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Evidence of penalty kicks in the fifa world cup 2022

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Abstrak
Penalty kicks in soccer become crucial moments that determine the outcome of the match. This research aims to analyze penalty kicks in terms of dominant foot and direction. Data were collected through video analysis of soccer players' penalty kicks in the 2022 FIFA World Cup matches via the official FIFA website. This study involved 5 videos of penalty shootout matches with a total of 41 kicks performed by professional players. Based on the analysis results, it was found that in the penalty shootout of the 2022 World Cup, 80.49% of players took the kick using their dominant right foot, and 19.51% used their dominant left foot. Regarding the target direction chosen by players, it was observed that players with dominant right foot more often aimed the ball towards the bottom left, while players with dominant left foot more frequently aimed towards the bottom middle. When considering the success rate of kicks resulting in goals, kicks with dominant right foot had a higher success rate when aimed towards the top middle and bottom middle, whereas kicks with dominant left foot had a higher success rate when aimed towards the bottom middle and bottom left. The research results indicate that dominant foot and target direction are contributing factors to the success of penalty kicks.
Keywords: Football, Penalty, Professional Player, Shooting.

INTRODUCTION

In football, matches are played in two halves with a duration of 45 minutes each half. In some competitions, matches often end in a draw, and to determine the winner, they are often followed by an additional period known as extra time, with a duration of 15 minutes per half (Konefał et al., 2023; Prüßner & Siegle, 2015). If the score between the two teams remains the same after extra time, a penalty shootout will be held to determine the winner. Penalty kicks are not only used as the decider of victory in the match, but can also be awarded during the course of the match as a consequence of fouls committed inside the opponent's penalty box. These fouls can vary, including deliberate actions to disadvantage the opponent, handball, or other actions that endanger the opposing team. The location of the foul inside the penalty area does not affect the awarding of a penalty kick. To take a penalty kick, the ball is placed at the penalty spot, which is 11 meters away from the goal line. Stronger teams win penalty shootouts significantly more often than weaker teams, with a winning probability of around 40%, even for very weak teams against very strong teams. Stronger teams win penalty shootouts significantly more often than weaker teams, with a winning probability of around 40%, even for very weak teams against very strong teams (Wunderlich et al., 2020).

Shooting is a fundamental skill that plays a crucial role in the game of soccer, aiming to put the ball into the opponent's goal to score a goal (Sinatriyo et al., 2020). Studies on the technical activities of soccer players have found that the frequency of shots hitting the target has a significant impact depending on different stages of the match (Konefał et al., 2019). This indicates the need to improve both the frequency and accuracy of shots to change the outcome of the match. Given various ball conditions, it is crucial to have good basic shooting technique to maximize scoring goals (Raudonius & Seidl, 2023). A study during the 2012 European Championship showed that the majority of shots aimed at the opponent's goal and resulting in goals were targeted at the lower zones of the goalposts, highlighting the importance of accuracy in kicking technique (Y.-S. Park et al., 2016).

A penalty kick is a type of free kick aimed towards the goal and taken from the penalty spot. Penalty kicks have increased in complexity since 1997 due to rule changes allowing goalkeepers to

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move laterally before the ball is kicked (Dalton et al., 2015). Penalty kick situations arise as a result of fouls occurring inside the penalty box. These fouls can arise due to various factors, such as handballs, intentional tackling by defending players to prevent a goal, goalkeeper errors in clearing the ball, and several other factors (Teguh Susanto, 2016). In research discussing penalty kicks, it's mentioned that the kicker can strike with varying speeds, affecting accuracy, while the goalkeeper's movement time affects their probability of moving in the correct direction (Hunter et al., 2022a).

The factors influencing the success of goals in penalty kicks involve aspects such as ball contact (Brinkschulte et al., 2023a), level of anxiety (Horn et al., 2021), And various forms of training conducted (Navia et al., 2019). For example, the success of penalty kicks, in terms of their contact, is discussed in this article where researchers explain that each foot contact has its own advantages and disadvantages when used for taking penalty kicks. Penalty kicks are not merely a game of luck, as differences in abilities between teams affect the probability of winning (Krumer, 2020). Self-confidence and anxiety levels play a significant role in the success of scoring goals in penalty kicks, impacting both the performance of the kicker and the goalkeeper's ability to save penalties (Arrondel & Duhautois, 2019; Brinkschulte et al., 2023b; Navia et al., 2019; Zheng & Wang, 2020). Therefore, from these issues, some researchers and coaches also conduct experiments to enhance their players' shooting accuracy in executing penalty kicks. Various types of training are conducted using aids to improve the players' penalty kick accuracy (Gaspar et al., 2019). From various types of research, researchers want to do something new, namely how the success rate of penalty kicks when viewed from the direction of the target and reviewed from the dominant foot of the kicker.

When it comes to taking a penalty kick, it may seem quite simple to just kick the ball as hard as possible towards the goal. One study explored the effects of strength training on soccer kicking technique and found that specific strength training interventions for stability improved kicking accuracy (van den Tillaar & Fuglstad, 2017; Van Den Tillaar & Ulvik, 2014). If the ball can be directed accurately, there is a high likelihood that it will go in. However, in executing the kick, not only strength is required, but also technique and accuracy in determining the target angle. Although the focus is on the kicker, it is important to note that the success of a penalty kick also depends on the goalkeeper's actions. A model is presented to predict the probability of success for different shooting strategies against goalkeepers with varying reaction times (Hunter et al., 2022b). When looking at the situation on the field, not all players have the ability to be penalty kick takers, and this is reflected in the decisions of some coaches who have designated certain players as takers when there is a penalty shootout opportunity. This is because factors like attention and motivation influence the accuracy of penalty kicks; the combination of both factors can improve results in motor skills (Makaruk et al., 2019).

Scoring as many goals as possible is the main objective in football games to secure victory. The success of a football team is linked to its ability to consistently create goal-scoring opportunities and prevent the opponent from doing the same, with the 'first goal effect' having a significant impact on the match outcome (Anwar et al., 2022). Goals can occur from good and accurate kicks. There are various methods to score goals, including using foot shots, headers, and taking penalty kicks. Scoring goals can be achieved by utilizing every part of the body except the hands, including involving both feet, both right and left, both of which are dominant parts often used to execute penalty kicks. Each soccer player is also known to have their own dominant foot abilities, as seen in soccer stars like Ronaldo and Messi who have different dominant foot skills. Based on the explanation above, research is needed to further understand the comparison of penalty kick outcomes between dominant feet, namely the right foot and the left foot, related to the accuracy of target direction in soccer during penalty shootout rounds in official FIFA matches at the 2022 World Cup.

METHOD

This research is a quantitative study, conducted by analyzing penalty shootout videos in official FIFA (Federation Internationale de Football Association) matches. The purpose of this study is to determine the direction of kicks used by professional soccer athletes, based on the dominant kicking foot, in the 2022 World Cup. The results of the research are then explained qualitatively; therefore, this research can be referred to as descriptive analysis research.

The population used in this research comprises the entire set of penalty shootout match videos from official FIFA (Federation Internationale de Football Association) matches. The sampling technique used in this study is purposive sampling, where samples are selected based on criteria; they have been

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published on the official FIFA website or YouTube channel. The samples used in this research are penalty shootout matches from official FIFA matches, matches with high intensity, knockout competitions, competitions involving all national teams worldwide. Hence, the 2022 World Cup competition was chosen. The sample table is attached as follows:

Table 1. Research video samples

No	Team	Phasee	Duration	Source
1.	Japan vs Kroasia	Round Of 16	02:15:40-02:21:30 (05':50")	http://surl.li/mbvqn
2.	Morocco vs spain	Round Of 16	02:17:00-02:23:00 (05':00")	http://surl.li/mbwhz
3.	Kroasia vs Brasil	Round Of 8	02:17:20-02:24:10 (06':50")	http://surl.li/mbxdm
4.	Netherland vs Argentina	Round Of 8	02:27:30-02:36:00 (08':30")	http://surl.li/mbxiu
5.	Argentina vs France	Final	02:28:10-02:34:40 (06':30")	http://surl.li/mbxlb

The implementation of this research test involves procedures, observing penalty shootout match videos from official FIFA (Federation Internationale de Football Association) matches in the 2022 World Cup, analyzing how many times kicks are made towards the top right, bottom right, top center, bottom center, top left, and bottom left directions, then reviewed based on the dominant foot using both the right and left feet in each played match. Furthermore, it categorizes the accumulation of kicks into goals, hitting the goalpost, saved by the goalkeeper, and out of the goal target area. In this study, the accuracy of shooting towards the goal target is divided into 6 target directions: right, left, and center, and the division of targets is adjusted according to the goalkeeper's body extremities into upper and lower parts. Thus, the accuracy of shooting towards the goal target is divided into top left, bottom left, top center, bottom center, top right, and bottom right directions.

RESULTS AND DISCUSSION

Results

In this study, samples were taken from 5 official FIFA matches in the penalty shootout round of the 2022 World Cup. From the conducted research, 5 matches were found to exhibit penalty shootout sessions, comprising 2 matches from the round of 16, 2 matches from the quarter-finals, and the final match, totaling 10 national teams with a total of 41 kicks performed by professional athletes overall. The results of these kicks are classified into the following table:

The data collected pertains to penalty kicks executed by professional athletes who served as kickers in the penalty shootout round of the 2022 World Cup, classified into 3 categories based on: the dominant foot used, the direction of the kick, and the outcome of the kick. The following is the result of data analysis based on the round of 16, quarter-finals, and the final match of the 2022 World Cup:

a. Round of 16

In the round of 16 of the 2022 World Cup, there were two matches that ended in a penalty shootout, namely between Japan and Croatia and Morocco and Spain, where Japan and Morocco emerged as the winners. A total of 15 kicks were taken in both matches, with 8 kicks occurring in the match between Japan and Croatia, and 7 kicks in the match between Morocco and Spain, as detailed in the table below:

Table 2. Analysis of Round of 16 Match Kicks

Dominant Foot	**Freq**	**Percent**	**Target Direction**	**Freq**	**Percent**	**Results**	**Freq**	**Percent**
Right	13	86,67%	Bottom-Right (BR)	4	30,77%	Goal	2	50 %
						GK save	2	50 %
						Hit Bar	0	0 %
						Out	0	0 %
			Bottom-Centre (BC)	2	15,38%	Goal	2	100 %
						GK save	0	0 %
						Hit Bar	0	0 %
						Out	0	0 %

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			Bottom-Left (BL)	7	53,85%	Goal	2	28,57 %
						GK save	4	57,14 %
						Hit Bar	1	14,29 %
						Out	0	0 %
Left	2	13,33%	Bottom-Centre (BC)	1	50 %	Goal	1	100 %
						GK save	0	0 %
						Hit Bar	0	0 %
						Out	0	0 %
			Bottom-Right (BR)	1	50 %	Goal	0	0 %
						GK save	0	0 %
						Hit Bar	1	100 %
						Out	0	0 %
Total Shoot							15	

From the given data, it is evident that in the penalty shootout of the Round of 16 matches of the 2022 World Cup, professional players tended to use their dominant right foot more than their dominant left foot when executing penalty kicks. Out of a total of 15 kicks taken, 13 of them were with the dominant right foot, while only 2 kicks were with the dominant left foot. The breakdown of these kicks shows that kicks with the dominant right foot were more often directed towards the target, with 4 kicks to the bottom right resulting in 2 goals and 2 kicks saved by the goalkeeper, 2 kicks to the bottom center resulting in a goal, and 7 kicks to the bottom left resulting in 2 goals, 4 kicks saved by the goalkeeper, and 1 kick hitting the goalpost. As for kicks with the dominant left foot, there were only 2 kicks, 1 goal to the bottom center and 1 kick hitting the goalpost to the bottom right.

b. Round of 8

In the quarter-finals of the 2022 World Cup, there were two matches that ended in a penalty shootout, namely between Argentina and the Netherlands and Croatia and Brazil, where Argentina and Croatia emerged as the winners. A total of 18 kicks were taken in both matches, with 10 kicks occurring in the match between Argentina and the Netherlands, and 8 kicks in the match between Croatia and Brazil, as detailed below:

Table 3. Analysis of Quarter-Final Match Kicks

Dominant Foot	**Freq**	**Percent**	**Target Direction**	**Freq**	**Percent**	**Results**	**Freq**	**Percent**
Right	14	77,78%	Bottom-Right (BR)	2	14,29%	Goal	1	50 %
						GK save	1	50 %
						Hit Bar	0	0 %
						Out	0	0 %
			Bottom-Centre (BC)	1	7,14 %	Goal	1	100 %
						GK save	0	0 %
						Hit Bar	0	0 %
						Out	0	0 %
			Bottom-left (BL)	10	71,43%	Goal	7	70 %
						GK save	1	10 %
						Hit Bar	1	10 %
						Out	1	10 %
			Centre-Top (CT)	1	7,14 %	Goal	1	100 %
						GK save	0	0 %
						Hit Bar	0	0 %
						Out	0	0 %
			Bottom-Centre (BC)	2	50 %	Goal	2	100 %
						GK save	0	0 %
						Hit Bar	0	0 %

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Left	4	22,22%				Out	0	0 %
			Bottom-Right (BR)	2	50 %	Goal	1	50 %
						GK save	1	50 %
						Hit Bar	0	0 %
						Out	0	0 %
Total Shoot							18	

From the table diagram above, it can be explained that professional players who served as penalty kick takers in the penalty shootout of the quarter-final matches of the 2022 World Cup tended to use their dominant right foot more often than their dominant left foot. Out of a total of 18 kicks taken by the players in the match, 14 kicks were with the dominant right foot, while only 4 kicks were with the dominant left foot. Kicks with the dominant right foot were more often directed towards the target, where there were 2 kicks to the bottom right resulting in 1 goal and 1 kick saved by the goalkeeper, 1 kick to the bottom center resulting in a goal, and 10 kicks to the bottom left resulting in 7 goals, 1 kick saved by the goalkeeper, 1 kick hitting the goalpost, and 1 kick going out of the goal target area. Additionally, there was 1 kick to the top center that successfully scored a goal. As for kicks with the dominant left foot, there were 2 kicks to the bottom center resulting in goals, and 2 kicks to the bottom right resulting in 1 goal and 1 kick saved by the goalkeeper.

c. Final Match

In the final of the 2022 World Cup, a penalty shootout occurred between Team Argentina and France, where Team Argentina emerged as the winner. A total of 8 kicks were taken in this match, with each team taking 4 kicks.

Table 4. Analysis of Final Match Kicks

Dominant Foot	**Freq**	**Percent**	**Target Direction**	**Freq**	**Percent**	**Results**	**Freq**	**Percent**
Right	6	75 %	Bottom-left (BL)	5	83,33%	Goal	3	60 %
						GK save	1	20 %
						Hit Bar	0	0 %
						Out	1	20 %
			Bottom-Centre (BC)	1	16,67%	Goal	1	100 %
						GK save	0	0 %
						Hit Bar	0	0 %
						Out	0	0 %
Left	2	25 %	Bottom-left (BL)	1	50 %	Goal	1	100 %
						GK save	0	0 %
						Hit Bar	0	0 %
						Out	0	0 %
			Bottom-Centre (BC)	1	50 %	Goal	1	100 %
						GK save	0	0 %
						Hit Bar	0	0 %
						Out	0	0 %
Total Shoot							8	

From the table above, it can be explained that in the penalty shootout of the final match of the 2022 World Cup, professional players tended to use their dominant right foot more than their dominant left foot. Out of a total of 8 kicks taken by the players in the match, 6 kicks were with the dominant right foot, while only 2 kicks were with the dominant left foot. Kicks with the dominant right foot were generally directed towards the target, where there were 5 kicks to the bottom left resulting in 3 goals, 1 kick saved by the goalkeeper, and 1 kick going out of the goal corner. Additionally, there was 1 kick to the bottom center that resulted in a goal. As for kicks with the dominant left foot, there was 1 kick to the bottom left resulting in a goal, and 1 kick to the bottom center that also scored a goal.

d. Overall Match Recap

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Of the five matches held in the 2022 World Cup Championship that ended in penalty shootouts, there were two matches in the round of 16, two matches in the quarter-finals, and one match in the final. Here is a summary of the results of all penalty shootout matches in the round of 16, quarter-finals, and final.

Table 5. Analysis of All Match Kicks

The results of the kicks								
All Matches								
Dominant Foot	**Freq**	**Percent**	**Target Direction**	**Freq**	**Percent**	**Results**	**Freq**	**Percent**
Right	33	80,49%	Bottom-left (BL)	22	66,67%	Goal	12	54,55 %
						GK save	6	27,27 %
						Hit Bar	2	9,09 %
						Out	2	9,09 %
			Bottom-Right (BR)	6	18,18%	Goal	3	50 %
						GK save	3	50 %
						Hit Bar	0	0 %
						Out	0	0 %
			Bottom-Centre (BC)	4	12,12%	Goal	4	100 %
						GK save	0	0 %
						Hit Bar	0	0 %
						Out	0	0 %
			Centre-Top (CT)	1	3,03 %	Goal	1	100 %
						GK save	0	0 %
						Hit Bar	0	0 %
						Out	0	0 %
Left	8	19,51%	Bottom-Centre (BC)	4	50 %	Goal	4	100 %
						GK save	0	0 %
						Hit Bar	0	0 %
						Out	0	0 %
			Bottom-Right (BR)	3	37,5 %	Goal	1	33,33 %
						GK save	1	33,33 %
						Hit Bar	1	33,33 %
						Out	0	0 %
			Bottom-left (BL)	1	12,5 %	Goal	1	100 %
						GK save	0	0 %
						Hit Bar	0	0 %
						Out	0	0 %
Total Shoot							41	

Furthermore, the data is presented in the form of a diagram table as follows:

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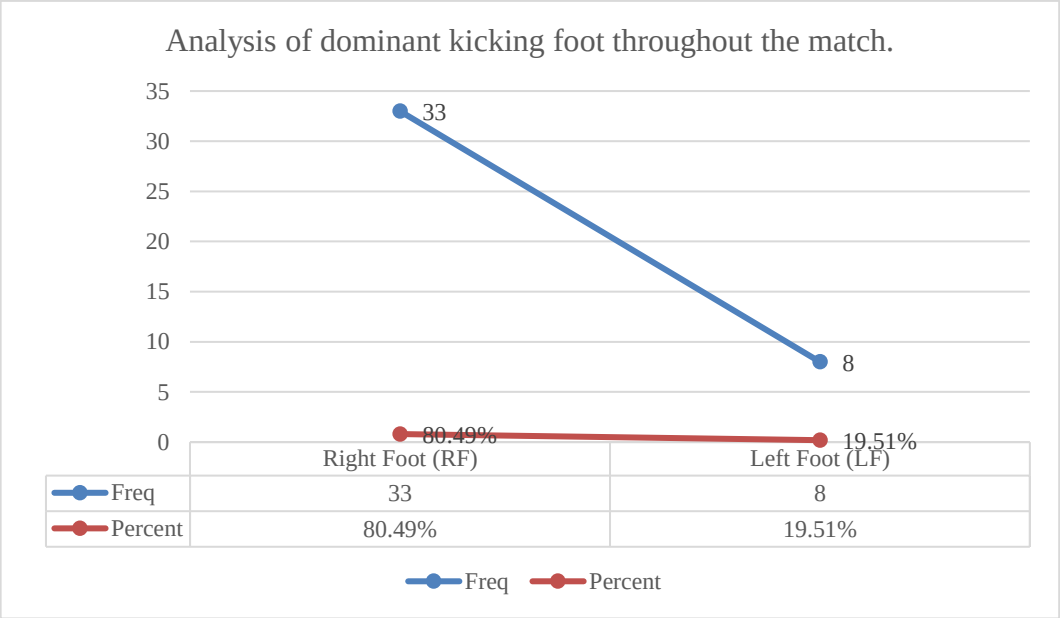

Figure 1. Diagram Analysis of Dominant Foot for All Matches

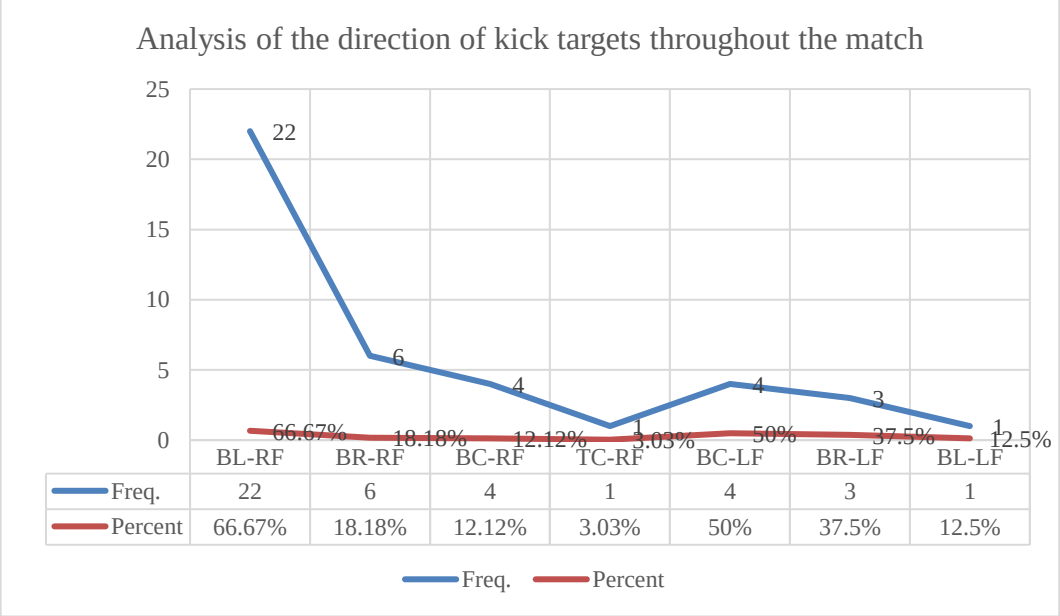

Figure 2. Diagram Analysis of Target Direction for All Matches

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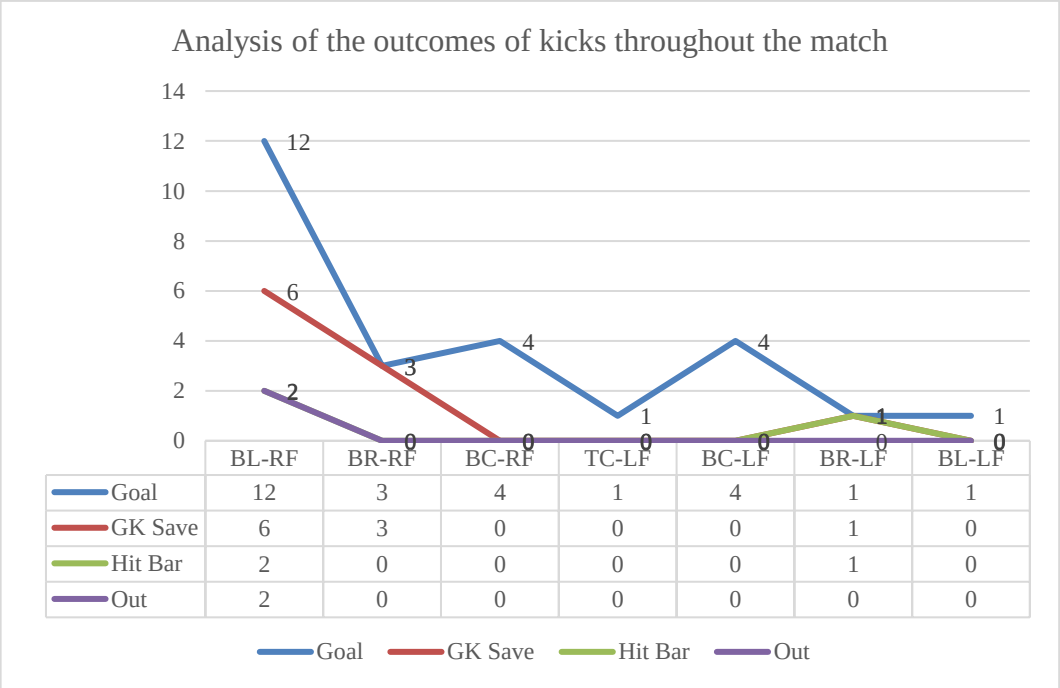
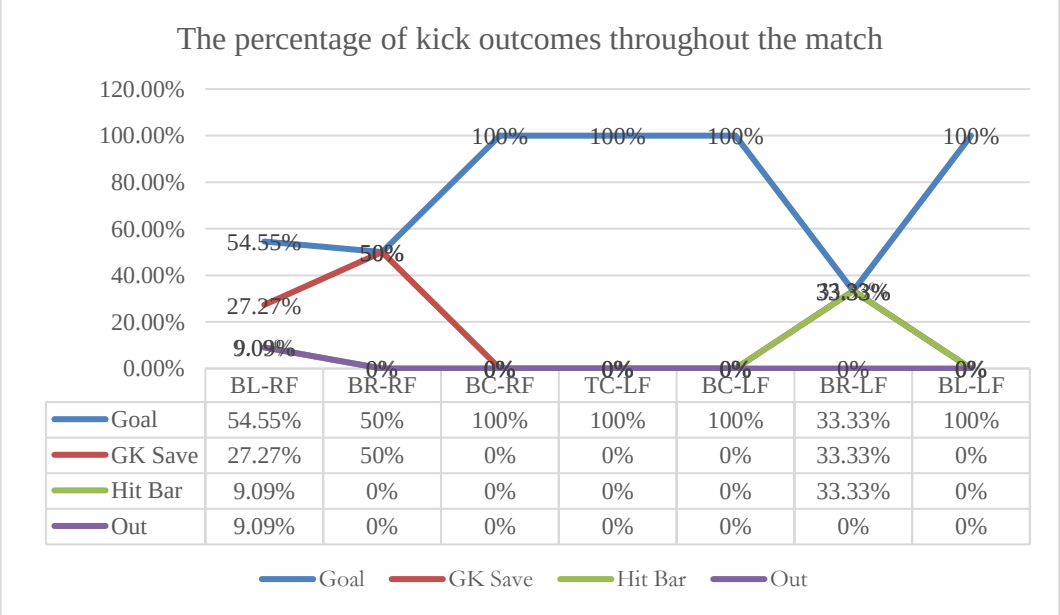


	BL-RF	BR-RF	BC-RF	TC-LF	BC-LF	BR-LF	BL-LF
Goal	12	3	4	1	4	1	1
GK Save	6	3	0	0	0	1	0
Hit Bar	2	0	0	0	0	1	0
Out	2	0	0	0	0	0	0

Figure 3. Diagram Analysis of Results for All Matches



	BL-RF	BR-RF	BC-RF	TC-LF	BC-LF	BR-LF	BL-LF
Goal	54.55%	50%	100%	100%	100%	33.33%	100%
GK Save	27.27%	50%	0%	0%	0%	33.33%	0%
Hit Bar	9.09%	0%	0%	0%	0%	33.33%	0%
Out	9.09%	0%	0%	0%	0%	0%	0%

Figure 4. Diagram Percentage of Results of All Match Kicks

From the diagram tables, it can be concluded that professional players who served as penalty kick takers in all penalty shootouts in the Round of 16, Quarter-finals, and Final Match of the 2022 World Cup tended to use their dominant right foot more often than their dominant left foot. The total number of kicks taken using the dominant right foot reached 33 times, while kicks using the dominant left foot were only 8 times. Kicks with the dominant right foot were directed towards the target as follows: 22 kicks to the bottom left resulting in 12 goals, 6 kicks to the bottom right resulting in 3 goals, 4 kicks to the bottom center all of which were successful goals, and 1 kick to the top center which was a successful goal. As for kicks with the dominant left foot, there were 4 kicks to the bottom center all of which were successful goals, 3 kicks to the bottom right resulting in 1 goal, 1 kick saved by the goalkeeper, and 1 kick hitting the goalpost, as well as 1 kick to the bottom left resulting in a goal.

Discussion

The findings indicate that during the 2022 FIFA World Cup, professional football players predominantly executed penalty kicks using their dominant right foot (80,49%) compared to the dominant left foot (19,51%). This result suggests that under high-pressure match conditions, players

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tend to rely on the limb perceived as the strongest, most stable, and most consistently developed through long-term training. To date, there is no empirical evidence explicitly demonstrating an absolute superiority between the right and left foot in penalty execution; rather, kicking effectiveness appears to be primarily influenced by functional foot dominance shaped through prolonged training habits.

Foot dominance is closely associated with players' physical condition and movement characteristics in football. Hermawan et al (2022) emphasized that football performance is the result of the integration of four key components; physical condition, technical skills, tactical understanding, and psychological factors. In the context of penalty execution, physical attributes particularly lower-limb strength, movement coordination, and postural stability serve as fundamental prerequisites that enable players to perform technical actions consistently using their dominant foot. Players with superior physical conditioning generally exhibit greater confidence in the foot most frequently utilized during training sessions and competitive matches.

These findings are consistent with the study by research Marcori et al (2022), who analyzed 1,826 European league matches and identified a significant asymmetry in kicking foot selection, with a strong preference for the dominant foot. The use of the non-dominant foot has been reported to reduce movement control quality, particularly in terms of swing speed, upper-body kinematic coordination, and postural stability, thereby potentially decreasing penalty kick accuracy.

Beyond the kicking foot, the orientation of the supporting leg and overall biomechanical movement patterns also contribute to the direction and success of penalty kicks. The data indicate that right-foot-dominant players tend to direct the ball toward the lower-left area of the goal, whereas left-foot-dominant players more frequently target the lower-central zone. This pattern aligns with the findings of Marcori et al (2022) and is further supported by Fattah et al (2023), who reported that alignment between the direction of the supporting leg and the ball trajectory can increase penalty success rates by up to 82.83%.

From the perspective of physical condition and match performance, penalty kick effectiveness is also related to players' endurance capacity and overall physical readiness. Fadli et al (2024), highlighted that football is a complex sport requiring optimal physical fitness as a fundamental prerequisite for performance. Players with higher aerobic fitness levels (high VO_2max) tend to demonstrate more stable motor control, even under conditions of fatigue or competitive pressure, allowing them to maintain the quality of technical execution, including penalty kicks.

Furthermore, Noël et al (2014), identified the kicking foot as a significant factor influencing the probability of penalty success. However, this finding contrasts with the results of Horn et al (2021), who concluded that foot dominance does not significantly affect either the outcome or the direction of penalty kicks. These discrepancies across studies suggest that penalty success is not deterministic but rather shaped by a complex interaction of biomechanical factors, physical condition, and psychological context.

Psychological factors have also been shown to play a critical role in penalty kick execution. Brinkschulte et al (2023c; 2023d), reported that high situational pressure increases the probability of penalty failure by approximately 6% regardless of players' skill levels. Such pressure is associated with elevated cognitive anxiety and increased respiratory rates, which subsequently affect shot variability and quality (Ellis & Ward, 2022). Nevertheless, players with superior technical proficiency and physical conditioning are more likely to function as a buffer against the detrimental effects of pressure.

In addition, the dynamic interaction between the penalty taker and the goalkeeper influences penalty outcomes. Furley et al (2017) explained that excessive attentional focus on the goalkeeper may increase the likelihood of saves, while goalkeeper distraction strategies can reduce kicking accuracy. Emotional pressure from a hostile crowd may further prompt players to adopt avoidance-based decision-making strategies, which negatively affect penalty execution quality (S. H. Park et al., 2022).

Overall, the results of this study demonstrate that during the 2022 FIFA World Cup, players more frequently executed penalty kicks using the dominant right foot, with a tendency to direct shots toward the lower-left area of the goal. The selection of both the kicking foot and shot direction is influenced not only by technical and biomechanical factors but also by optimal physical conditioning and psychological readiness. These findings are consistent with those of Hermawan et al (2022) and Fadli et al (2024), who emphasized that optimal football performance emerges from the synergy of physical, technical, and mental components. Therefore, penalty kick success should not be viewed as the outcome of a single factor but rather as the product of a complex, multidimensional interaction.

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CONCLUSION

Based on the research conducted by the researchers on a total of 41 kicks performed by professional players in the 2022 World Cup, it can be observed that players who use their dominant right foot tend to aim the ball towards the bottom left, while players with a dominant left foot tend to aim the ball towards the bottom center. Despite these research findings, and based on research conducted in similar contexts, the success of penalty kicks is determined by various factors.

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