WHAT CAN COACHES DO? THE RELATIONSHIP BETWEEN SUBSTITUTION AND RESULTS OF PROFESSIONAL FOOTBALL MATCHES

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ABSTRACT

The purpose of this study was to analyze the relation between substitutions and results of football matches in championships and national Cups. One hundred and twenty-nine championship matches and 129 national Cups matches were analyzed (258 in total), which occurred during the 2016-2017 season in 16 countries. Away and home games were analyzed. During the championships, 737 player substitutions were made and 721 substitutions in national cups. The match reports were analyzed to collect data, and the ANOVA was used to compare the analyzed tournaments. The results showed that the substitute players scored 10,76% of all goals, corresponding to 26,19% of the goals scored after the first substitution. In the National Cups, the substitute players were responsible for 10% of the goals scored, which corresponded to 24,84% of the goals scored after the first substitution. The teams playing in championships had more goals scored after the first substitution (p=0,013), after the third substitution (p=0,008), and after all substitutions (p=0,000), comparing to the teams playing in national cups. This research showed the importance that the players` substitutions have in modern football, becoming an indispensable strategy. Finally, the substitutions seems to be essential to coaches improve team performance.

Key words: Football. Tournaments. Match analysis. Substitution.

RESUMO

O que os treinadores podem fazer? A relação entre as substituições e o resultado de jogos profissionais de futebol

O objetivo do estudo foi analisar a relação entre as substituições e os resultados de jogos de futebol em campeonatos e copas nacionais. Cento e vinte e nove partidas dos campeonatos e 129 das copas nacionais foram analisados (258 jogos no total), os quais ocorreram durante as temporadas de 2016-2017 em 16 países. Jogos dentro e fora de casa foram analisados. Durante os campeonatos, 737 substituições foram feitas e 721 durante as copas nacionais. Os relatórios dos jogos foram utilizados para coletar as informações, e a ANOVA foi utilizada para comparer os torneios. Os resultados mostraram que os jogadores que entraram na partida marcaram 10,76% dos gols, correspondendo a 26,19% dos gols marcados após a primeira substituição. Nas copas nacionais, os substitutos foram responsáveis por 10% dos gols marcados, representando 24,84% dos gols após a primeira substituição. Equipes jogando os campeonatos fizeram mais gols após a primeira substituição (p=0,013), após a terceira substituição (p=0,008), e após todas as substituições (p=0,000), comparado com as equipes jogando em copas nacionais. Essa pesquisa mostrou a importância dos jogadores substitutos tem no futebol moderno, sendo a troca de jogadores uma estratégia indispensável. Finalmente, as substituições são essenciais para que os treinadores possam melhorar o desempenho da equipe.

Palavras-chave: Futebol. Torneios. Análise dos jogos. Substituições.

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INTRODUCTION

The use of new technologies in football, such as notational analysis, data analysis software, Global Positioning System (GPS), new training materials and metabolic analysis, are essential to improve performance in the playing field. Indeed, performance indicators must be able to reveal essential aspects to coaches, such as interactions between two or more athletes, rehearsed plays, tactics, and techniques (Hughes and Bartlett, 2002).

In this context, predominant factors should be differentiated from determinant factors for the game result. We understand the determinant factor as the most important data to be collected in a game, such as goals scored, assists and substitutions. These variables may represent what really matters in understanding how a game was played.

The increase in the number of studies in the past few years has made possible unimagined advances in this field (Debanne, Laffaye and Trouilloud, 2017; Del Corral, Barros and Prieto-Rodríguez, 2008; Fernandez-Navarro and collaborators, 2016; Flôres and Balsan, 2016; Njororai, 2013b). However, even today there are several gaps and questions to be answered on how different variables can influence teams` performances during competitions. The player substitution is one of them.

The substitution of a player during a match could be understood as a determinant factor to the final result (Bradley, Lago-Peñas and Rey, 2014; Del Corral, Barros and Prieto-Rodríguez, 2008; Myers, 2012), and coaches need to be prepared to do it wisely. On a large scale and with the accumulation of games during the tournaments, all the substitutions (as determinants of the result) can influence performance. Different studies showed that players` performance are strongly influenced by the distance covered in the field (Barros and collaborators, 2007; Di Salvo and collaborators, 2007) and by a congested calendar (Lago-Peñas and collaborators, 2011; Rey and collaborators, 2010).

According to Barros and collaborators (2007), players run, on average, 10 km per game. The number of matches and the small period for physical recovery add up to the time in the field, physically tiring the players. Thus, the substitution has great importance in short, medium and long-term, by improving the performance during the season.

The demand of new and better information and the need for actualization by coaches, players, and researchers, makes the research involving new visions on the understanding of the game, vital for the evolution of sport. The insert of a new player in the field through substitutions, together with the physical aspects, can be an essential tool providing tactical changes through the different characteristics of the available athletes. Although there are some studies addressing the influence of substitutions on football (Bradley, Lago-Peñas and Rey, 2014; Conte and collaborators, 2015; Del Corral, Barros and Prieto-Rodríguez, 2008; Myers, 2012), we did not find studies that compare and analyze the influence of substitutions in Championship and Cup games.

The present paper intended to examine how the replacement of a player can be a determinant factor for the outcome of professional football matches.

Thereby, the aim was to analyze the relation between player substitutions and matches` final results in Championships and National Cups. It is expected that player replacement influences the number of goals scored and final results, and that substitutions tend to be carried out differently in different types of competitions.

MATERIALS AND METHODS

Match Sample

The data include a sample of the sixteen major leagues of world football. For the analysis, 258 professional football matches from different competitions were observed (Argentina, Belgium, Brazil, Colombia, England, France, Greece, Italy, Netherlands, Portugal, Scotland, Spain, Turkey, Ukraine, United States, and Uruguay). It was observed, on average, seven matches from each country (see the teams at supplementary data).

A sample of 129 matches from sixteen national Championships and 129 of sixteen national Cups were analyzed. During the championships, 737 player substitutions were made (a mean of 5.71 per match) and 511 goals were scored (a mean of 3.95 per match) while in the national cups, there were 721 substitutions (a mean of 5.58 per match) and 390 goals scored (a mean of 3.01 per match).

The sample included matches from the 2016-2017 season, and the data were collected intentionally, according to the

following criteria: i) the analyzed games were selected in order to choose games at the beginning, middle and end of the competitions (reducing the influence of the number of games played); ii) matches or teams without substitutions were not analyzed; iii) to reduce the influence of the quality of the teams, two matches of each team, at most, were analyzed; iv) in order to control the individual influences (i.e., teams or players with greater technical or financial conditions), only games played on equal terms between teams were analyzed (i.e., games between the first and last places in the classification table were not analyzed); v) all the cup games were in the playoff system, choosing randomly between games at home or away. Other studies were conducted similarly (Aquino and collaborators, 2017; Conte and collaborators, 2015; Myers, 2012).

Procedures

The match reports were analyzed to collect data. The data were provided by Wyscout ®, which is a well known and renowned system used by many teams around the world. Two trained observers collected the data. Both are football analysts who have been working with football for at least two years. Different studies also chose to carry out data collection in a similar way (Azli and collaborators, 2016; Castellano, Casamichana and Lago, 2012; Flôres and Balsan, 2016; Hughes and Franks, 2005; Lago-Ballesteros Lago-Peñas, 2010; Njororai, 2013a; Silveira and Flôres, 2018). This research was conducted according to the Helsinki Protocol, and since the data is available in match reports and internet websites, the Statement of Consent was not required.

Statistical analysis

Descriptive analysis with mean scores and the standard deviation was used to characterize the data. The Shapiro-Wilk test confirmed the data normality and all statistical assumptions underlying ANOVA were met. After removing outliers, ANOVA was used to compare the Championships and National Cups. For follow-up analyses, we used Tukey posthoc test. The Software Statistical Package for Social Sciences TM (SPSS 22.0) was used and, in all analysis, the alpha level was set at 05.

RESULTS

In Championships, the substitute players scored 10,76% of all goals, representing 26,19% of the goals scored after the first substitution. In the National Cups, the substitute player was responsible for 10% of the goals scored, which represents 24,84% of the goals scored after the first substitution. Statistical differences were found when comparing goals scored after the substitutions in championships and national cups (p=0,000).

Teams playing in championships had more goals scored after the first substitution (F=6,223; p=0,013), after third substitution (F=7,038; p=0,008), and after all substitutions (F=24,375; p=0,000). No statistically significant differences were found after the second substitution, or before the first substitution.

When analyzing the championships, comparing win at home games and win away games, the results showed a statistical difference between goals scored before and after the substitutions (p=0,000), the same occurring in National Cups (p=0,000). Also, when each substitution was analyzed separately, results showed that the first one is more important when the team plays at home (p=0,009).

Table 1 - Percentage and average of total goals, before and after substitutions.

| | | **Championships** | | | | |
	Total	**Goals before substitutions**	**Goals after first substitution**	**Goals after second substitution**	**Goals after third substitution**	**Goals after substitutions**
n	511	301	77	62	71	210
%	100	58,90	15,07	12,13	13,89	41,10
Mean	3,96	2,33	0,60	0,48	0,55	1,63
		National Cups				
	Total	**Goals before substitutions**	**Goals after first substitution**	**Goals after second substitution**	**Goals after third substitution**	**Goals after substitutions**
n	390	233	52	56	49	157
%	100	59,74	13,33	14,36	12,56	40,26
Mean	3,02	1,81	0,40	0,43	0,38	1,22

Table 2 - Percentage and average of goals, before and after the substitutions, according to the result of the matches of the Championships.

		Total	Goals before substitutions	Goals after first substitution	Goals after second substitution	Goals after third substitution	Goals after substitutions
Wins at home	n	231	127	45	25	34	104
	%	100	54,98	19,48	10,82	14,72	45,02
	Mean	3,92	2,15	0,76	0,42	0,58	1,76
Wins away	n	169	105	16	25	23	64
	%	100	62,13	9,47	14,79	13,61	37,87
	Mean	2,86	1,78	0,27	0,42	0,39	1,08
Draws	n	108	64	16	13	15	44
	%	100	59,2	14,81	12,04	13,89	40,74
	Mean	1,83	1,08	0,27	0,22	0,25	0,75

Table 3 - Percentage and average of goals, before and after the substitutions, according to the final result of the matches of the National Cups.

		Total	Goals before substitutions	Goals after first substitution	Goals after second substitution	Goals after third substitution	Goals after substitutions
Wins at home	n	177	90	28	29	30	87
	%	100	50,85	15,82	16,38	16,95	49,15
	Mean	1,37	0,70	0,22	0,22	0,23	0,67
Wins away	n	125	78	20	13	14	47
	%	100	62,40	16	10,40	11,20	37,60
	Mean	0,97	0,60	0,16	0,10	0,11	0,36
Draws	n	44	25	5	10	4	19
	%	100	56,82	11,36	22,73	9,09	43,18
	Mean	0,34	0,19	0,04	0,08	0,03	0,15

Table 4 - Goals scored by the substitute player.

	Championships				National Cups			
	Wins at home	Wins away	Draws	Total	Wins at home	Wins away	Draws	Total
n	21	14	9	55	19	9	6	39
Goals scored by substitute player after substitutions	20,19	21,88	20,45	26,19	21,84	19,15	31,58	24,84
Goals scored by substitute player (%)	9,09	8,28	8,33	10,76	4,87	2,31	1,54	10

Table 5 - Goals scored with substituition effect, comparing National Cups and Championships.

Substitution	Championships			National Cups		
	Average time (min)	Goals	%	Average time (min)	Goals	%
First	55,26	77	36,67	57,67	52	33,12
Second	70,34	62	29,52	70,00	56	35,67
Third	80,40	71	33,81	79,32	49	31,21
Mean	68,66	70	100	69,00	52,3	100
Total	-	210	-	-	157	-

DISCUSSION

This paper aimed to enhance the professional football understanding by analyzing the relation between the player substitutions and the results of the football matches in Championships and National Cups.

The results show that when the coaches make good substitutions, it may change the course of the match. In other words, the staff of professional football teams must be prepared to change players when the game result is not as expected. Moreover, the results showed that substitutions could be understood as a Determinant Factor for goals scored and game results, mainly in Championships.

The analysis of the matches indicated that the first substitution is the most influent for a higher number of goals scored in comparison to the second and the third, both in Championships and in National Cups, with statistical differences ($p=0.013$). It was also noted that the second substitution had less influence on the results of the matches. The reason for this result can be explained due to the longer time to participate in the game. Our findings showed that during the championships

the first substitutions allowed, on average, 15.08 and 25.14 more minutes to play than the second and the third substitution did, respectively. Also, the same pattern occur during the national cups (12.33 and 21.65 more minutes to play than the second and third substitutions, respectively).

The outcomes showed that when the home teams win a match, they make better use of substitutions, scoring more goals directly influenced by them (p=0.000). Despite that, few researches aimed to evaluate the importance of a player substitution (Bradley, Lago-Peñas and Rey, 2014; Del Corral, Barros and Prieto-Rodríguez, 2008; Myers, 2012).

According to Frencken, Lemmink, Delleman, and Visscher (2011) during offensive moves, the attackers increase the distances traveled to make moves by opening spaces between markers. This strategy results in more fatigue and, consequently, the attackers are the first choice to be replaced in a 90-minute match. Bradley, Lago-Peñas e Rey (2014) observed that the entry of a new player rises the levels of speed, intensity, and the distance covered. In general, the substitution could enhance the teams' performance, which were find in the present study.

The analysis of substitutions was also observed in other team sports (Messersmith and Corey, 1931; Morato and collaborators, 2016; Prudente, 2006). Gómez and collaborators (2016) showed that the substitution in basketball is a fundamental process to optimize the teams' performance. The authors found that the team enhances the performance after replacing a player. According to Ronglan, Raastad and Børgesen (2006) in handball, the use of substitutions occur in the same way. The replacement of a player may be made at any time, so this allows an increase in intensity. Due to the high intensity and the inherent characteristics of the football game, the number of substitutions is an important question that should be more discussed in the literature.

Del Corral, Barros and Prieto-Rodríguez (2008), state that the most crucial factor for the first substitution is the game score before it, thus, the preferable substitution is by an attacker. It is shown in the literature that changing a player creates a new fact at the match, in which the new player increases the odds to score more goals (Barros and Prieto-Rodríguez, 2008; Bradley and Lago-Peñas and Rey, 2014; Del Corral and Myers,

2012; Gómez and collaborators, 2016). The same was found in the present paper.

According to Conte and collaborators (2015), during a football game, many variables can influence the substitution of a player. The authors explain that one of the main reasons is to make a tactical change. Although the present study did not evaluate the main reasons for the substitutions, we agree with Conte and collaborators (2015).

Other studies corroborate with the authors' findings (Del Corral, Barros and Prieto-Rodríguez, 2008; Janković and Leontijević, 2006; Rey, Lago-Ballesteros and Padrón-Cabo, 2015). In addition, according to Janković and Leontijević (2006), coaches prefer to change players using attackers, instead of players from other positions. Thus, to Janković and Leontijević (2006) this fact confirms that coaches influenced the increasing of efficiency by tactical changes using substitutions.

To Myers (2012), when the team is losing a match, the substitutions must be made at specific periods of the game. The results showed that these should be done before the minutes 12, 27, and 33 of the second half of the match. However, if the match is being won or is a draw situation, there is no rule to follow.

To Anderson and Sally (2013), when the performance of the regular players begins to decline, it is necessary that something be done and then, the most correct attitude is to carry out the substitution. Similar results were found in the present paper (see table 2).

Gomez, Lago-Peñas and Owen (2016), analysing the Spanish football league (La Liga BBVA) found that most of first and second substitutions occurred between 61 and 90 minute period, and the third occurred during the 76 and 90 minute. The results of the present study corroborate to the authors' results (see table 5). Thus, our data together with those provided by Gomez, Lago-Peñas and Owen (2016) and Myers (2012) show that an effective substitution strategy may booster the team's performance especially during championship tournaments.

Myers (2012), also pointed out that in 40% of the opportunities that coaches followed these instructions, the teams improved their field performance. On the other hand, it was also verified that coaches who did not follow these instructions, obtained the expected results only in 22% of the matches. With the evolution of sport and sports` analysis, rules and game strategies are also being improved.

In this sense, the International Board and FIFA adopted the fourth substitution, when the match has overtime (FIFA, 2017). This alteration can be beneficial to the sport because they can reduce the levels of fatigue and improve players` performance.

According to our results, the substitutions are essential in professional football matches. Although there are differences between how they are used in Championships and National Cups, the results show that they follow a pattern and, in most cases, the substitutions of a player in Championships has a more significant direct effect in goals scored than in National Cups. Therefore, when performed correctly, and at the appropriate time, substitution may be a factor influencing sports performance (Wilson, 2013).

The findings of the present research add new information to the literature and have practical applications for professionals who work with football. As far as we know, there is no study designed to analyze differences between championship and national cup tournaments. Therefore, knowing that are significant differences between the tournaments, these results can help coaches and sport analysts during training sessions and preparation to the games. Hence, we showed that the substitutions follow a pattern and they need to be understood as a determinant factor during professional football games.

CONCLUSION

This research showed the importance that the players` substitutions have in modern football, being an indispensable strategy to enhance performance.

When well used, it can change the performance and results of matches, as well as influence the rest of the season, especially in championship tournaments.

Although the information contained in this manuscript is of paramount importance for high-performance professional practice and the study of football, some limitations need to be considered when interpreting the findings.

First, the sample size in each analyzed country was small – this fact made it difficult to compare countries.

Second, we do not know what would have happened if the substitution was not made. In addition, due to the nature of the study, we cannot analyze the influence of the substitute player during the match in other important plays, such as the construction of tactical movements or assistances for goals.

Finally, the nature of the substitution was not observed, so, we cannot verify the main reasons that led to player substitution.

Despite that, future researches should seek to understand how substitutions are made in matches played at high altitude and in games where heat and cold predominate, as well as analyze the influence of the player who entered, if he participated effectively in the plays that resulted in goals. Moreover, analyzing the negative aspects of the substitution (i.e.: ball loses, fouls committed, goals suffered, etc.) may be fundamental to future research. Understanding how substitution patterns are made, in different situations, can aid in the organization of training cycles and pre-game preparation.

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