Timeline, Scores and Results Prediction in Professional Men's Soccer FIFA World Cups (1930-2018)
Cronología, planteadores y predicción de resultados en las Copas Mundiales de Fútbol Profesional Masculino (1930-2018)
Timeline, placares e predição de resultados nas Copas do Mundo de Futebol Profissional Masculino (1930-2018)

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Abstract

Professional men's soccer FIFA World Cup (FWC) takes place every four years, so it is an excellent opportunity to follow evolution in this modality. Hence, three objectives were set: a) to verify the trend of the average goals scored and score frequency; b) to analyze the association between first-half results and final results of matches; and c) to identify if half times results could predict matches outcomes. Thus, were analyzed all 900 FWC matches between years 1930 and 2018. Data were organized in goals scored and against in the first half and at the end of matches, first-half and matches outcome (win, draw or lose). Descriptive and trend analysis were carried out for the evolution of goals in FWC editions. A cross table was used to verify the final scores of matches, followed by an analysis of the association between partial results (first half) and final matches outcome, and a multinomial logistic regression to identify the match win odds ratio. It concludes that goals average in FWC has an undulatory trend; scores up to three goals were prevalent; first half win is associated to final win matches, and first half lose or draw increases odds to lose at the end of matches.

Keywords: Match analysis. Notational analysis. Game-related statistics. Goal score. FIFA World Cup.

Resumen

La Copa Mundial de la FIFA de fútbol masculino (CMFIFA) que se celebra cada cuatro años, brinda una excelente oportunidad para seguir la evolución y el rendimiento del deporte. Se plantearon tres objetivos: a) Verificar la tendencia evolutiva del promedio de goles y la frecuencia de los puntajes finales en los partidos del CMFIFA ya celebrados (1930-2018); b) Analizar la asociación entre resultados parciales (primer tiempo) y finales dichos los partidos; c) Identificar si los goles y los resultados parciales son capaces de predecir los resultados finales en los partidos. Para esto, se analizaron los 900 partidos CMFIFA jugados entre los años 1930 y 2018. Los datos se organizaron en: goles marcados y recibidos en la primera y segunda mitad de los partidos; y resultados parciales (primera mitad) y finales (victoria, empate, derrota). Se llevaron a cabo análisis descriptivos y de tendencias para verificar la evolución de la cantidad de goles en promedio. Se realizó una tabla cruzada para verificar los resultados finales de los juegos, seguido de un análisis de la asociación entre los resultados parciales y finales de todos los partidos, y una regresión logística multinomial para identificar la proporción final de probabilidades de ganar partiendo de los resultados parciales. Se concluye que la cantidad de goles promedio del CMFIFA tiene una tendencia ondulatoria; los tanteadores por debajo de tres goles prevalecieron; la victoria en la primera mitad está asociada con la victoria final; y perder o empatar en la primera mitad aumenta las posibilidades de derrota.

Palabras clave: Análisis de partidos. Análisis de notación. Estadísticas de partidos. Tanteadores. Copa del Mundo FIFA.

Resumo

Realizada a cada quatro anos, a Copa do Mundo Masculino da FIFA (CMFIFA) oferece uma excelente oportunidade para acompanhar a evolução e o desempenho do esporte. Por consequência, três objetivos foram estabelecidos: a) Verificar a tendência evolutiva da média de gols e frequência de placares finais nos jogos das CMFIFA já realizadas (1930-2018); b) Analisar a associação entre os resultados parciais (primeiro tempo) e finais nos jogos das CMFIFA já realizadas (1930-2018); c) Identificar se os gols e resultados parciais são capazes de prever os resultados finais nos jogos das CMFIFA já realizadas. Para isso, foram analisados todas as
900 partidas das CMFIFA realizadas. Os dados foram organizados em: gols marcados e sofridos no primeiro tempo e final das partidas; e resultados parciais e finais das mesmas (vitória, empate, derrota). Foram realizadas análises descritivas e de tendência para verificar a evolução da média de gols nas edições das CMFIFA. Foi realizada uma tabela cruzada a fim de verificar os placares finais dos jogos, seguida de uma análise de associação entre os resultados parciais e finais de todas as partidas, e uma regressão logística multinomial para identificar a razão de chance de vitória final a partir dos resultados parciais (primeiro tempo). Conclui que as médias de gols das CMFIFA possuem uma tendência ondulatória; os placares abaixo de três gols foram prevalentes; vitória no primeiro tempo está associada à vitória final, e que perder ou empatar no primeiro tempo de jogo aumenta a chance de derrota no final do jogo.

**Unitermos:** Analise de jogo. Analise notacional. Estatísticas de jogo. Placares. Copa do Mundo FIFA.

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**Introduction**

Match complexity in invasion team sports is characterized by an environment of cooperation and opposition, in which there is a dispute for shared space in constant confrontation between defense and offence, searching to overcome the opponent (Galatti et al., 2017). In this context, soccer is one of the most highlighted modalities in the world. This phenomenon can be proven for being one of the best known and practiced worldwide, being present at more than 211 countries. ("FIFA", 2017)

The more people engage in professional soccer, the greater the revenue of clubs, leagues and federations tends to be. For example, Brazilian’s Serie A Championship earnings exceeded 1 billion euros during 2016 season (Campelo, 2017). Therefore, soccer is seen as one of the most worldwide competitive and profitable sports. Despite the success of greatest national (England, Spain, and Brazil) or continental leagues (South America and Europe), the most important competition is FIFA World Cup (FWC). Unlike those other championships, FWC calendar has a four-year calendar and seeks the participation of national teams from all continents, representing the elite of world professional men’s soccer. In this sense, because it occurs in four-year cycles, FWC is an excellent opportunity to observe evolution and the new trends in soccer.

In this perspective, studies centered on this matter have become more and more observed at scientific literature recently. Approaches cover comparisons amongst competitive levels (Aquino et al., 2017; Bradley et al., 2013), physiological demands by position (Aquino et al., 2017; Taylor, Mellalieu, & James, 2004), and game style (Hewitt, Greenham, & Norton, 2016; Lago-Peñas, Gómez-Ruano, & Yang, 2018; Lago, 2009). Moreover, match analysis studies have proved to be crucial for a more comprehensive and more detailed understanding of players and teams performance (Mackenzie & Cushion, 2013; Sarmento et al., 2014). Goal scoring is the most potent performance indicator in soccer, and undoubtedly, match outcome rely on this event. (Pratas, Volossovitch, & Carita, 2018)

Evangelos et al. (2018) found that European elite teams tend to score more goals during second-half of matches than lower performance level teams. Njororai (2014) gathered data from South American Leagues, FIFA and UEFA tournaments and noted that 40% of goals occurred during the last 30 minutes of the game. Leite (2013) observed that UEFA EURO 2012 teams scored 58% of goals during second-half, and that teams who scored first won the games on 71% of occasions. Even though these studies showed impressive
results, all of them followed a cross-sectional design, which do not allow identifying trends. Wallace & Norton (2014) evaluated longitudinally several FWC (1966-2010), but only their final games, and limited to game structure, speed, and play patterns.

Therefore, a more comprehensive analysis of data from elite teams and competitions would make feasible a better understanding of the game and for coaches’s decision making process (Pratas, Volossovitch, & Carita, 2018). However, to the best of our knowledge, no studies monitored the evolutionary trends of soccer based on goals scored and results and predict the matches outcomes based in first half time throughout all FWC editions. Thus, our objectives were three-fold: a) to verify the trend of the average goals scored and score frequency; b) to analyze the association between first-half results and final results of matches; and c) to identify if half times results could predict matches outcome.

Methods

Study design

This is a descriptive and retrospective.

Sample

Sample was composed for all matches of the 21 FWC editions occurred between 1930 and 2018, totalling 900 games (no extra time events included). This championship was selected because it is the world's largest representation in professional soccer, and for being seen as cut-off points for new trends in this sport.

Procedures

All data were gathered from FIFA World Cup's archive official website https://www.fifa.com/fifa-tournaments/archive/worldcup/index.html. Mean and standard deviation of goals, number of goals per match (scored and against), final scores, and first-half and final results (win, draw or lose) of each match of the FWC editions (1930-2018) were determined.

Statistical analysis

Initially, descriptive analysis was performed to find the mean and standard deviation of goals per match in each FWC, using the Shapiro-Wilk normality test to confirm the normality of data. Subsequently, contrast analysis was made to observe the trends of evolution in the average of goals scored in each FWC.

After trend analysis, FWC editions were organized into five groups, based on cut-off points from the median of goals per match. Thus, competitions were categorized as follows: FWC with marked upward trend (CMUT) (1930 to 1954, n = 5); b) FWC with marked downward trend (CMDT) (1958 to 1970, n = 4); C) FWC with slight downward trend
(CSDT) (1974 to 1990, n = 5), FWC with linear trend (CLT) (1994 to 2010, n = 5) and FWC with slight upward trend (CSUT) (2014 and 2018, n = 2). After that, a new trend analysis of categorized FWC was carried out.

With regard to score frequency, a cross table between goals scored and against in each match was performed. The first-half and final results of the match categorizations are presented in Table 1. Then, chi-square analysis was performed to find association between first-half results and the final results. Ultimately, a multinomial logistic regression was applied to identify if goals and first-half results could predict match outcomes (win, draw or lose). For all analyses, 95% confidence interval (CI) and significance level of 5% were adopted, along with effect size analyses. SPSS 22.0 software (IBM, USA) was used to tabulate and analyze data.

Table 1. Operational definitions of results observed in the first half and end of the match

<table>
<thead>
<tr>
<th>Results</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Win</td>
<td>Scorers in which the team has higher number of goals scored than the opponent</td>
</tr>
<tr>
<td>Open Win*</td>
<td>Scores in which the team partially surpasses the other by two or more difference goals</td>
</tr>
<tr>
<td>Close Win *</td>
<td>Scores in which the team partially outperforms the opponent by one goal difference</td>
</tr>
<tr>
<td>Draw</td>
<td>Partial scores in which the teams have the same number of goals scored</td>
</tr>
<tr>
<td>Lose</td>
<td>Scores in which the team has smaller number of goals scored than the opponent</td>
</tr>
</tbody>
</table>

* Result considered only for the first half of the match.

Results

Regarding the average of goals per match

The fifth-order polynomial contrast analysis showed significant trend $F(20.879) = 5.623; p \leq 0.01; r = 0.34$, with the highest average for FWC Switzerland 1954 (Goals = 5.23 ± 2.86) and the lowest average for FWC Italy 1990 (Goals = 2.1 ± 1.56) (Figure 1).

Figure 1. Descriptive data and trend line by contrast in the professional men's soccer FIFA World Cups mean and standard deviation goals (1930-2018)
When the polynomial contrast analysis was performed for categorized FWC editions, quadratic trend was observed $F(4.895) = 22.627; \ p \leq 0.01; \ r = 0.96$ (Figure 2).

Figure 2. *Descriptive data and trend line by contrast in the categorized professional men's soccer FIFA World Cups (1930-2018)*
Final score frequency analyses

The more prevalent scores throughout FWC editions ranged between 0x0 and 2x1 (64% of matches), highlighting 1x0 and 2x1 as the most common scores, remaining only 36% for all other final scores (Table 2).

Table 2. Final score frequency in all matches of FWC editions (1930-2018)

<table>
<thead>
<tr>
<th>Team 1*</th>
<th>Goals</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Team 2*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>9.2%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>9.2%</td>
</tr>
<tr>
<td>1</td>
<td>18.3%</td>
<td>11.4%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>29.8%</td>
</tr>
<tr>
<td>2</td>
<td>10.9%</td>
<td>14.2%</td>
<td>4.3%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>29.4%</td>
</tr>
<tr>
<td>3</td>
<td>5.9%</td>
<td>7.1%</td>
<td>4.1%</td>
<td>0.4%</td>
<td></td>
<td></td>
<td></td>
<td>17.6%</td>
</tr>
<tr>
<td>4</td>
<td>2.7%</td>
<td>3.1%</td>
<td>1.4%</td>
<td>0.1%</td>
<td>0.2%</td>
<td></td>
<td></td>
<td>7.6%</td>
</tr>
<tr>
<td>5</td>
<td>0.8%</td>
<td>0.8%</td>
<td>1.0%</td>
<td>0.1%</td>
<td>0%</td>
<td>0%</td>
<td></td>
<td>2.7%</td>
</tr>
<tr>
<td>6</td>
<td>0.6%</td>
<td>1.1%</td>
<td>0%</td>
<td>0.2%</td>
<td>0%</td>
<td>0%</td>
<td></td>
<td>1.9%</td>
</tr>
<tr>
<td>7</td>
<td>0.4%</td>
<td>0.3%</td>
<td>0.1%</td>
<td>0.1%</td>
<td>0%</td>
<td>0.1%</td>
<td>0%</td>
<td>1.1%</td>
</tr>
<tr>
<td>8</td>
<td>0.3%</td>
<td>0%</td>
<td>0%</td>
<td>0.1%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>0.4%</td>
</tr>
<tr>
<td>9</td>
<td>0.2%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>0.2%</td>
</tr>
<tr>
<td>10</td>
<td>0%</td>
<td>0.1%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>0.1%</td>
</tr>
</tbody>
</table>
First-half and final results of matches analyses

First-half results were associated to the final results of FWC matches (1930-2018), $\chi^2 (6) = 803.501; p \leq 0.01; r = 0.47$ (Table 3). First-half wins resulted in match win in at least 70% of games, whereas losing in first-half limited the chance of winning by less than 10%.

Table 3. Association between first-half and final results of FWC matches (1930-2018)

<table>
<thead>
<tr>
<th>First-half result</th>
<th>Lose</th>
<th>Draw</th>
<th>Win</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lose</td>
<td>76.8%</td>
<td>14.8%</td>
<td>8.4%</td>
</tr>
<tr>
<td>Draw</td>
<td>30.2%</td>
<td>39.2%</td>
<td>30.6%</td>
</tr>
<tr>
<td>Close Win</td>
<td>10.7%</td>
<td>18.8%</td>
<td>70.5%</td>
</tr>
<tr>
<td>Open Win</td>
<td>0%</td>
<td>4.6%</td>
<td>95.4%</td>
</tr>
</tbody>
</table>

Final result odds ratio analyses

First-half results predicted final results of FWC matches. Odds ratio analyses showed more than 100-fold chance of losing the game after finishing first-half with a partial lost in contrast of partial wins. Even drawing on first-half represented a 10-fold chance of being defeated instead of a partial win (Table 4).

Table 4. Odds ratio analyses of first-half results and goals predicting final match results during FWC (1930-2018)

<table>
<thead>
<tr>
<th>Variables *</th>
<th>OR</th>
<th>p</th>
<th>Confidence Interval (95 %)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Lower</td>
<td>Upper</td>
<td></td>
</tr>
<tr>
<td>Lose</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Goals scored (First half) = 0</td>
<td>.933</td>
<td>.821</td>
<td>.512</td>
</tr>
<tr>
<td>Goals scored (First half) &gt; 0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Goals against (First half) = 0</td>
<td>1.105</td>
<td>.745</td>
<td>.604</td>
</tr>
<tr>
<td>Goals against (First half) &gt; 0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>First half lose</td>
<td>102.643</td>
<td>.000</td>
<td>35.064</td>
</tr>
<tr>
<td>First half draw</td>
<td>10.203</td>
<td>.000</td>
<td>5.477</td>
</tr>
<tr>
<td>First half win</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Draw</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Goals scored (First half) = 0</td>
<td>1.027</td>
<td>.932</td>
<td>.553</td>
</tr>
<tr>
<td>Goals scored (First half) &gt; 0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Goals against (First half) = 0</td>
<td>1.096</td>
<td>.755</td>
<td>.616</td>
</tr>
<tr>
<td>Goals against (First half) &gt; 0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>First half lose</td>
<td>9.503</td>
<td>.000</td>
<td>3.253</td>
</tr>
</tbody>
</table>
Discussion

This study purposed to verify the trend of the average goals scored and score frequency, the association between first-half results and final results of matches, finally to identify if goal and first half results could predict matches outcomes in all FWC editions, 1930 – 2018. Main findings indicate an undulatory trend of goals averages, and that first-half result seems to be a good model to be used as a predictive tool of match outcome.

Palacios-Huerta (2004) analyzed the average of goals scored in the Premier League between 1950 and 2010 and found a downward trend, indicating a leveling of averages until the first decade of the 21st century. Our study shows a similar trend; however, emphasizing the identification of an undulatory phenomenon. In this sense, average of goals oscillated over time, clearly forming the five trend lines categorized from the average of goals in FWC matches. These data show that in the first championships, the average of goals was higher. On the other hand, with the development of defensive tactical training, especially in the late 1950s, the average of goals tended to a sharp fall, stabilizing from the USA 1994 FWC. It should also be noted that our study showed a slight increase in the last two FWC editions (2014 and 2018).

Switzerland 1954 FWC presented the highest average of goals among all FWC editions and can be understood as a milestone in the evolutionary line of soccer. This may be due to the use of the 1-4-2-4 team formation, mainly adopted by Brazil and Hungary teams, in opposition to the traditional patterns of that time. This team formation was understood as an organizational innovation, allowing a better balance between defense and attack to easily surpass less organized teams (Coelho, 2013, Wilson, 2016).

This development served as a basis for the establishment of more balanced team formations. Thus, when moving back one of the attackers to compose the midfield, Brazil’s team played in a 4-3-3 team formation during Sweden 1958 FWC. This was the first time a team came up with a more organized defense and midfield player distribution, created as an opposition to the traditional "WM" and "MW" team formations (Wilson, 2016). As a result, the average of goals dropped on an undulatory pattern. Since then, 1-4-3-3 team formation was widely used until England 1966 FWC, causing a downward trend in the average of goals (Anderson & Sally, 2013, Wilson, 2016).

After the 1960s, there was a continuation in the downward trend in the average of goals, although more attenuated. This trend can be explained by two aspects. The first aspect was the onset of "Total Training Method", based not only on skills training, but also on strong physical, tactical and psychological training (Mollet, 1963). The second was the development of training methods focused on physiological specificities, mainly to overcome the difficulties related to Olympics Games and FWC, held respectively in 1968 and 1970, in cities such as Mexico City, whose altitude exceeds 2,300 m above sea level. (Kasperowski, 2009)

Aligned to the new high-level physical standards and concerned with a greater occupation of the field, teams like Brazil and England began to use the 1-4-4-2 team formation. This tactical organization is based on physical strength, aiming at reducing spaces, especially in the midfield and defense sectors (Wilson, 2016). As a result of this trending, which lead to a reduction of goals per match, Italy 1990 FWC presented the lowest average of goals of all time. In this context, this World Cup was considered an unattractive
tournament, since offensiveness has always been seen as synonymous of greatness and high-performance matches (George, Ionel, & Cristian, 2014). Hence, winning teams like Italy and Germany applied formations with few effectively attacking players, such as 1-3-5-2 and 1-4-5-1 team formations, whose main purpose was to overcome opponents through truncated and high-density matches in mid-field sectors (Wilson, 2016).

Cyclically, there was a need to confront such defensive systems and make soccer a more interesting game, towards more offensive-minded teams (Anderson & Sally, 2013, Wilson, 2016). These discussions lead soccer to an improvement on tactical balance, which consequently produced more stable average of goals, evoking a linear trend in number of goals per match (Palacios-Huerta, 2004). Most teams returned to play with 1-4-4-2 team formation until South Africa 2010 FWC.

Moreover, these new tactical directions associated to a culture of training smarter and more creative players have developed teams even more offensive. As a result, team formations like 1-4-3-3 were once again widely used in FWC Brazil 2014, increasing the average of goals. According to this upward trend, during FWC Russia 2018, at least 25 of the 32 teams played with three forward players at the starting lineup (FIFA, 2017).

Identifying game patterns facilitates coaches’ and athletes’ decision-making in an open, nonlinear and highly complex system such as soccer (Teoldo, Guilherme & Garganta, 2015). In this sense, our study reveals an undulatory pattern of average goals scored per match in FWC. Our results can serve as a basis for match analysis, supporting the hypothesizing that the subsequent World Cups would maintain the offensive characteristics until more defensive-minded teams would be once again exploited.

Despite an increase in the average of goals in recent years, 50% of FWC matches finished with a maximum of two goals scored, endorsing that goal is a rare event in soccer (Anderson & Sally, 2013). In fact, the historical record of FWC indicates that the most prevalent score was 1x0 (18% of games). In addition, it is worth noting the small difference between the number of matches whose results were 2x0 (10.9%) and 1x1 (11.4%). However, table 3 reveals that matches ended with two and three goals (22.3% and 20.1%, respectively) are more frequent than those with only one goal scored. These results show the importance of teams trying to score at least a second goal, as this partial score increases their chances of winning (Anderson & Sally, 2013). Finally, Pratas, Volossovitch & Carita (2018) draw attention to the fact that the goal is not only the main aim of the game, but it is also adopted as a prominent performance indicator.

Regarding the relationship between goal scoring and playing time, Leite (2013) analysed the UEFA Euro 2012 matches and found that 58% of goals were scored in the second half. Similarly, Evangelos, Gioldasis, Gissis, & Axeti (2018) found that teams with better performance are more likely to score in the last 15 minutes of the match. Njororai (2014) observed teams from several European and South American national leagues, as well as UEFA Euro and FWC teams and also found that those more physically, technically, tactically and psychologically prepared have better conditions to score goals in the first minutes of the match.

In the other hand, the analysis of association and regression between partial (first half) and the final score of FWC matches (1930-2018) shows the importance of scoring goals mainly in the first half of the match. In our study, win in first half of the match was a strong determinant of association for teams to win matches, since in more than 75% of matches teams with close partial wins ended up winning, teams that obtained open partial wins in the first half were winners in more than 95% of cases, emphasizing that none was defeated. Moreover, if a team was defeated in first half have increases the odds of losing the game by 102-fold. These numbers show the importance of an offensive-minded
style of play since the first half, especially considering the high probability of goals achievement during the second half of the match. (Evangelos et al., 2018; Leite, 2013; Njororai, 2014)

**Conclusion**

Average number of goals through FWC editions (1930-2018) showed an undulatory trend, with FWC Switzerland 1954 being the most offensive and FWC Italy 1990 being the most defensive edition. Currently, this trend is increasing in the average of goals per match. As for the final scores, most FWC matches finished with maximum of three goals scored. Finally, a first half win shows an association with a win match outcome in FWC matches (1930-2018). As also, lose and draw in first half increases the odds to lose games and win in first half like a mirror of match outcome success. This may be an important predict factor to be taken for coaches’ decision-making looking for successful tactical organizations.

**References**


