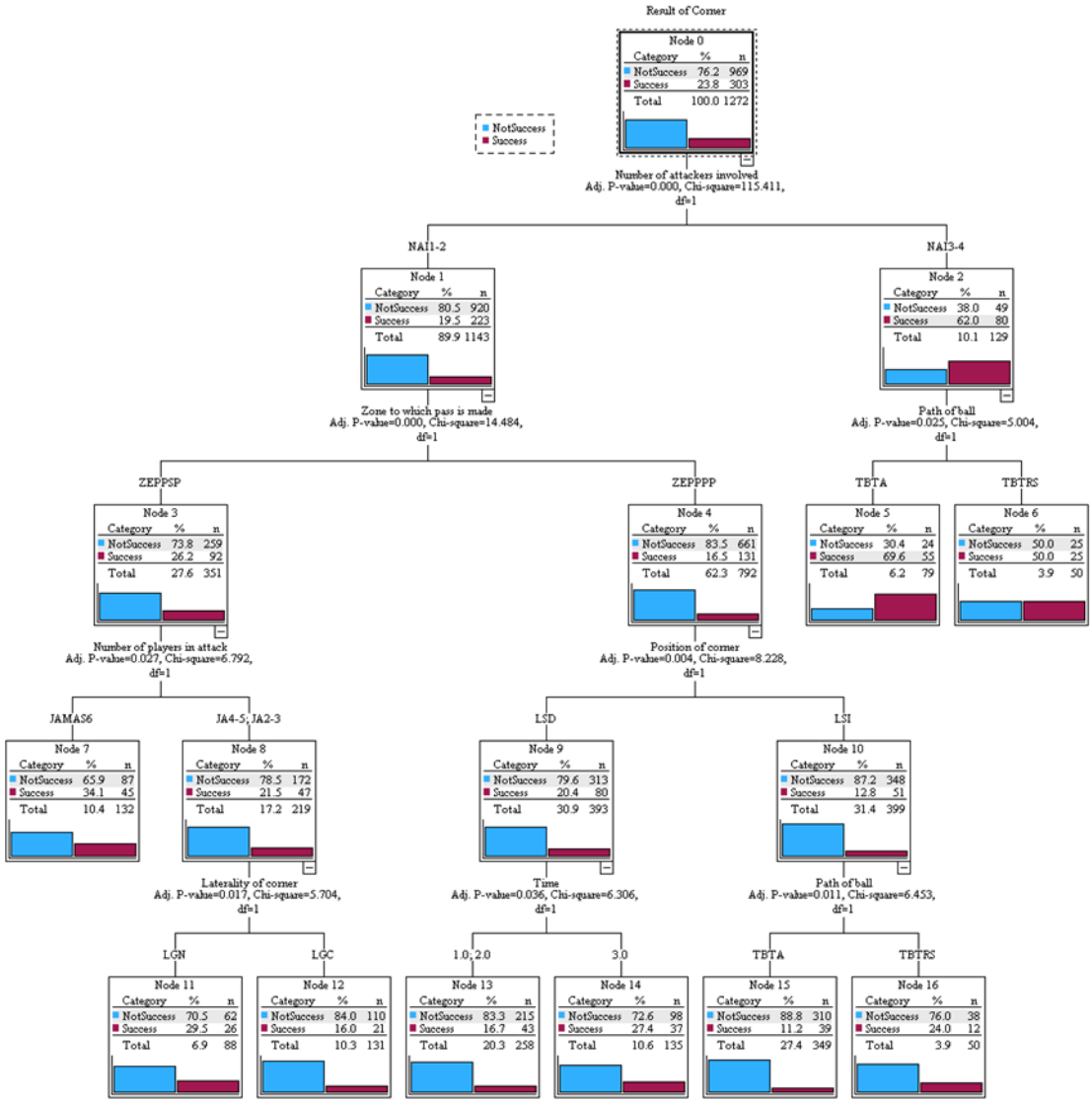
Table 5
Bivariate results of corner kicks based on Goal/No goal.

Criterion	Category	G	G %	NG	NG %	χ^2	P	Cont. Coef
Match Status	Win	11	0.9	255	20.0	1.33	0.51	0.03
	Draw	16	1.3	573	45.0			
	Loss	15	1.2	402	31.6			
Time	1	7**	0.6	351*	27.6	6.99	<.05	0.07
	2	11	0.9	420	33.0			
	3	24*	1.9	459**	36.1			
Position of corner	Right	24	1.9	576	45.3	0.97	0.33	0.03
	Left	18	1.4	583	45.8			
Laterality of corner	Natural	19	1.5	467	36.7	0.91	0.34	0.03
	Switched	23	1.8	763	60.0			
Number of players in attack	2-3	0	0.0	20	1.6	0.89	0.64	0.03
	4-5	26	2.0	789	62.0			
	6 o more	16	1.3	421	33.1			
Number of players on defense	4-5	0	0.0	12	0.9	0.41	0.52	0.02
	6 o more	42	3.3	1218	95.8			
Interaction context in end zone	Inferiority	42	3.3	1222	96.1	0.28	0.60	0.02
	Equality	0	0.0	8	0.6			
Delivery of ball	Direct delivery	39	3.1	1100	86.5	0.51	0.48	0.02
	Indirect delivery	3	0.2	130	10.2			
Path of ball	Ground	3	0.2	152	11.9	1.03	0.31	0.03
	Air	39	3.1	1078	84.7			
Type of marking used by the defending team in the finishing zone	Individual	0	0	7	0.6	0.44	0.80	0.02
	Zonal	9	0.7	229	18.0			
	Combined	33	2.6	994	78.1			
Number of defenders on the posts	Zero	32	2.5	877	68.9	0.48	0.79	0.02
	One	8	0.6	281	22.1			
	Two	2	0.2	72	5.7			
Number of attackers involved	1-2	25**	2.0	1118*	87.9	43.86	<.001	0.18
	3-4	17*	1.3	112**	8.8			
Zone to which pass is made	Near post	23**	1.8	875*	68.8	5.25	<.05	0.06
	Far post	19*	1.5	355**	27.9			
End zone of the play	Near post	15**	1.2	772*	60.7	12.60	<.001	0.10
	Far post	27*	2.1	458**	36.0			
Offensive organization	Static	29	2.3	689	54.2	2.80	0.09	0.05
	Dynamic	13	1.0	541	42.5			

*Note. E% = percentage of success, NE% = percentage of non-success. * = More observed values than expected obtained from adjusted residuals (p<.05) for each category, ** = Less observed values than expected.*

Finally, the decision tree model is presented in figure 1 using Shot/No Shot as the dependent variable in the corner kicks.

Figure 1.
Decision tree model



The decision tree presented an initial node 0 based on the corner kick outcome with 1272 observations, and most of No success (969 cases, 76.2%) and 303 cases (23.8%) with Success. The next criterion introduced by the algorithm was the Number of attackers involved ($\chi2=115.411$; $p<.001$), branching into two nodes corresponding to the categories Number of attackers involved 1-2 and Number of attackers involved 3-4. In this split, we can observe that the category Number of attackers involved 3-4 has a higher probability of success compared to Number of attackers involved 1-2. In node 1 (NAI1-2), we observe a total of 1143 observations, with 80.5% corresponding to No success, while in node 2 (NAI3-4), we observe that out of the total 129 observations, 62.0% would correspond to Success, and 38.0% to No success.

The next predictive criterion introduced by the algorithm is developed based on the Number of attackers involved 1-2 category, being the Zone to Which Pass is Made ($\chi2=14.484$, $p<.001$). Node 3 (Zone to Which Pass is Made, near post) presented 351 observations, with a Success probability of

34.1% and 73.8% No success. On the other hand, node 4 (Zone to Which Pass is Made, far post) presented 792 observations and yielded a Success probability of 16.5%. Nodes 5 and 6 of the decision tree are terminal and introduce the Ball trajectory in its delivery to the finishing area as a predictive criterion ($\chi2$=5.004, p<.025). We observe that node 5 had 79 observations and achieved probabilities of 69.6% Success when the player delivered the ball through an aerial trajectory. Meanwhile, in node 6, we observe that out of a total of 50 observations, 50% correspond to Success with the Ground-level trajectory category.

Continuing with the interpretation of the decision tree vertically, from node 3, two nodes emerged based on the Number of players in attack criterion ($\chi2$=6.792, p<.027). Node 7 was terminal and presented 132 observations with a Success probability of 34.1% when 6 or more players were able to participate in the attack. On the other hand, in node 8, we can observe that out of a total of 219 observations, 21.5% correspond to the Success outcome. Nodes 9 and 10 introduced Position of corner as a predictive criterion based on the criterion Delivery zone, far post ($\chi2$=8.228, p<.004). Thus, node 9 with the Right category presented a total of 393 observations, of which 79.6% would correspond to No success, and 20.4% to Success. Node 10, on the other hand, presented 399 observations and yielded a Success probability of 12.8% with the Left category.

From node 8 (1-2 players, Delivery zone, far post, and 2 to 5 players in attack), the next predictive criterion introduced by the algorithm is Laterality of corner ($\chi2$=5.704, p<.017) and branches into nodes corresponding to the categories Natural and Switched, forming terminal nodes 11 and 12. Node 11 introduced the Natural criterion and presented a total of 88 observations with a probability of 29.5% of achieving Success. On the other hand, node 12 presented a total of 131 observations and yielded a Success probability of 16% under the Switched category.

Two other terminal nodes that can be consulted in the decision tree were terminal nodes 13 and 14, introducing the Time as a predictive criterion ($\chi2$=6.306, p<.036). Node 13 presented a total of 258 observations (83.3% No success; 16.7% Success) under the influence of categories 1 and 2, while in node 14, there was a slight increase in the probability of Success (27.4%) in actions that took place under the influence of category 3.

Finally, the last predictive criterion introduced by the algorithm unfolded from node 10 (Number of players 1 or 2, Delivery zone, near post, and lateral pass left), being the Path of ball ($\chi2$=6.453, p<.011) the criterion that became part of the algorithm's interaction. From this decision node, nodes 15 and 16 were deployed, both terminals. Node 15 presents 349 actions with a Success probability of 11.2% when the ball was delivered to the area through an aerial trajectory. On the other hand, this probability of success increased slightly to 24% in node 16 (n=50) under the influence of the Ground category.

DISCUSSION

The objectives of this study were: (1) to analyze and describe corner kicks in the Chinese Super League in 2020, and (2) to identify the indicators that influence the outcome of corner kicks, as well as to recognize the interaction of criteria that provide a higher probability of success in corner kicks.

In 160 matches of the 2020 Superliga, a total of 1391 corner kicks were executed, suggesting an average of 8.69 corner kicks per match, however, out of 1391 corner kick, 119 were eliminated for not meeting the inclusion criteria of the present study. Mitrotasios et al. (2021) analysis of corner kicks in

the Greek Super League 2018-2019 found an average of 6.72 executed per match. The average corner kick execution in the 50 matches of the Premier League recorded by Pulling et al. (2013) for the 2011-2012 season was also 8.72, results that are more consistent with those of the present study.

Out of a total of 1272 corner kicks analyzed, 303 (23.2%) ended in a shot on goal, indicating that 3 out of every 4 corner kicks were clearly ineffective. These findings align with the results reported by De Baranda and Lopez-Riquelme (2012) and Silva Puig (2011). Regarding whether the corner kick resulted in a goal or not, the available data from this research align with previous investigations. Specifically, it has been found that only 3.2% of corner kicks end in a goal, a finding consistent with earlier research (Ardá et al., 2014; Strafford et al., 2019). These similar goal-scoring efficiency values across different championships may indicate a stable trend in success.

In 2020, there were 16 teams in the Chinese Super League, and we recorded 1272 corner kicks, averaging 7.95 corner kicks per team. Regarding the defense of corner kicks, only six teams were above the average in terms of the number of corners defended. However, it is noteworthy that these six teams finished in the lower-middle part of the table. Jiangsu Suning defended only 58 corners (4.6%), the lowest number, and they became the champions of the 2020 Chinese Super League as well. There is very little literature on the analysis of teams' corner kick performance, and we only describe it to address the first of the specific objectives: describing the development and action of corner kicks in the 2020 Chinese Super League. However, from the described data, it is evident that a comparison or study of each team's corner kick strategy could be valuable, serving as a direction for future research.

It is observed that the highest number of corner kicks occurred in the period between the 61st minute and the end of the match, and the success rate of these actions was also higher. A significant association is noted between the criteria Temporality of the action and shot/no shot ($\chi2=6.16$, $p<.04$) and goal/no goal ($\chi2=6.99$, $p<.03$). This observation aligns with much of the existing literature (Ardá et al., 2014; Casal et al., 2015; Kubayi, 2020; Maneiro et al., 2021). On one hand, with the changing conditions and the decrease in player strength, the game becomes more open, and attacking players have more space to exploit and create goal-scoring opportunities (Ensum et al., 2005), resulting in more corner kicks being awarded. On the other hand, player fatigue may lead to reduced concentration (Armatas et al., 2007). Another factor to consider is the tactics developed in the second half, which may be more successful compared to the first half (Sarmento et al., 2014).

Regarding position of corner kick, in most of the research, the execution from one side of the attack or the other has no impact on the success rate. However, a significant association was found between the laterality of the corner kick and the Success outcome in the 2020 Chinese Super League ($\chi2=5.28$, $p<.02$), a finding that aligns with the results of Sánchez-Flores et al. (2012). And this study also emphasizes that this may not be pivotal in the outcome. The statistical significance of this variable still needs to be tested in further studies of this nature.

In most of the literature (Maneiro et al., 2021; Prieto-Lage et al., 2021), the number of attacking players involved has no effect on the outcome of corner kicks. However, in this study, a significant effect was found between the criterion of the number of players in attack and shot/no shot ($\chi2=6.79$, $p<.03$), with corner kicks being more likely to be successful when only 2-3 attacking players are in the area. This is an unusual statistic, as the statistical results revealed that with fewer attacking players (2-3), the success rate was higher, possibly due to the reduced attention and concentration of the defending team towards the attacking team with fewer players, or alternatively due to a recurrent scenario in which exactly three players are involved in the action—the taker, the crosser, and the finisher—which may lead to an oversampling of this type of action that typically ends successfully.

However, in this study, there was no significant association between the method of delivering the ball into the area and the outcome of corner kicks, contradicting other studies. For instance, Souza et al. (2021) and Mitrotasios et al. (2021) found that delivering the ball directly into the area was more efficient, but Ardá et al. (2014), Casal et al. (2015), and De Baranda and Lopez-Riquelme (2012), on the other hand, discovered that delivering the ball into the area indirectly was more efficient. This discrepancy may be because this type of delivery forces defenders to abandon the defensive method they have developed previously (Maneiro et al., 2017).

Although the most common action involves only the intervention of 1-2 players, when 3-4 players are involved in the corner kick, higher efficiency rates are observed. This aligns with most studies (Ardá et al., 2014; Casal et al., 2015; Maneiro et al., 2021; Prieto-Lage et al., 2021). However, Mitrotasios et al. (2021), in their analysis of corner kicks in the 2019-2020 La Liga Santander season, discovered that it was more likely for teams to be successful in finishing when only 1-2 attacking players were involved.

This result could be due, on the one hand, to the pre-designed tactics breaking the defensive strategy of the defending players, and, on the other hand, to the fact that 86.1% of the goals scored resulted from the attacking team winning the first aerial confrontation (Souza et al., 2021).

About the Delivery zone of the primary pass, we found that most corner kicks were directed to the near post area, aligning with the findings of De Baranda and Lopez-Riquelme (2012); Maneiro et al. (2021); Kubayi and Larkin (2019); and Sánchez-Flores et al. (2012). However, higher efficiency was achieved by delivering the ball to the far post area. This result is consistent with the conclusions of Maneiro et al. (2021); Kubayi and Larkin (2019); and Pulling and Newton (2017), but contradicts the findings of Carling et al. (2007); Pulling (2015); and Prieto-Lage et al. (2021), which suggest that delivering the ball to the near post is more likely to yield positive results. This may be because delivering the ball to the far post gives attacking players more time to prepare, and players from the near post area interfere with defenders, making delivering the ball to the far post appear more effective.

As for the Finishing zone of the play, although most corner kicks were executed in the near post area, corner kicks in the far post area were more likely to be fruitful. This result is consistent with the findings of Ardá et al. (2014) and Casal et al. (2015), but conflicts with the results of Borrás and Sainz de Baranda Andújar (2005) and Sánchez-Flores et al. (2012), which suggest that corner kicks are more likely to be headed towards the near post to achieve positive outcomes.

So far, we have finished analyzing a subdimension of the observation instrument, and many criteria have proven to have a key impact on the outcome of corner kicks. The work of Iván-Baragaño et al. (2021) considers that factors such as chance, uncertainty, or variability, which are currently not sufficiently researched, may potentially modulate many of the criteria associated with success in these actions. Therefore, a multivariate analysis is justified from this perspective, as it helps integrate irregular variables, predict, and draw valid conclusions. To achieve this, a decision tree model has been implemented to analyze the subdimensions that may impact the completion of corner kicks.

In this study, it has been observed that the involvement of 3-4 players in the attack, sending the ball into the area through an aerial trajectory, would have a higher likelihood of achieving a shot in a corner kick. However, the participation of 3-4 players in the attack and delivering the ball into the area through a ground-level trajectory also had a similar success rate.

Regarding the multivariate results, in this regard, these findings align with those of Ardá et al. (2014), Casal et al. (2015) and Maneiro et al. (2021), who found that the chances of a corner kick ending with a shot were higher when three or four players participated dynamically in the action.

Despite the results obtained in this study, it should be noted that the examination of a single competition and a single season reduces the external validity when extrapolating results. Additionally, it is important to take into account that the particular context of the 2020 season in the Chinese Super League, played at neutral venues without spectators due to COVID-19, may represent a confounding factor with a direct influence that should be considered in future studies. Therefore, future research on set-piece analysis should focus on studying multiple competitions simultaneously and over several seasons.

On a practical level, the results of this study can serve as a foundation for training strategies in these types of actions. Thus, coaching staff may prepare rehearsed actions in which, through prior training, 3 or 4 players participate around the ball, utilizing aerial connections that are more likely to be fruitful. This can increase the chances of offensive success in corner kicks.

CONCLUSIONS

From this study, various conclusions can be drawn. Firstly, while there are differences compared to other competitions, corner kicks in the Chinese Super League are infrequent and exhibit low efficiency, consistent with most previous studies. Secondly, the criteria of Temporality of the action, Position of corner, Number of players in attack, Number of attackers involved, Main Pass Sending Zone and End zone of the play modified the probability of successfully concluding corner kicks in the 2020 Chinese Super League. Lastly, strategies that teams may adopt to increase success should focus on developing set-piece actions where 3 or 4 players participate, utilizing aerial connections. In addition, the methodological contribution—based on observational methodology and the application of the decision tree technique—helps to consolidate the use of multivariate techniques in this type of analysis and facilitates a clearer interpretation for practitioners.

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