



Relationship between time and goal scoring in soccer games: Analysis of three World Cups

Armatas, V., Yiannakos, A., & Sileloglou, P.

Sports Performance And Coaching Laboratory,
Department of Physical Education and Sport Sciences,
Aristotle University of Thessaloniki, Greece.

Abstract:

The purpose of this study was to record the time that goals were scored in course of soccer games. All matches (n=192) of the three latter World Cups were recorded using video and analysed with computerized match analysis hardware and video playback system for game performance analysis using Sportscout. Chi-square methods were used for the data analysis and the level of significance was set in $p<0.05$. The 45-min analysis revealed that in World Cups 1998 and 2002 most goals were scored in the second half ($p<0.05$), while in the recent World Cup (2006) no significant difference were observed although second half presented greater percentage (52.5%). The 15-min analysis presented that in World Cup of 1998 most goals were scored in last period (76-90, $p<0.05$). Also in World Cups 1998 and 2002 there was presented a trend towards more goals scored as time progressed. Finally, in the latter World Cup most goals were scored in the last period (32.8%, $p<0.05$). The statistical analysis showed that there was not a uniform distribution in goals scored ($p<0.01$) and no differences occurred between World Cups. The results revealed that goal scoring might be depending on time and specifically that more goals are scored as time progresses. The above could be explained by the deterioration in physical conditioning, the tactical play, fluid balance and lapses in concentration.

Keywords: soccer, goal frequency, video-analysis

1. Introduction

Soccer is a complex sport and depends on many external and unanticipated factors that coaching process attempts to control in order to bring success to clubs. Within coaching process, great emphasis is placed on the coach's ability to observe and recall all the critical discrete incidents from a sport performance (Borrie, Jonsson & Magnusson, 2002). However, it has been shown that coaches cannot accurately observe and recall all of the detailed information that is required for a complete understanding or interpretation of performance (Franks & Miller, 1986). The coaching process is, therefore, enhanced by the provision of additional information that describes sport performance in detail beyond that which coaches can provide through recall of personal observations. Detailed quantitative analyses can enhance performance through the improvement of performer feedback if the feedback is provided in an appropriate form (Franks, 1997). An objective record of teams' behavior and collection of the important information can be achieved with the method of observation (Armatas, Yiannakos, Ampatis & Sileloglou, 2005b) and the feedback of the above process is a major factor in the improvement of sport skill performance (Liebermann, Katz, Hughes, Bartlett, McClement & Franks, 2002).

Low frequency of scoring is one of soccer's characteristics; thus, an objective evaluation of the specific characteristics of scoring, that directly determines the factors that ultimately lead to successful attempts and goals, is imperative (Yiannakos & Armatas, 2006). Great attention has been given on the record of goal scoring from a tactical and technical point of view (Olsen, 1998; Jinshan, Xiaoke, Yamanaka & Matsumoto, 1993; Garganta, Maia & Basto, 1997; Michailidis, Michailidis, Papaiakevou & Papaiakevou, 2004, Armatas, Ampatis & Yiannakos, 2005a). These types of analyses are important for identifying the characteristics of successful team play (Abt, Dickson & Mummery, 2002). Yet there is much interest in the relationship, if any, between time and goal scoring.

Although there are plenty of researches that examined whether goal scoring is affected by time (Jishan et al., 1993; Reilly, 1996; Michailidis et al., 2004; Yiannakos & Armatas, 2006), only one study, to our knowledge, examined exclusively the above relationship (Abt, Dickson & Mummery, 2002). The researcher examined the Australian Soccer League and concluded that goal scoring patterns are time dependent. Jishan examined 1986 and 1990 World Cup and found controversial results. In the 1986 World Cup Jishan (1986) found no significant difference between 15 min periods while in the 1990 World Cup (Jishan et al., 1993) concluded that most goals were scored in the final 15 min of play. Reilly (1996) examined matches from Scottish League 1991-1992 and reported a higher than average scoring rate in the final 10 minutes of play. In most recent studies Michailidis et al. (2004) concluded that time do not affect goal scoring while Yiannakos et al.

(2006) examined the total number of goals and Armatas and Yiannakos (2006) examined the set-plays of Euro 2004, both reported that more goals were scored in second half.

From the above it is clear that the relationship of time and goals scored in a course of a match is indistinct. An analysis of these kind would provide useful information to both coaches and sports scientists, as the relationship between goal scoring and time would appear to be linked to those aspects of play which inherently change as match progresses, such as physical conditioning and tactical play (Abt et al., 2002). Thus the purpose of this study was to record the time that the goals were scored in order to conclude the coefficient of dependence.

2. Methods

Subjects:

Sixty four games from each of the three latter World Cups (World Cup 1998 - France, 2002 – Korea/ Japan and 2006 Germany) were studied (n=192). The reason for the selection of this tournament was the participation of top international teams.

Study Design - Instrumentation

The football games were videotaped and digitized with the help of a Sony video SLV-SE 210D, a PC AMD-XP professional 1333 GHz and a television capture board for PC (PCTV, Pinnacle Systems GmbH, Braunschweig, Germany). The study was based on the researcher's personal observation who recorded the time that goals scored. The Sportscout video-analysis program for PC was used for the data recording.

The analysis' variables were: 1) the frequency of goal scoring per 45 minutes (two periods: 1-45+ min, 46-90+ min), 2) the frequency of goal scoring per 15 minutes (six periods: 1-15min, 16-30min, 31-45+ min, 46-60min, 61-75min, 76-90+ min). The observation of the chosen soccer games conducted in the department of Technical and Tactical Analysis in the Laboratory of Sports Performance and Coaching.

Data Analysis

All data were analyzed using the statistical package for PC SPSS 12.0. Chi-square analysis was used to determine the statistically significant differences and the level of significance was set at $p < 0.05$.

3. Results

Figure one exhibits the frequency of goal scoring in World Cup 1998, 2002 and 2006 as this is examined in time-basis of 45 minutes. There is statistically significant difference in World Cup of

1998 and 2002 in goals scored in the second half compared to the ones scored in the first half (W.C. 1998: 60.8 vs. 39.2, $x^2=9.33$, $p<0.05$, W.C. 2002: 59 vs. 41, $x^2=6.48$, $p<0.05$). In the latter World Cup that took place in Germany (2006), the statistical analysis did not showed any significant difference between the two halves (52.5 vs. 47.5, $x^2=0.50$, $p>0.05$).

No statistical differences were found among 1st half times and between 2nd half times of the three World Cups ($p<0.05$).

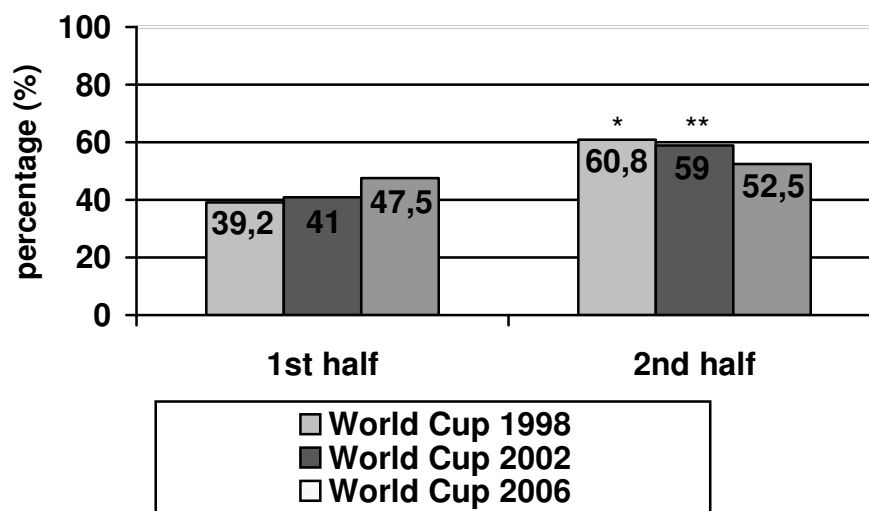


Figure 1: Frequency of goal scoring / 45 min in three World Cups.

As far as the 15-min analysis of the goals in World Cup 1998 presented that the majority of the goals were scored in the last 15-min period (75-90+). Also there was observed a trend of being scored more goals in the last three periods of the game (2nd half). There are statistical differences between the last period and first (25.7 vs. 14, $x^2=4.3$, $p<0.05$), second (25.7 vs. 11.7, $x^2=6.46$, $p<0.05$) and third (25.7 vs. 13.5, $x^2=4.72$, $p<0.05$).

In World Cup 2002 the results of the goal scoring frequency showed that in the three last 15-min periods of the match were scored the majority of the goals. Although there was a trend for more goals scored as time progressed, there was not presented any statistical significant differences between the six periods of time.

Finally, in the latter World Cup in the first three periods was observed similar results. Contrary, in the next two periods there was presented a decrease in goal scoring and in the last period (75-90+) the majority of goals were scored. The statistical analysis showed significant differences between the last period and first (32.8% vs. 15.6%, $x^2=8.06$, $p<0.05$), second (32.8% vs. 16.3%, $x^2=7.34$, $p<0.05$), fourth (32.8% vs. 12.9%, $x^2=11.23$, $p<0.05$) and fifth (32.8% vs. 6.8%, $x^2=21.28$, $p<0.05$).

The statistical analysis showed that there was not a uniform distribution in goals scored ($\chi^2=35.86$, $p<0.01$) and no differences occurred between World Cups ($\chi^2=0.453$, $p>0.05$).

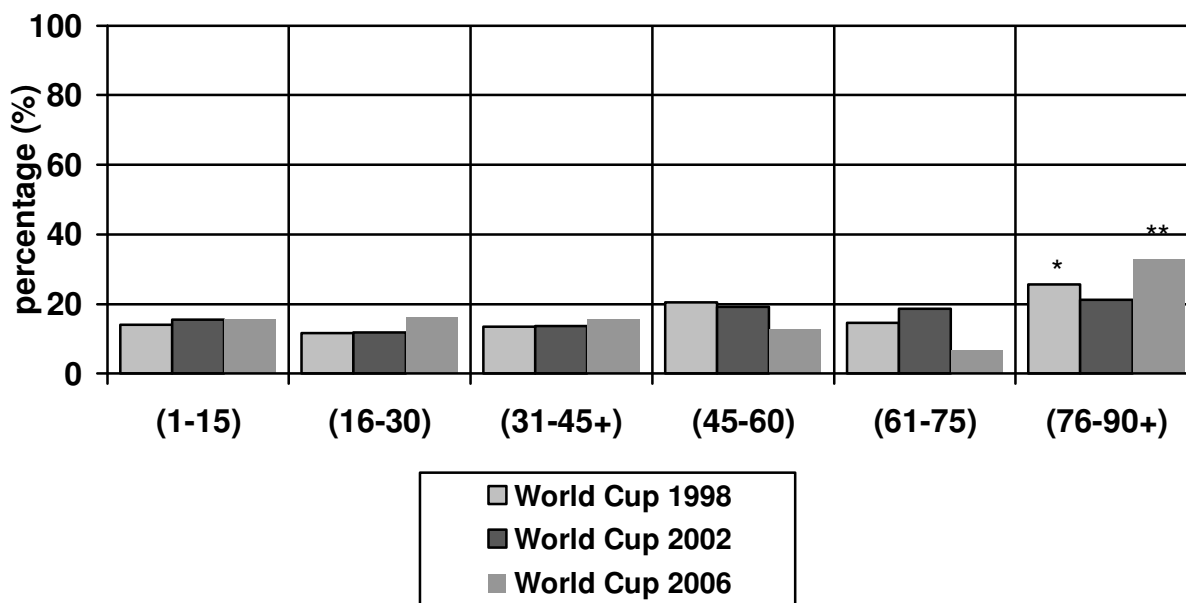


Figure 2: Frequency of goal scoring / 15 min in three World Cups.

4. Discussion

The purpose of this study was to record the time that goals were scored in order to conclude the coefficient of dependence. To succeed the above the three recent World Cups were observed. The results of the present study indicate that more goals are scored as time progresses through soccer matches. In World Cups of 1998, 2002 and 2006 second half presented higher frequency. As far as the 15-min analysis there was presented more goals towards the end of the match. Specifically in World Cups of 1998 and 2006 the last 15-min period of the game presented significant difference to the rest periods. Additionally, there was not presented a significant difference in both analyses (45-min and 15-min) between the three World Cups.

The review of relevant studies that concentrated on the goal scoring in reference to time of accomplishment (per half time or per 15-min) supports that the frequency of goals scored during a match is time dependent, (Saltas & Ladis, 1992; Ridder, Cramer & Hopstaken, 1994; Reilly, 1996; Abt et al., 2002; Bekris, Louvaris, Souglis, Hountis & Siokou, 2005; Sotiropoulos, Mitrotasios & Travlos, 2005; Yiannakos & Armatas, 2006) while others purport that there is no immediate correlation between them (Jinshan, 1986; Michailidis et al., 2004). Many factors are probable responsible for the present's study's results that were mentioned above.

From a purely physiological perspective there is a strong body of knowledge supporting a reduction in physical condition over the course of a match leading to a state of fatigue and reduced physical performance (Saltin, 1973; Bangsbo, 1994). However, it appears that physical condition may not influence goal-scoring ability (Abt et al., 2002). Studies by Zeederberg et al. (1996) and

Abt et al. (1998) have shown that neither carbohydrate depletion nor supplementation appears to influence the performance of game related skills such as shooting. As such, maintenance of shooting ability as a match progresses would further aid attackers in gaining an advantage over defenders.

The appearance of fatigue that mentioned above can be presented easily from diverse factors. Several studies that worked on time-motion analysis of soccer matches have provided evidence that players' ability to perform high intensity exercise is reduced towards the end of games in both elite and sub-elite soccer (Krustrup et al., 2006; Mohr et al., 2004a; Mohr, Krustrup & Bangsbo, 2005; Drust, Reilly & Rienzi, 1998; Van Gool, Van Gerven & Boutmans, 1988). 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 a game (Bangsbo, Nørregaard & Thorsøe, 1991; Bangsbo, 1994; Mohr, Krustrup & Bangsbo, 2003; Reilly & Thomas, 1979). Furthermore, it has been observed that the amount of high-intensity running is reduced in the final 15 min of a top-class soccer game (Mohr et al., 2003) and that jumping, sprinting and intermittent exercise performance is lowered after versus before a soccer game (Mohr, Krustrup, Nybo, Nielsen & Bangsbo, 2004b; Mohr, Krustrup, & Bangsbo, 2005; Rebelo, 1999). In a review of the prolonged run-up, which the Korean team adopted in preparing for the 2002 World Cup Finals, Verheijen (2003) described how initially the team could not keep up the desired pace of the game for the full 90 min. Players made high intensity runs less frequently and fewer explosive actions as the second half progressed. This reduction may indicate the development of fatigue in the second half, although total distance covered appears not to be a perfect indicator of physical performance in a match (Bangsbo, 1994). From the above it is clearly that in second half, and more specifically towards the end of the match, fatigue that player face leads them to make mistakes and as a result are scored more goals. The physiological mechanisms responsible for fatigue appear to change during different periods of a match. Temporary fatigue may be related to disturbed muscle ion homeostasis. Impaired exercise ability in the first few minutes after half-time could be explained by a markedly lowered muscle temperature at the start of the second half. The decrement in the last stage of a game may be caused by a depletion of muscle glycogen in individual fibres, and under thermal stress conditions also dehydration and the concomitant hyperthermia (Mohr et al., 2005).

There are major individual differences in the physical demands of players, in part related to his position in the team (Bangsbo, Mohr & Krustrup, 2006). A number of studies have compared playing positions (Bangsbo, 1994; Bangsbo et al., 1991; Ekblom, 1986; Reilly & Thomas, 1979). In a study of top-class players, Mohr et al. (2003) found that the central defenders covered less overall distance and performed less high-intensity running than players in the other positions, which probably is closely linked to the tactical roles of the central defenders and their lower physical

capacity (Bangsbo, 1994; Mohr et al., 2003). The full-backs covered a considerable distance at a high-intensity and by sprinting, whereas they performed fewer headers and tackles than players in the other playing positions. The attackers covered a distance at a high intensity equal to the full-backs and midfield players, but sprinted more than the midfield players and defenders. The midfield players performed as many tackles and headers as defenders and attackers. They covered a total distance and distance at a high intensity similar to the full-backs and attackers, but sprinted less. Previous studies have shown that midfield players cover a greater distance during a game than full-backs and attackers (Drust et al., 1998; Bangsbo, 1994; Bangsbo et al., 1991; Ekblom, 1986; Reilly & Thomas, 1979). These differences may be explained by the development of the physical demands of fullbacks and attackers, since, in contrast to earlier studies, Mohr et al. (2003) observed that players in all team positions experienced a significant decline in high-intensity running towards the end of the match. This indicates that almost all elite soccer players utilize their physical capacity during a game. Individual differences are not only related to position in the team.

A possible reason for appearance of fatigue temporary during a game but also of fatigue at the end of a match (Mohr et al., 2005) is the faster tempo of the game. Williams, Lee & Reilly (1999) have provided evidence of a faster tempo of the game in the 1997 –1998 season compared with the 1991 – 1992 season, including more movement of the ball and shorter intermissions in play. Changes in the rules, such as the rule prohibiting the goalkeeper from picking up a back-pass, the penalizing of time-wasting and permission to use three substitutes, have contributed to the rise in tempo.

Another possible factor of higher frequency towards the end of a match is the tactic. In the study by Mohr et al. (2003), within each playing position there was a significant variation in the physical demands depending on the tactical role and the physical capacity of the players. As far as the tactical factor concerned Reilly (1996) reports that play may become urgent towards the end of play as teams chase a result. Although, “urgent” game is difficult to quantify, it would appear that the players are more willing to take greater risks towards the end of a match in order to affect an outcome (Abt et al., 2002). It is also possible that the losing team pushes players forward in order to create scoring opportunities, thereby scoring themselves or conceding further goals (Reilly, 1997). Mohr et al. (2003) supported that the reduced amount of high-intensity work at the end of the game was related to the fact that the outcome of the match had been decided.

Factors such as dehydration and hyperthermia may also contribute to the development of fatigue in the later stages of a soccer game (Magal et al., 2003; Reilly, 1997) and influencing goal scoring patterns. Soccer players have been reported to lose up to 3 litres of fluid during games in temperate thermal environments and as much as 4 – 5 litres in a hot and humid environment (Bangsbo, 1994; Reilly, 1997), and it has been observed that 5 and 10m sprint times are slowed by hypo hydration

amounting to 2.7% of body mass (Magal et al., 2003). Moreover, cognitive function is diminished in the hypohydrated state (Reilly & Lewis, 1985), possibly leading to a reduction in decision making ability and/or skill performance. However, in the study by Krstrup et al. (2006) a significant reduction in sprint performance was observed, although the fluid loss of the players was only about 1% of body mass, and no effect on core or muscle temperature was observed in a study with a similar loss of fluid (Mohr et al., 2004b). Also, Hoffman, Stavsky and Falk (1995) reported no decrease in shooting ability during a simulated basketball game, despite fluid losses approaching 2% of body mass. Thus, it would appear that fluid loss is not always an important component in the impaired performance seen towards the end of a game. Finally, icy or waterlogged surfaces are likely to impair all movements, whereas high altitudes or very hot conditions predispose to fatigue in the second half of a match (Reilly, 1994).

Last factor of goal scoring patterns is lapses in concentration of the players. Abt et al. (2002) concluded that higher percentage of scoring before half time and in the final 5 min of the game, are derive from lapses in concentration.

From the above it could be concluded that the higher frequency in goal scoring that is presented in second half and the trend for more goals scored as match progress, emanates from several factors. The players' deterioration in physical condition (appearance of fatigue), managers' tactical choices, fluid balance and lapses in concentration are those factors possible interact with goal scoring patterns and lead to the higher frequency of goals scored towards the end of soccer matches, as seen above. Future research will be directed towards examining questions such as how goal scoring patterns are demonstrated in female soccer games and if goal frequency depends on home advantage. Additionally, useful information could be gained from an examination of the total offensive action, and not only goal scoring, in regard time.

5. References

- Abt, G., Zhou, S. and Weatherby, R. (1998). The effect of high carbohydrate diet on the skill performance of midfield soccer players after intermittent treadmill exercise. *Journal of Science and Medicine in Sport*. 1, 203-212.
- Abt, G.A., Dickson, G. and Mummery, W.K. (2002). Goal scoring patterns over the course of a match: An analysis of the Australian National Soccer League. In *Science and Football IV* (Eds Spinks, W., Reilly, T., Murphy, A.) Routledge London, pp 107-111.
- Armatas, V. and Yiannakos, A. (2006). Record and evaluation of set-plays in European Football Championship in Portugal 2004. *Inquiries in Sport & Physical Education* (electronic), in press.

- Armatas, V., Ampatis, D. and Yiannakos, A. (2005a). Comparison of the effectiveness between counter-attacks and organized offences in Champions League 2002-03. 1^o International Scientific Congress in Soccer, 8-10 April, Trikala, Greece.
- Armatas, V., Yiannakos, A., Ampatis, D. and Sileloglou, P. (2005b). Analysis of the successful counter-attacks in high-standard soccer games. *Inquiries in Sport & Physical Education (electronic)*, 3(2), 187-195.
- Bangsbo, J., Mohr, M. and Krstrup P. (2006). Physical and metabolic demands of training and match-play in the elite football player. *Journal of Sports Sciences*, 24(7): 665 – 674.
- Bangsbo, J. (1994). The physiology of soccer - with special reference to intense intermittent exercise. *Acta Physiologica Scandinavica*, 151 (Suppl. 619), 1-155.
- Bangsbo, J., Nørregaard, L. and Thorsøe, F. (1991). Activity profile of competition soccer. *Canadian Journal of Sports Sciences*, 16, 110 – 116.
- Bekris, E., Louvaris, Z., Souglis, S., Hountis, K. and Siokou, E. (2005). Statistical analysis of the ability of shot in high standard matches. 1^o International Scientific Congress in Soccer, 8-10 April, Trikala, Greece.
- Borrie, A., Jonsson, G. and Magnusson, M. (2002). Temporal pattern analysis and its applicability in sport: an explanation and exemplar data. *Journal of Sports Sciences*, 20, 845-852.
- Drust, B., Reilly, T. and Rienzi E. (1998). A motion-analysis of work-rate profiles of elite international soccer players 2nd Annual Congress of the European College of Sport Science, 20-23 August, Copenhagen, Denmark. In *Journal of Sports Sciences*, 15, 5, p. 460.
- Ekblom, B. (1986). Applied physiology of soccer. *Sports Medicine*, 3, 50 – 60.
- Franks, I.M. (1997). Use of feedback by coaches and players. In *Science and Football III* (edited by T. Reilly, J. Bangsbo and M. Hughes), pp. 267-268. London: E & FN Spon.
- Franks, I.M. and Miller, G. (1986). Eyewitness testimony in sport. *Journal of Sport Behaviour*, 9, 39-45.
- Franks, I.M. and Miller G. (1991). Training coaches to observe and remember. *Journal of Sports Sciences*. 9, 285-297.
- Garganta, J., Maia, J. and Basto, F. (1997). Analysis of goal-scoring patterns in European top level soccer teams. In *Science and Football III* (Eds Reilly, T., Bangsbo, J., Hughes, M.) E. & F. Spon, London, pp. 246-250.
- Hoffman, R., Stavsky, H. and Falk, B. (1995). The effect of water restriction on anaerobic power and vertical jumping height in basketball players. *International Journal of Sports Medicine*. 16, 214-218.

- Jinshan, X., Xiakone, C., Yamanaka, K. and Matsumoto, M. (1993) Analysis of the goals in the 14th World Cup. In *Science and Football II* (Eds Reilly, T., Clarys, J., Stibbe, A.) E. & F. Spon, London, pp. 203-205.
- Jinshan, X. (1986). The analysis of the techniques, tactics and scoring situations of the 13th World Cup. *Sandong Sports Science and Technique* (April), 89-91.
- Krustrup, P., Mohr, M., Steensberg, A., Bencke, J., Kjøer, M. and Bangsbo, J. (2006). Muscle and blood metabolites during a soccer game: Implications for sprint performance. *Medicine and Science in Sports and Exercise*, 38(6), 1 – 10.
- Liebermann, D.G., Katz, L., Hughes, M.D., Bartlett, R.M., McClements, J. and Franks, I.M. (2002). Advances in the application of information technology to sport performance. *Journal of Sports Sciences*, 20, 755-769.
- Magal, M., Webster, M. J., Sistrunk, L. E., Whitehead, M. T., Evans, R. K. and Boyd, J. C. (2003). Comparison of glycerol and water hydration regimens on tennis-related performance. *Medicine and Science in Sports and Exercise*, 35, 150 – 156.
- Michailidis, C., Michailidis, I., Papaiakevou, G. and Papaiakevou, I. (2004). Analysis and evaluation of way and place that goals were achieved during the European Champions League of Football 2002-2003. *Sports Organization*, 2(1), 48-54.
- Mohr, M., Krustrup, P. and Bangsbo, J. (2005). Fatigue in soccer: A brief review. *Journal of Sports Sciences*, 23, 593 – 599.
- Mohr, M., Krustrup, P., Nybo, L., Nielsen, J. J. and Bangsbo, J. (2004b). Muscle temperature and sprint performance during soccer matches – beneficial effects of re-warm-up at half time. *Scandinavian Journal of Medicine and Science in Sports*, 14, 156 – 162.
- Mohr, M., Nordsborg, N., Nielsen, J. J., Pedersen, L. D., Fischer, C., Krustrup, P. et al. (2004a). Potassium kinetics in human interstitium during repeated intense exercise in relation to fatigue. *Pflugers Archive*, 448, 452 – 456. In Bangsbo, J., Mohr, M. and Krustrup P. (2006). Physical and metabolic demands of training and match-play in the elite football player. *Journal of Sports Sciences*, 24(7): 665 – 674.
- Mohr, M., Krustrup, P. and Bangsbo, J. (2003). Match performance of high-standard soccer players with special reference to development of fatigue. *Journal of Sports Sciences*, 2003, 21, 519–528.
- Olsen, E. (1988). An analysis of goal scoring strategies in the World Championship in Mexico 1986. In *Science and Football*, (Eds Reilly, T., Lees, A., Davids, K., Murphy, W.J.) E. & F. Spon, London, pp. 373-376.
- Rebelo, A. N. C. (1999). Studies of fatigue in soccer. PhD thesis, University of Porto, Porto, Portugal.

- Reilly, T. (1997). Energetics of high intensity exercise (soccer) with particular reference to fatigue. *Journal of Sports Sciences*, 15, 257-263.
- Reilly, T. (1996). Motion analysis and physiological demands. In *Science and Football III* (Eds Reilly, T., Bangsbo, J., Hughes, M.) E. & F. Spon, London, pp. 65-81.
- Reilly, T. (1994). Motion characteristics. In *Football (Soccer)* (edited by B. Ekblom), pp. 31- 42. Oxford: Blackwell Scientific .
- Reilly, T. and Lewis, W. (1985). Effects of carbohydrate feeding on mental functions during sustained exercise. In *Ergonomics International 85* (eds I.D. Brown, R. Goldsmith, K. Coomers, M.A. Sinclair). Taylor and Francis, London, pp. 700-702.
- Reilly, T. and Thomas, V. (1979). Estimated energy expenditures of professional association footballers. *Ergonomics*, 22, 541 – 548.
- Ridder, G., Cramer, S. and Hopstaken, P. (1994). Down to ten: estimating the effect of a red card in soccer. *Journal of the American Statistical Association*, 89, 1124-1127.
- Saltas, P. and Ladis, S. (1992). Soccer and study in shots. Thessaloniki, Greece.
- Saltin, B. (1973). Metabolic fundamentals in exercise. *Medicine and Science in Sports*, 5, 137-146.
- Sotiropoulos, A., Mitrotasios, M. and Traulos, A. (2005). Comparison in goal scoring patterns between Greek professional and amateur teams. 1^o International Scientific Congress in Soccer, 8-10 April, Trikala, Greece.
- Van Gool, D., Van Gerven, D. and Boutmans, J. (1988). The physiological load imposed on soccer players during real matchplay. In T. Reilly, A. Lees, K. Davids, & W. J. Murphy (Eds.), *Science and Football* (pp. 51 – 59). London/New York: E & F.N. Spon.
- Verheijen, R. (2003). Periodisation in football: Preparing the Korean national team for the 2002 World Cup. *Insight: The FA Coaches Association Journal*, 6(2), 30 – 33.
- Williams A. M., Lee, D. and Reilly, T. (1999). A quantitative analysis of matches played in the 1991 – 92 and 1997 – 98 seasons. London: The Football Association.
- Yiannakos, A. and Armatas, V. (2006). Evaluation of the goal scoring patterns in European Championship in Portugal 2004. *International Journal of Performance Analysis in Sport* (electronic), 6(1), 178-188.
- Zeederberg, C., Leach, L., Lambert, V., Noakes, D., Dennis, C. and Hawley, A. (1996). The effect of carbohydrate ingestion on the motor skill proficiency of soccer players. *International Journal of Sport Nutrition*, 6, 348-355.