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Original research article

ANALYSIS OF GOALS IN SOCCER WORLD CUPS AND THE DETERMINATION OF THE CRITICAL PHASE OF THE GAME

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Abstract. *The aim of this study was to analyze and quantify, in absolute and percentage terms, the incidence of goals in games of soccer during World Cups; to verify in which periods and half of the games goals happen, in relation to the overall game time; and determine a critical stage of the game with the highest incidence of goals. The playing time was split into 15-minute periods, in order to obtain results regarding the distribution of the incidence of goals throughout the game and the relationship between the results and the physical, technical, tactical and psychological aspects. We performed a quantitative study on a sample of 772 games, by analyzing the official dockets, which are available in the database of the FIFA official website. After analyzing the data, we studied the occurrence of a greater number of goals (54.44%) in the second half of the games, and their highest incidence (19.61%) in the final 15 minutes of play in the period between the 76th and 90th minute. The highest incidence of goals in the final 15 minutes of play can be explained by the decrease in physical performance, consequently, by the tactic disorganization, psychological fatigue and the need for a result, thus affecting the actions of a team at the end the game.*

Key words: *goals, soccer, World Cup, critical phase of goals.*

INTRODUCTION

In competitive sports, and more specifically in soccer, the level of performance is determined by a number of dexterities and abilities that are significantly inter-correlated: Technique (coordination abilities, kinetic skillfulness), tactics (cognitive and planning abilities), psychological factors (motivation, desires, willingness) and finally, fitness (Weineck, 1997). The union of these skills and capabilities has as its main objective the

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pursuit of victory, through a good defensive performance, avoiding goal marking by the opposing team, and a good offensive performance, by goal marking. In soccer games the goal is the pinnacle of the game.

Despite the fact that there is ample amount of studies that have examined the characteristics of goals that have been achieved in many tournaments, the need for constant a record and evaluation of football characteristics is prevalent since it presents continuous evolvement and change as far as the mode of the game is concerned. Additionally, the information collected from researchers through these studies, and transferred to coaches and players, is very important for the design of the training, the choice of the appropriate tactic and its application in the game (Yiannakos & Armatas, 2006).

The aim of this study was to analyze and quantify, in absolute and percentage terms, the incidence of goals in games of soccer World Cups; to verify in which periods and half of the games goals happen, over total time of the game; and determine a critical stage of the game with the highest incidence of goals. The data allow us to perform multiple comparisons between different analyzed tournaments. In soccer games, scientific information can be developed by the profile that occurs with the goals. Some aspects, e.g., field location, type of play, time of occurrence or body parts with which the goals are marked, can provide useful information for decisions in training and in games (Silva & Campos Jr., 2006).

The evaluating goal scoring patterns in soccer matches may contribute to determining the factors that enable effective competition performance (Armatas et al., 2009). Recently several researchers have studied the goals of the World Cup because of the importance this event has for the world of soccer (Marques Jr., 2012). According to Silva and Campos Jr. (2006), the World Cup is the last step of development and a reflection of the level of modern soccer, serving as a parameter for a variety of studies in various subjects that are related to football.

THE METHOD

The sample

We analyzed the official summaries of all the games played (n = 772), in 19 Football World Cups, from 1930 to 2010. In total, we analyzed 2,208 goals, noting the period and half game in which they occurred.

The method

The data were obtained from the database of the website of the Fédération Internationale de Football Association - FIFA (www.fifa.com) through official overviews of the games. We collected quantitative data, which are related to the times the goals were scored in the course of the games. The data were cataloged in a table.

The study was developed through variable analysis: a) dividing the total time of the game into time periods of 15 minutes (with the exception of increasing periods on the 1st and 2nd half), the playing time was split into 10 periods: 1st - 15th min.; 16th - 30th min.; 31st - 45th min.; increases the 1st half, 46th - 60th min., 61st - 75th min.; 76th - 90th min.; increases the 2nd half, 1st extra time (91st - 105th min.) and 2nd extra time (106th - 120th min.), b) frequency of goals scored by half of the game (1st and 2nd half).

Data analysis

For the presentation of the results we used descriptive statistics, consisting of a frequency distribution. Statistical data were reproduced with Absolute Frequency (number of goals) and Relative Frequency (percentage of goals).

RESULTS

Table 1 Distribution of goals scored in World Cups, divided by periods of the game.

Half	1st half				2nd half				Extra time		Total	Games	Average
Minutes	1st–15th	16th–30th	31st–45th	45th+	46th–60th	61st–75th	76th–90th	90th+	1st e.t.	2nd e.t.			
2010	14	23	20	2	22	27	29	6	1	1	145	64	2.2
2006	24	24	20	3	19	10	36	8	1	2	147	64	2.2
2002	27	18	20	5	28	30	27	4	1	1	161	64	2.5
1998	24	20	16	10	31	25	35	9	-	1	171	64	2.7
1994	22	19	24	-	23	23	27	-	2	1	141	52	2.7
1990	9	13	12	-	19	22	34	-	2	4	115	52	2.2
1986	19	18	18	-	21	26	25	-	2	3	132	52	2.5
1982	16	22	12	-	28	40	24	-	3	1	146	52	2.8
1978	12	10	30	-	13	20	15	-	1	1	102	38	2.7
1974	14	16	15	-	16	16	20	-	-	-	97	38	2.6
1970	12	14	8	-	19	19	16	-	3	4	95	32	3
1966	14	13	15	-	11	14	20	-	1	1	89	32	2.8
1962	16	14	9	-	15	17	18	-	-	-	89	32	2.8
1958	16	22	18	-	22	23	24	-	1	-	126	35	3.6
1954	20	29	14	-	25	20	28	-	2	2	140	26	5.4
1950	9	17	15	-	15	12	20	-	-	-	88	22	4
1938	11	13	16	-	8	12	15	-	6	3	84	18	4.7
1934	9	16	8	-	11	14	8	-	2	2	70	17	4.1
1930	12	11	9	-	9	17	12	-	-	-	70	18	3.9

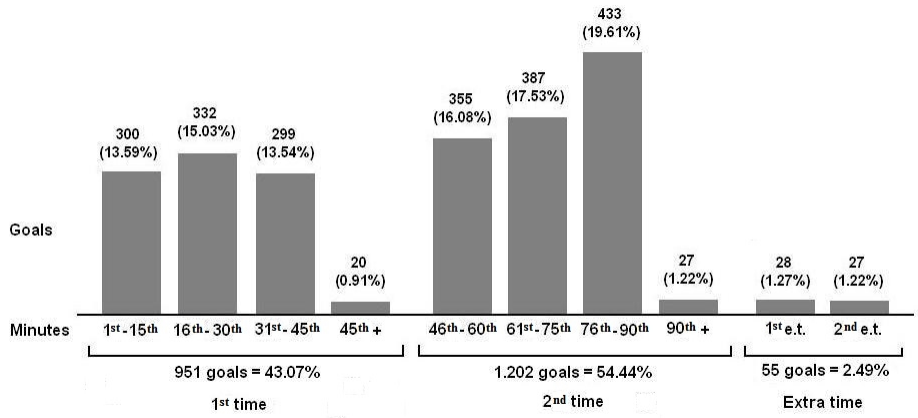

Chart 1 Frequency of absolute and relative total goals, divided by half of the game.

According to Figure 1, in 772 games, played in 19 World Cups were labeled a total of 2.208 goals, including: 951 goals in the 1st half, 1202 goals in 2nd half and 55 goals in ex-

tra time. When we analyzed the period of game in which goals were scored, we obtained: 300 goals (13.59%) in the period from 1st to 15th min.; 332 goals (15.03%) of the 16th to 30th min.; 229 goals (13.54%) of 31st to 45th min.; 20 goals (0.91%) in injury time the 1st half, 355 goals (16.08%) in the period from the 46th to the 60th min.; 387 goals (17.53%) of 61st to 75th min., 433 goals (19.61%) from 76th to 90th min.; 27 goals (1.22%) in stoppage time of the 2nd half; 28 goals (1.27%) in the 1st extra time, and 27gols (1.22%) in the 2nd extra time.

DISCUSSION

Incidence of goals per game period

Looking at the data in table 1, we can see that in the 19 World Cups the highest incidence of goals was found during the final 15 minutes, between the 76th and 90th minute. This incidence was higher in 10 World Cups, indicating this period of the game as the critical phase in the incidence of goals. Analyzing the total amount of goals scored (2,208) in the World Cup (chart 1), we can also see that most goals (19.61%) occurred during the final 15 minutes, the 76th to the 90th minute. A review of the relevant studies shows that the frequency of goals during one game usually depends on time. According to Godik (1996), most goals in Russian and European Championships happen in the final 15 minutes of the second half of the game, confirming the same numbers in this study. In Silva's study (2007), we analyzed 7,599 goals in 2,902 games, 8 National Championships of Professional Football (Argentine, German, Brazilian, Spanish, French, Dutch, English and Italian), verifying a higher incidence of goals also in the final 15 minutes (21.88%). Armatas et al. (2007a) examined all 90 games played in three World Cups of women's soccer (1995, 1999 and 2003) and also found that the highest incidence of goals was during the final 15 minutes, the 76th to the 90th min, 32.3% , 22% and 24.3%, respectively. Armatas et al. (2007b) analyzed the goals in 192 games in three World Cups (1998, 2002 and 2006), and found that the highest incidence of goals scored in the crowns from 1998 to 2006 was in the period of the last 15 minutes of the game, 27.5 % and 32.8%, respectively. Some authors have, individually, studied the goals scored in the last World Cups and also found the period of the final 15 minutes marked by a higher incidence of goals.

This predominance of goals at the end of the game can be related mainly to the athletes' fatigue. This deterioration of performance at the end of the game can be related to a number of factors such as decreased level of muscle glycogen, accumulation of metabolic byproducts, failures in the nervous system and the mechanism of stimulus-contraction (Spencer & Katz, 1991; Bianchi et al., 1997; Rienzi et al., 2000; Weineck, 2000; Wilmore & Costill, 2001; Reilly, 2003; Rahnama et al., 2004; Mohr et al., 2005).

Currently, soccer is highly competitive, with teams that are at very similar levels in relation to the demands and physiological demands that accompany them, several times resorting to science to increasingly achieve positive results (Gomes et al., 2011). These physiological demands may be too high, which increases fatigue, affecting the physical performance and psychological technique of the players and, consequently, their motor actions and tactics in the game (Weineck, 2000; Reilly, 2003; Rahnama et al., 2004; Mohr et al., 2005). According to Reilly (1997) and Rahnama et al. (2004), the decline, mainly of explosive force, would have the worst effects for the actions of the players at the end of the game, when they give short sprints and jump less vigorously, unlike the

beginning of the game. Thus, it has been observed that the amount of high-intensity running is reduced in the final 15 minutes of a top-class soccer game (Mohr et al., 2003).

Alternatively, players could be related to psychological fatigue and a lapse in concentration, more marked as a result of sustained physical exertion, leading to tactical and motor errors, opening the possibility of the goals being converted (Solera et al., 1999; Weineck, 2000; Reilly, 2003; Aragon-Vargas, 2004). Bompa (2005) states that the higher the player's level, the bigger the requirement and therefore stress during a game. According to Brandão (2000), from the psychological point of view, stress is related to the activation of cognitive, psychological or mental activity. The author found stress factors in soccer players, saying that, in the modality, stress is a complex and multifunctional process that can negatively influence the performance of an athlete.

A good aerobic capacity is also indicated, and therefore may protect against the decline in the working rhythm at the end of the game (Weineck, 2000; Wilmore and Costill, 2001; Reilly, 2003). Differentiated strategies and tactics can also be used to reduce the effects of fatigue that can happen in the final stages of the game (Reilly, 1997; Drubscky, 2003). Thus, fatigue, both physical and psychological, in soccer, can manifest itself as a complicating factor, especially at the end of the game, because, according to several studies, a significant number of goals have been scored at this point (Piekarski, 1987; Ekblom, 1994; Reilly, 2003; Palomino et al., 2000; Weineck, 2000; Njororai, 2004).

Incidence of goals per game time

Analyzing the goals scored by game time (chart 1), the data show that 43.07% of the goals were scored in the 1st half of the game, while 54.44% of the goals were scored in the 2nd half of the games. Analyzing the goals throughout the game, we can see that the goals scored in the first 3 periods of the 1st half of the game have very close results and a slight variation. While in the 2nd half, the dynamics of incidence of goals in the first 3 periods appears on an increasing scale. More goals are scored according to the progression of time, showing the last period as the most common.

In the study by Silva (2007), of the 7599 goals analyzed, 44.17% of the goals were scored in the first half and 55.83% of the goals in the second half of the games. In his study, Armatas et al. (2007a) found out that most goals in women's soccer World Cup in 1995, 1999 and 2003, were marked in the 2nd half of games: 53.5%, 57.7% and 58%, respectively. In the study by Armatas et al. (2007b), on goals scored in World Cups of 1998, 2002 and 2006, the results showed that most goals scored so well in the second half of games, and scored 60.8%, 59% and 52.5% of goals, respectively. Yiannakos and Armatas (2006) in their study on the goals at Euro 2004, found that 57.4% of the goals were scored in the 2nd half of the games.

Studies that compared the rates of effort between the first and second half have shown reduced performance of athletes. There is a 5% reduction in the total distance of the second half compared to the first (Bangsbo et al., 1991; Rienzi et al., 2000). Thus, it has been demonstrated that the amount of sprinting, high-intensity running, and distance covered are lower in the second half than in the first half of the game (Bangsbo et al., 1991; Bangsbo, 1994; Mohr et al., 2003; Reilly & Thomas, 1979 as cited in Armatas et al., 2007b).

According to Gomes et al. (2004), the best performance (physical, technical, tactical and psychological) in the soccer game is directly linked to physical, i.e., the smaller the physical wear, the better the performance. At the same time, a team which is early in the

game better able to perform actions will face his opponent with the same conditions. Therefore, the higher incidence of goals in the second half of play may be due to better resistance to decreased physical performance, psychological and the technical and tactical organization of a team, allowing it to stand out in comparison to the other.

For Reilly (2003), the highest occurrence of goals at the end of the game cannot simply be explained by a fall in intensity due to physical wear, as this is balanced, logically for both teams. For the author, the more marked deterioration in performance between the defenders, which gives an advantage to the attackers at the end of the game, and lapses of concentration could be possible explanations.

CONCLUSION

Through various studies on game analysis in soccer have become common, in the relevant literature of the sport most goals happens in the 2nd half of games, and the critical phase of the game, the game period with the greatest incidence of goals usually is the final 15 minutes, the 76th to the 90th minute.

Given these results, we can say that physical performance should directly interfere in the technical, tactical and psychological performance of a team, with the highest incidence of goals in the final 15 minutes of the game associated mainly to the drop in physical performance. This clearly shows the importance of physical fitness for good performance of a soccer player during the game, so that he can quickly achieve technical and tactical actions, performing well throughout the game without a performance drop.

With such relevant information, the coaching staff of each team must work the fundamental components of athletes, whether physical, technical, tactical, psychological and/or nutritional, so there is no drop in performance between and not in a state of great fatigue, leading to the final period of the game in ideal conditions, so as not to receive goals.

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ANALIZA GOLOVA POSTIGNUTIH NA SVETSKIM PRVENSTVIMA U FUDBUALU I ODREĐIVANJE KLJUČNIH FAZA U SAMOJ IGRI

Cilj ovog istraživanja bio je da se analizira i kvantifikuje, u apsolutnim vrednostima i procentima, učestalost postizanja golova tokom fudbalskih utakmica odigranih na svetskim prvenstvima; da se utvrdi u kojim se delovima igre i tokom kojeg poluvremena uglavnom postižu golovi, u odnosu na celokupno trajanje utakmice; da se utvrde ključne faze u samoj igri, koje odlikuje najveća stopa postignutih golova. Samo vreme igre podeljeno je na petnaestominutne segmente, kako bi se utvrdila učestalost postizanja golova tokom čitave utakmice, kao i odnos između rezultata i fizičkih, tehničkih, taktičkih i psiholoških aspekata. Izvršena je kvantitativna analiza uzorka (772 fudbalske utakmice), tako što su analizirani zvanični podaci o utakmicama dostupni na sajtu organizacije FIFA. Nakon analize podatka, utvrđen je najveći broj golova postignutih (54.44%) tokom drugog poluvremena ovih utakmica, i njihova najveća učestalost (19.61%), kao i tokom poslednjih 15 minuta igre, u periodu između 76. i 90. minuta. Najveći broj golova postignut je tokom poslenjih 15 minuta igre, što se može objasniti smanjenjem u fizičkoj snazi učesnika, a samim tim u nedostatku taktiči bolje organizacije, psihološkim umorom, i jakom željom da se postigne dobar rezultat, što utiče na aktivnosti igrača na samom kraju utakmice.

Ključne reči: *postignuti golovi, fudbal, svetska prvenstva, ključne faze.*