

## Evaluation of Pressure Elements in the Penalty Kicks

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### ABSTRACT

**Background:** A penalty kick in football is one of the most important rules that directly affect the score of the match. Penalty kicks have always been the focus of attention in terms of both the result and the shot.

**Aim:** The aim of this study is to determine whether the one who takes the penalty or saves the penalty is more effective and to determine whether the players who use the penalty show a tendency in a certain direction.

**Methods:** In this study, a detailed analysis of penalty shootouts with the 10-year data of the Turkish Super League was made. SPSS.22 package program was used in statistical analyses. Analyses of penalty kicks were compared with the Chi-square test and the level of significance was taken as 0,05 in all tests.

**Results:** According to the results of the analysis, goalkeepers guessed correctly 46% of the direction where the ball passed in all penalties ( $r=0.74$ ;  $p=0.000$ ). 52% of left-footed penalty takers shot to the left, and 46.9% of right-footed penalty takers to the right. There was no statistical difference between the direction where the ball was thrown, and the foot used by the penalty kicker ( $p>0.05$ ).

**Conclusion:** In the analysis made with 10-year data, it has been determined that the players do not tend to a certain direction when using penalties.

**Keywords:** Penalty kick; football; penalty zone; Turkish Super League; penalty direction

### INTRODUCTION

Football is the most-watched sport today and creates its own economic values beyond being just a game. Perhaps penalty is one of the most discussed rules in football. Penalty decisions, especially in the last moments of the game, can be discussed for days, maybe even for weeks. The reason why the concept of penalty is so popular is probably that it can affect the result directly. One penalty in the game can bring a win or a championship. For this reason, there are many elements of pressure in penalty kicks. One of the factors affecting the result of the penalty is the choice of penalty shooter, and many factors may arise while making this choice. For example, many factors may

affect the result such as the fatigue of the penalty shooter, the goalkeeper's showing attitudes that may guide the player, the importance of the game in which the penalty is taken, fan pressure in the stadium, weather, and field conditions. Some of these factors can be measured, while some can only be estimated with assumptions. In this study, 845 penalty kicks taken in 9.5 seasons in the Turkish Football Super League were examined by using measurable factors, and the factors affecting the results of penalties were analyzed. Thus, it was tried to determine whether the penalties tended in a certain direction and whether the scoring advantage/disadvantage of the penalty-taker team influenced the score.

Table 1: Selected reference results on penalty kicks

Author/s	Data Taken From	Dates	Score of Penalty in the Game (%)	Score of Penalty Shoot-Out (%)	Sample Size
McGarry and Franks 20093	World Cup European Championship	1982:1998 1996	82,5	75,6	257
Dohmen 20087	German Bundesliga	1963:2003/04	74,25	-	3619
Jordet et al. 20078	World Cup, European Championship, and Copa America	1970:2004	-	78,9	409
Kuss et al. 20079	German Bundesliga	1993:2005	-	74,4	835
Jordet and Hartman 200810	World Cup, European Championship and UEFA Champions League	1974:2006; 1972:2004; 1992:2006	73,8	--	359
Dalton et al. 20155	World Cup and European Championship	2002:2010; 2000:2008	68,3	73	118
Moll et al. 201011	World Cup and European Championship	1974:2006; 1972:2008	-	75	325
Roskes et al. 20111	World Cup	1982:2010	-	71	204
Chiappori et al. 20024	Italy Serie-A France Ligue-1	1997:2000 1997:1999	73,5 76,5	-	242 217
Baumann et al. 201112	German Bundesliga	1995:2007	74	-	999

There are several studies in the literature on the tendencies shown during a penalty kick. While some of these studies examined whether goalkeepers or penalty takers tended towards certain directions, others examined the psychological factors while taking the penalty kick. Roskes et al.<sup>1</sup> examined the penalty shootouts in the 1982-2010 FIFA World Cup. According to the 204 penalty kicks taken in 22 games, it was found that goalkeepers dived to their rights with a rate of 71% if their team was behind, with a rate of 48% if their team was ahead, and with a rate of 49% if the score was tied. In their study, Price and Wolfers<sup>2</sup> analyzed the 240 penalty shootouts in UEFA Championships League and Copa America held between the years 1984 and 2011. According to the penalty kicks taken, it was found that goalkeepers dived to their rights with a rate of 65.6% if their team was behind, with a

rate of 56% if their team was ahead, and with a rate of 55.6% if the score was tied. McGarry and Franks<sup>3</sup> studied the order in which penalty takers should take the penalties on 1982-1998 World Cup and 1996 European Championship penalty shootouts. They concluded that the best 5 ranked penalty takers from the on-field players should be assigned to the first five penalty kicks in their reverse order of ability. In their study, Chiappoi et al.<sup>4</sup> examined a total of 459 penalty kicks within a period of 2 years (1997-1999) in France League 1 and a period of 3 years (1997-2000) in Italy League 1. The paper develops a game-theoretic model of penalty kicks in soccer and tests the assumptions and predictions of the model using data from two European soccer leagues. The empirical results reject that, the players optimally choose strategies, conditional on the opponent's behaviours. Dalton et al.<sup>5</sup>

examined the penalties in World and European football championships held between the years 2000 and 2010. Significantly more penalties were awarded late in the game: twice as many penalties in the second half than the first and close to four times as many in the fourth quarter vs. the first. Teams awarded penalty kicks during gameplay won 52%, drew 30%, and lost 18% of the time; chances of winning increase to 61% if the penalty was scored, but decreased to 29% if missed. Teams participating in either the World Cup or European Championship final game had roughly a 50% chance of being involved in a penalty shootout during the tournament. In their study, Wood and Wilson<sup>6</sup> examined whether the penalty takers were goalkeeper-oriented or goal-oriented during the kick. According to the analysis results, it was found that while penalty takers used the goal-oriented approach more as their experience increased, less experienced players used a goalkeeper-oriented strategy.

Table 1 below summarizes some of the studies conducted in the literature on the penalty. It has been found that studies tried to examine the tendencies of players while shooting with both penalties in the game and penalty shootouts.

**MATERIAL AND METHOD**

This study examined and analyzed 845 penalty kicks taken in the Turkish Football Super League from the 2010-11 season to the second half of the 2019-20 season. SPSS.22 package program was used in statistical analyses and while forming the tables. Analyses of penalty kicks were compared with the Chi-square test and the level of significance was taken as 0,05 in all tests.

While the zones where penalties are kicked are grouped in 3 in many studies (left, right, and middle), they were grouped in both 3 and 6 in this study. Table 2 shows the 6 penalty zones used in the study.

Table 2: Penalty zones divided into six

Left Up	Middle Up	Right Up
Left Down	Middle Down	Right Down

The variables of the direction where the penalty taker kicked the ball, the direction where the goalkeeper dived, the minute intervals during which penalties were taken, the score advantage of the team taking the penalty when the penalty was taken (ahead, tied, or behind), the result of the penalty and the position of the penalty taker were used in the analyses.

**RESULTS**

Of the 845 penalties taken, 78.3% were scored as a goal, 16.1% were saved by the goalkeepers and 5.6% hit the goalpost, crossbar, or were out. In 45.6% of the penalties taken, the direction where the ball went was guessed correctly by the goalkeeper (when we divided it into 6 zones, this rate was 37.75%). A statistically significant correlation was found between the direction the penalty was kicked and the direction the goalkeeper dived when

the goal zone divided in to 6 parts ( $r=0.213$ ;  $p=0.000$ ). But it has insignificant correlation between them when the goal zone divided in to 3 parts ( $r=0.012$ ;  $p=0.736$ ).

Secondly, it was examined whether the relationship between the direction where the penalty was taken and the direction where the goalkeeper made a dive depended on the time interval when the penalty was taken. Statistical difference was found between the time intervals of 0-15 minutes ( $p=0,014$ ), 31-45 minutes ( $p=0,000$ ) and 76-90+ minutes ( $p=0,000$ ) and no statistical difference was found between the time intervals of 16-30 minutes ( $p=0,306$ ), 46-60 minutes ( $p=0,163$ ) and 61-75 minutes ( $p=0,828$ ). The percentages of the goalkeepers who correctly predicted the direction where a penalty was taken were found as follows, according to the minute intervals: 42.4% for the first 15 minutes, 38.7% for 16-30 minutes, 43.9% for 31-45+ minutes, and % for 46-60 minutes 31.6%, 39.3% for 61-75 minutes and 34.1% for 76-90+ minutes. It is seen that the highest percentages are in the first 15

and last 15 minutes of the first half. Similarly, the lowest percentage was between 46-60 minutes.

The Table 3 shows the number of penalty shootouts used in 15-minute time units. A statistically significant difference was found between penalty decisions that increased in the last 15 minutes of the first half and the game and the time intervals (as 15 minute) in which they were taken ( $p=0,000$ ).

Table 3: Distribution of penalty kicks in 15-minute time intervals

Time Intervals	Frequency	%
0-15	73	8,6
16-30	106	12,5
31-45+	166	19,6
46-60	133	15,7
61-75	135	16,0
76-90+	232	27,5
Total	845	100,0

The distribution of the relationship between the foot used by the players taking the penalty and the direction where the ball goes is given in Table 4.

Table 4: Movements of the ball and the goalkeeper in penalty kicks

		Direction of the ball			Total
		Left	Middle	Right	
Foot used by the penalty taker	Left	105	19	78	202
	Right	278	67	298	643
Total		383	86	376	845

According to Table 4, 51.9% of the penalty takers who used their left foot kicked to the left side, while 46.3% of the penalty takers who used their right foot kicked to the right side. No statistically significant difference was found between the direction the ball was kicked and the foot penalty taker used ( $p>0,05$ ). The percentages of kicking the penalty to the opposite corner were 43.2% for those who took a penalty with their right foot, and 38.6% for those who scored a penalty with their left foot.

Table 5: The score of the team that scored the penalty during the penalty kick

	The score advantage of the team taking the penalty during the penalty kick			Total
	Ahead	Tied	Behind	
Goal	166	278	218	662
Goalkeeper saved	38	57	41	136
Goalpost, crossbar or out	13	21	13	47
Total	217	356	272	845

In Table 5, 76.5% of the penalties scored when the teams are ahead are goals, while this rate is 80.1% when the teams are behind. We can say that the falling teams use penalties more carefully. No statistically significant difference was found between the score of the team at the moment the penalty was taken and penalty results ( $p>0,05$ ). Table 6 shows the distribution of the directions the penalty was kicked, and the directions goalkeeper dived in terms of the score of the team taking the penalty at the moment the penalty was taken (when the goal area was divided into 3 zones).

Table 6: The directions of the goalkeeper and the ball in terms of the scoring advantage of the team taking the penalty when the goal area is divided into three

		The score advantage of the team taking the penalty during the penalty kick			Total
		Ahead	Tied	Behind	
Direction of the ball	Left	94	150	139	383
	Middle	21	36	29	86
	Right	102	170	104	376
Direction of the goalkeeper	Left	103	166	132	401
	Middle	7	10	8	25
	Right	107	180	132	419
Total		217	356	272	845

In Table 6, it was found that goalkeepers dived to their rights with a rate of 48.5% if their team was behind, with a rate of 49.3% if their team was ahead, and with a rate of 50.6% if the score was tied. Similarly, goalkeepers dived to their lefts with a rate of 48.5% if their team was behind, with a rate of 47.5% if their team was ahead, and with a rate of 46.6% if the score was tied. It is seen that the percentage of the penalty shooter to the right is 47% when the team taking the penalty is ahead, 47.75% when the game is drawn, and 38.23% when the team is behind. Only in the absence of a score advantage, the rates of throwing penalties to the left were found to be higher than those thrown to the right (51.1%). While the goalkeepers' teams were ahead, the right and left moves of the goalkeepers were found to be equal. It is seen that the percentages of the players who throw the penalty to the middle are 9.6%, 10.1% and 10.6%, respectively, while the percentages of the goalkeepers standing in the middle are 3.2%, 2.8% and 2.9%, respectively. When the goal area was divided into 6 zones, we can see the table given above in more detail in Table 7 and Table 8.

Table 7: The direction of the goalkeeper according to the score advantage of the team that scored the penalty

The score advantage of the team taking the penalty during the penalty kick				
Direction of the goalkeeper	Ahead	Tied	Behind	Total
Left down	94 (43.3%)	154 (43.3%)	115 (42.3%)	363
Middle down	4 (1.8%)	7 (2%)	5 (1.8%)	16
Right down	95 (43.8%)	167 (46.9%)	117 (43%)	379
Left up	9 (4.2%)	12 (3.4%)	17 (6.3%)	38
Middle up	3 (1.4%)	3 (0.8)	3 (1.1%)	9
Right up	12 (5.5%)	13 (3.6%)	15 (5.5%)	40
Total	217	356	272	845

Table 8: The direction of the ball according to the score advantage of the team that scored the penalty

The score advantage of the team taking the penalty during the penalty kick				
Direction of the ball	Ahead	Tied	Behind	Total
Left down	65 (29.9%)	98 (27.5%)	92 (33.8%)	255
Middle down	8 (3.7%)	12 (3.4%)	12 (4.4%)	32
Right down	62 (28.6%)	127 (35.7%)	61 (22.4%)	250
Left up	29 (13.4%)	52 (14.6%)	47 (17.3%)	128
Middle up	13 (6%)	24 (6.7%)	17 (6.3%)	54
Right up	40 (18.4%)	43 (12.1%)	43 (15.8%)	126
Total	217	356	272	845

It is seen that 89.7% of goalkeepers make downward moves in penalty shootouts. Similarly, it is seen that this rate is 63.5% for the players who scored the penalty. According to the score advantage of the penalty kicker's team, the percentages of throwing the ball down are as follows: 88.5% when his team is ahead, 87.1% when his team is behind, and 92.1% when the game is tied. According to the score advantage of the penalty kicker's team, the percentages of goalkeepers diving down are as follows: 62.2% when opponent team is ahead, 60.6% when opponent team is behind, and 66.6% when the game is tied. When we divide the penalty zone into 6 part, no statistically significant difference was found between the score of the team at the moment of the penalty and the directions of the ball and the directions goalkeepers dived ( $p>0,05$ ). Table 9 shows the number of directions goalkeepers dived according to the minute interval. The most preferred directions were the left down and right down directions. No statistically significant difference was found between the dives to these two directions according to the minute interval ( $p>0,05$ ).

According to the minute intervals, the percentages of penalty shooters to shoot upwards were 5.4%, 4.7%, 12.65%, 12.78%, 9.6% and 12.06%, respectively. Especially at the end of the first half and at the beginning and end of the second half, a significant increase in this rate is observed. Table 10 shows the number of directions the goalkeepers kicked the penalty according to the minute interval. Similar to the table above, it can be seen that the most preferred directions are left down and right down directions.

No difference was found between the dives to these two directions according to the minute interval ( $p>0,05$ ).

Table 9: Zones where the penalty kick is scored according to the minute intervals

Minute interval							
Direction of the ball	0-15	16-30	31-45+	46-60	61-75	76-90+	Total
Left down	29	49	66	55	68	96	363
Middle down	4	2	2	1	3	4	16
Right down	36	50	77	61	51	104	379
Left up	3	1	14	7	5	8	38
Middle up	0	1	1	4	1	2	9
Right up	1	3	6	5	7	18	40
Total	73	106	166	133	135	232	845

Table 10: Distribution of the ball directions according to the minute interval

Minute interval							
Direction of the ball	0-15	16-30	31-45+	46-60	61-75	76-90+	Total
Left down	28	33	45	30	43	76	255
Middle down	3	3	6	4	5	11	32
Right down	19	44	58	40	34	55	250
Left up	13	10	23	24	25	33	128
Middle up	2	3	10	14	12	13	54
Right up	8	13	24	21	16	44	126
Total	73	106	166	133	135	232	845

As for minute intervals, the percentages of penalty shooters to shoot downwards were 68.5%, 75.5%, 65.6%, 55.6%, 60.7% and 61.2%, respectively. No statistical difference was found between penalty kick results and minute intervals ( $p>0.05$ ). When the percentages of missed penalties are examined, it can be seen that the minimum percentage of missed penalties (15.5% and 21%) was in the last 15 minutes of the first and second half (including extra time). It can be said that the penalty takers were careful and more concentrated in these minutes.

Table 11: Result of the penalties according to time interval

Minute interval							
Result of the penalty	0-15	16-30	31-45+	46-60	61-75	76-90+	Total
Goal	57	82	131	102	104	186	662
Saved	14	17	30	23	23	29	136
Direct or out	2	7	5	8	8	17	47
Total	73	106	166	133	135	232	845
Missed penalty %	21.9	22.6	21	23.3	22.9	15.5	

Finally, when the ranking of the teams in the league and the minute intervals of the penalties were examined, it was found that the teams at the bottom of the league (teams in 13th-17th places) used more penalties in the last 15 minutes of the first half, while the teams which were fighting for the championship (teams in the 1st-6th place) used more penalties in the last 15 minutes of the game.

## DISCUSSION

Penalty kicks are important in football. Penalties can have a direct effect on the outcome of the game, they can leave the penalty-taking team with fewer players and they can even bring championship in the last game of the season. In the Turkey Super League data used in the study, we can see that there was 1 penalty kick in 2.48 games. Even this data emphasizes the importance of penalty kicks.

In this study, 845 penalty kicks taken in 9.5 seasons were examined. 69% of the penalties were taken in the second half, while 31% were taken in the first half. The penalties awarded in the

last 15 minutes of the game are 3.17 times the penalties awarded in the first 15 minutes of the game. The reasons for this difference can be the fact that players or referees are tired at the end of the game, players take more risks towards the end of the game, especially if they are losing, players decide in a rush due to fatigue, and also the pressure of the audience. In the light of all this information, the measures that can be taken about penalty kicks can be teams' being more careful at the end of the games, coaches' advising team players tactically.

According to the results of the 845 penalties analyzed in the study, the percentage of success was found as 78.3%. In some studies in the literature, this rate was found as 68-83%. Most of these studies cover the periods before and after the rule for goalkeepers to move on the penalty line which took effect in 1997. The data used in the present study cover the period after 1997 and it is also worth noting that it is easier to find out whether some shots are goals or not with the VAR system.

32.2% of the teams that took the penalty were losing at the moment they were awarded the game, while the game was a draw in 42.1%. This shows with a rate of 74.3% that they got a chance to change the balance in the game. It can be seen that 79% of the penalties taken when the game was a draw and 80.1% of the penalties taken when the team was losing were goals. It can be seen that Turkish teams turned the score balance in their favor by 80%.

Some of the players or goalkeepers in Turkish Super League teams are foreign, others are Turkish. While foreign goalkeepers were found to tend to dive left in penalties (49.8%-47.5%), Turkish goalkeepers were found to tend to dive right (51.2%-45.5%). A similar tendency can also be seen in penalty takers. It was found that 45.6% of the foreign penalty takers (n=561) kicked to the left, 42.6% kicked to the right. It was found that 48.2% of the Turkish penalty takers (n=284) kicked to the right, 44.7% kicked to the left. A team taking a penalty increases their chance of winning more than 2 times while losing the same penalty increases the chance of losing more than 3 times.<sup>5</sup> In Turkish Super League, the mean goals per game were 2.86 in the last season. 1 penalty was awarded in 2,6 games in the same study.

In studies conducted in literature, it was found that when compared with the penalties used in elimination tournaments such as World Cup or European Championship, goalkeepers or players did not prefer specific directions for the penalty. For example, in their study, Roskes et al. (2011) found that goalkeepers were more likely to dive to the right (71%) than to the left (29%) when their team was behind; in our study, this rate was 49%. Similarly, in the study, while the rate of diving right was 49% and the rate of diving left was 48% when the game was a draw, these rates were found as 50,5%-46,6% in our study. While the rate of diving right was 48% and the rate of diving left was 51% when the team was ahead, while this rate was found as 49.3%-47.4% in our study. In Chiappori et al. (2002), they found that the goalkeepers tended to the right with 56.6% and to the left with 41%. Similarly, they determined that the players who scored the penalty preferred the right with 44.9% and the left with 37.9%. The tendency of penalty takers to throw penalties into certain corners has been investigated in many studies. In some studies, it has been determined that penalties tend to be thrown especially to the right. Considering the results obtained from this study, it cannot be said that the players show a dominant tendency in a certain direction in penalty shootouts. In the study, it was observed that 10.9% of the players (n=135) who took more than one penalty kicked the ball to a different corner at least once. It can be said that the preparations of the coaches or goalkeepers according to the penalty data of the opposing teams are effective in these decisions. By increasing the

sample size, it will be possible to more clearly investigate the direction preferences of goalkeepers or penalty shooters.

## CONCLUSION

With the 10-year data used in this study, it is possible to generalize with the tendencies of penalty shooters or goalkeepers. However, it is also conceivable that the quality of the leagues analyzed (such as the fact that the world's best goalkeepers or standing free kickers play in the English, Spanish and Italian leagues) will be an important factor in reaching different conclusions about the trend investigated. Penalty kicks are very important especially in leagues in which fewer goals are scored. It is the responsibility of both coaches and players for goalkeepers and players to prepare better about the penalty. Such analysis studies will be a guide to both coaches and players about using penalties and making more qualified shots. With the inclusion of other side factors that affect penalty kicks –except the factors specified in this study- maybe we can better understand the performances of the penalty takers or the goalkeepers. For this, long-term data about a national league can be analyzed, the data can be compared with the data of other leagues, and generalizations can be made.

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