Journal of Physical Education and Sport ® (JPES), 11(3), Art 43, pp.277 - 283, 2011
online ISSN: 2247 - 806X; p-ISSN: 2247 – 8051; ISSN - L = 2247 - 8051 © JPES

Original Article

Algerian professional soccer specific aerobic endurance during competitive period

DADI ABDELAZIZ
Department of Physical Education, University of Mentouri Constantine, Algeria

Published online:: September 25, 2011
(Accepted for publication Jully 18 2011)

Abstract
The aim of the current study was to assess the cardio-respiratory profile (VO_2 max) of Algerian soccer players during competitive season, and secondly, to assess the effects of a close season training plan on end- season levels of fitness.
Materials and Methods: seventeen soccer players were tested at (03) Three different time points throughout the competitive soccer season participated in the study, of which 17 second division forwards with an average age of 22.86 ± 2.56 years; height 180, 82 ± 3.68 cm; weight 80,20 ± 3,17 kg; body mass index 24,52± 0,40 kg/m^2. To evaluate the VO_2 max of players, the 20-m Multi Stage Shuttle Run Test (MST) protocol was used as recommended by (Leger et al., 1988).
Results: of the total sample (n=17) with a general (range 45.00~66.85 ml/kg/min). A statistically significant differences between the $VO_{2\ max}$ was assessed by MST method at the mid-season was significantly lower at the start of season period and at the end-season (51.49±4.77 vs. 54.43±5.38, 57.21±5.83 respectively; $p<0.05$; values are mean ± SD) as shown in the summary.
Conclusion: Show that the Algerian second division football players tested have a normal VO_2 max at the beginning of the preseason in comparison with the findings of other studies of international soccer players. It is possible to increase the performance of professional soccer players after the competitive period of 15 weeks duration.
Key Words: Soccer, competitive season, Aerobic Endurance.

Introduction

The nineteenth edition of the FIFA World Cup in South Africa, organized under the auspices of FIFA. With nearly three billion television viewers in total audience and about 73 000 hours of broadcast in 214 countries, at a rate of sixty-four match, the Paris is the most publicized event on the planet. It is also a financial bonanza for FIFA. In other words, Professional soccer is big business nowadays. Between the broadcasting rights, advertising contracts, ticket sales and partnerships with companies like Coca-Cola or McDonald's, it hopes to garner nearly three billion euro's in total revenue, part of which is for players under form of grants for multiple zeros, and clubs, Equipment manufacturers provide everything needed for the physical preparation of soccer players, the most important.

Physiological, technical, and strategic skills are all important to soccer performance. Factors such as acceleration (Hoff and al, 2002), running velocity, jumping height, and capacity to release energy are of major importance. Because of the length of a soccer match, at least 90% of the energy release must be aerobic (Bangsbo. 1994); during a 90 minute match, players run about 10 km (Bangsbo. 1991; Helgerud, 2001) at intensity close to anaerobic threshold or 80–90% of maximal heart rate. (Bangsbo. 1994; Helgerud, 2001; Reilly and Ball, 1984)

Soccer is considered a high-intensity intermittent activity (Esposito et al., 2004; Rienzi et al., 2000). is characterized by short-duration high-speed runs, jumps (Coledam et al, 2010), headings and ball disputes, besides other activities, such as trots, low-speed running and walks (Coelho et al 2010), tackling, jumping and other quick movements during heading, defence and offence duelling actions have to be taken into account. (Shephard, 1999) Because of the very short duration and high intensity of decisive game phases, the ability to produce fast muscle contractions might be a performance-limiting factor. „Therefore, when trying to identify possible genetic factors associated with elite soccer performance, it would be interesting to assess the possible role of candidate genes with a documented influence on the ability of muscles to generate fast contractions". (Santiago and al, 2007)

In addition, the intensity to which the soccer professional player is subjected during a soccer match has been reported from different parameters; for instance, the average distance covers about 8000–12 000 m during a 90-min match. (Bangsbo and al. 1991; Withers and al, 1982), (10 km) (Shephard, 1992; Silva et al., 2008).A

Correspondence: Dadi Abdelaziz Email: a.dadi@yahoo.fr

large amount of this distance corresponds to walking or ‘‘easy’’ running, (Bangsbo and al. 1991; Tumilty and al, 1993) and up to 20% corresponds to maximal or near maximal running velocity hat is, during the decisive phases of games. (Bangsbo and al. 1991; Reilly and al, 1976; Tumilty and al, 1993; Kirkendall, 1985), percent of oxygen uptake (75%VO2max), lactate concentration (12mM), body temperature, average running speed (7,5 km/h) and maximal heart rate percent (%HRmax) (85%HRmax) (Bangsbo,1994a; Coelho et al 2010). Among all possible factors used to determine intensity, the heart rate (HR) presents itself as the most feasible and practical variable to determine the production of aerobic energy (Achten and Jeukendrup, 2003). This is imputable to the linear relationship between HR and oxygen uptake (VO2) (Coelho et al 2010).

A current study showed that increasing VO_2 max by 11% increased match intensity by 5% and distance covered in a match by 1800 m. (Helgerud, 2001). The third variable that influences a player’s aerobic endurance performance is running economy. Hoff et al, 2002) estimated that an improvement in running economy by 5% would increase the distance covered in a match by about 1000 m (Chamari et al, 2004).

Previous studies (McMillan and al, 2005) mention the mean VO_2 max of elite soccer players is normally reported to be between 55 and 68 ml kg21 min21. (Astrand and Rodahl, 1986; Williams and al, 1973; Wisløff and al, 1998). In original study realized in Algeria, that players should have $VO_{2\ max}$ values superior to 60.10 ml·kg-1·min-1 obtained by the MST method (Dadi and Ababsa, 2011). These moderate to high values are similar to those found in other team sports, (Ekblom, 1986) but are substantially lower than elite endurance performers where values close to 90 ml kg21 min21 have been found. (Hoff and al, 2004) Individual values higher than 70 ml kg21min21 for modern soccer players have been recently reported. (Helgerud and al, 2001; Hoff and al, 2004; Wisløff and al, 1998)

In Algeria, the soccer season over 10 months of the years, 2 months (Aout - Sep) for PRE I, first preconditioning period and 8 months (Oct - Mai) for the competitive period, SS, start of season (15 week and 15 Match), MS, mid-season (02 week), and the ES, end-season (15 week and 15 Match) .It is essential in the design of physical conditioning plans designed both to enable players to cope with the physiological demands and technical excellence required in a single game and to maintain an optimal level of fitness over the season.

Currently, (Heller et al, 1992) suggested optimal fitness may not be maintained over the season, although. A few studies have focused on change in fitness levels over a competitive season. Of these, the findings are equivocal with (Bangsbo, 1994) and (Reilly and Thomas, 1980) indicating fitness levels are maintained over season

Methods

Subjects

Seventeen soccer players from the second division Algerian professional soccer were evaluated in 03 three different time points throughout the competitive soccer season participated in the study, and provided written informed consent in accordance with the Declaration of Helsinki. The university ethics committee approved the study protocol. The subjects could withdraw from the study at any time. Their physical characteristics were as follows (mean ± SD): Age of 22.86 ± 2.56 years; height 180, 82 ± 3.68 cm; weight 80,20 ± 3,17 kg; body mass index 24,52± 0,40 kg/m^2. Subjects were invited to participate. Of the 22 local second division teams invited 17 accepted to participate in the evaluations, whose names are not provided to protect anonymity of the sports institutions. Players received information before participating in the tests, which were part of the medical evaluations planned by the medical staff of each team. (This investigation benefited the sports institutions since they were provided with the reports including evaluation results). Researchers were authorized by the clubs to use the data to write scientific articles.

Table 1. Age and physical characteristics of the Algerian soccer players.

N	Age (years)	Height (cm)	Weight (kg)	Bmi (kg· m$^{2)}$
17	22.86 ± 2,.58	180.82 ± 3,68	80.2 ± 3,17	24.52 ± 0,40

n = Number of subjects (Values are presented as means ± SD).

Procedure

Subjects start running back and forth on a 20-m course and must touch the 20-m line at an initial speed of 8.5 km/hr which gets progressively faster (0.5 km/hr. every minute), in accordance with a pace dictated by a sound signal on an audio tape. Several shuttle runs make up each stage; each stage is of one-minute duration. As the test proceeds, the number of shuttle runs (laps) increases in each stage and subjects are instructed to keep pace with the signal for as long as possible. When the subject can no longer follow the pace, the last stage announced is used to predict maximal oxygen uptake using the equation of (Leger et al., 1988) which is

$Y = 31.025 + 3.238\ X - 3.248A + 0.1536AX$

Where,
Y= VO_2 max (ml/kg/min)
X= Maximal shuttle run speed (km/hr.)
A= Age (yr.).

All participants were subject to the protocol at their maximum effort until attaining VO_2 max, which was determined by the 20-m Multi Stage Shuttle Run Test method. (MST method)

Testing procedure

Testing took place at three points during the competitive period year; (T1) at the first start of season (SS), (T2) mid-season (MS), and (T3) last end-season (ES). A schematic figure of the periodized year can be found in Figure 1.

Figure 1. **A schematic representation of the period competitive of the Algeria soccer player's, as well as the testing points (T1-T3) is presented.**

Month	***Oct***	***Nov***	***Dec***	***Jan***	***Fev***	***Mar***	***Avr***	***Mai***
N° Match	04	04	04	03	03	04	04	04
Competitive period	SS **15 week**			MS **02 week**	ES **15 week**			
Test			**T1**	**T2**				**T3**

SS, start of season, MS, mid-season, ES, end-season

Statistical analysis

The SPSS (15.0 for Windows) was used for all statistical analyses. Descriptive data for subject characteristics and experimental variables was calculated as mean ± SD. A probability level less than 0.05 was accepted as statistically significant. Tukey's HSD is a post hoc test, meaning a follow‐up that is done after an ANOVA in order was used to determine if there were significant differences in VO_2 max in the SS, MS and ES.

Results

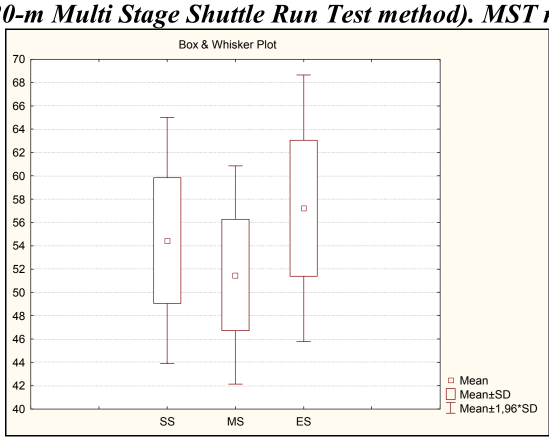
Distribution of frequency histograms of *VO_2 max* are shown in fig. 2. Normality of distribution of other series was proved (at standard level). Determined variables achieved in soccer are given in Table 2.

Table 2. Averages and standard deviations (SD) maximal oxygen consumption

	N	Min	Max	Average (ml/kg/min)	ANOVA Chi Square	p
SS *VO_2 max*	17	45.96	64.43	54.43±5.38		
MS *VO_2 max*	17	45.00	61.77	51.49±4.77	30.117	0.000
ES *VO_2 max*	17	46.93	66.85	57.21±5.83		

SS, start of season, MS, mid-season, ES, end-season

Figure 2. Plotting of difference between VO_2 max values against their means *(The 20-m Multi Stage Shuttle Run Test method). MST method*



The table.2 above shows the results of the total sample (n=17) with a average of 54.43±5.38 ml/kg/min (range 45.96~64.43 ml/kg/min) in the start of season, in which Second test with a average of 51.49±4.77

ml/kg/min (range 45.00~61.77 ml/kg/min) in the mid-season, in which third test with a average of 57.21±5.83 ml/kg/min (range 46.93~66.85 ml/kg/min) in the end-season.

The Tukey's HSD indicates that the difference between the SS$VO_2\,max$, MS$VO_2\,max$ and ES$VO_2\,max$ is significant. Notice that each possible comparison of two conditions (called a pair wise comparison) is done using the Tukey's. This result would be reported in APA format immediately after reporting the results of the ANOVA:

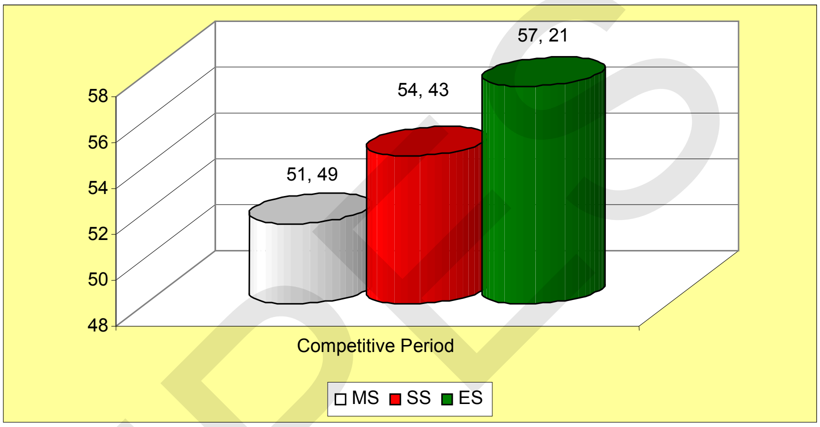
Tabl.3 Tukey's HSD comparisons in $VO_{2\,max}$ obtained by 20-m MST (Competitive period)

Tukey HSD test; Homogenous Group, alpha=0.05 .Within MS=2.627, DF =30.117

Cell N°.	R1	DV-1Mean	1	2	3
2	MS	51.49	***		
1	SS	54.43		***	
3	ES	57.21			***

Abbreviations SS, start of season; MS, mid-season; ES, end-season. $VO_{2\,max}$. [1] Statistically significant at $p < 0.05$ for SS *vs.* MS; [2] Statistically significant at $p < 0.05$ for SS *vs.* ES; [3] Statistically significant at $p < 0.05$ for MS *vs.* ES;

Figure. 3. The differences in $VO_{2\,max}$ between measurements performed during the Competitive period



A one - way between subjects ANOVA showed a significant difference among the three measurement performed in test scores, $F(2, 62) = 30.117$, $p < 0.05$. Tukey's HSD comparisons indicated a significant difference between the $VO_{2\,max}$ was assessed by MST method at the mid-season was significantly lower at the start of season period and at the end-season (51.49±4.77 vs. 54.43±5.38, 57.21±5.83 respectively; $p<0.05$; values are mean ± SD) as shown in the summary table.3

Discussion

As the Algerian third division soccer season over 10 months of the years, 2 months (Aout - Sep) for PRE I, first preconditioning period and 8 months (Oct - Mai) for the competitive period, SS, start of season (15 weeks and 15 Match), MS, mid-season (02 weeks), and the ES, end-season (15 weeks and 15 Match) . As observed above, average $VO_{2\,max}$ of Algerian players during the competitive period in general (range 45.00~66.85 ml/kg/min) agrees with the figures expected for high level football players according to what has been proposed by (Dadi and Ababsa, 2011), (Moreira 2008) and (Vänttinen et al. 2010). Regarding the average $VO_{2\,max}$ for the soccer obtained, it behaves very similarly to what has been reported by (Silvestre et al. 2006).

For high level, that players should have $VO_{2\,max}$ values superior to 66.85 ml·kg-1·min-1 obtained by the MST method in this study, the reference values obtained from laboratories in peer-reviewed articles appear to range between 55 – 70 ml· kg · min. (Bangsbo et al., 1991; Casajús, 2001; Kemi et al., 2003; Stolen et al., 2005), with some individual values reported as superior to 73 ml· kg min (Silva et al., 1999). Also, direct $VO_{2\,max}$ measurements from match-play have been measured although the method is limited due to the inhibition of full involvement in soccer performance due to the restrictions from the equipment needed (Kawakami et al., 1992; Reilly, 1997). Therefore, it is suggested that players should have $VO_{2\,max}$ values superior to 60 ml·kg-1·min-1 in order to be competitive at the highest levels in soccer (Reilly et al., 2000).

The exercise pattern of soccer can be described as dynamic, random and intermittent (Bloomfield et al., 2007) to an extent which makes physical conditioning of players a complex process. This pattern involves a myriad of physiological processes which act in random sequences throughout match-play and this provides a huge challenge for coaches to condition players for the specific requirements of the game. However, it has been established that in order to advance in playing level, players must develop.

Their aerobic capacity to tolerate the physiological load at higher levels of play (Da Silva et al. 2008, Helgerud et al., 2001; Stolen et al. 2005; Wisloff et al., 1998). The total mean distance covered by the top-level players during match-play has been reported to be between approximately 10,000m to 13,500m with distinct differences observed between each playing position (Bangsbo et al., 2006; Barros et al., 2007; Di Salvo et al., 2007). (Da Silva et al. 2008) state that an adequate level of oxygen consumption permits the performance of endurance activities with a higher level of effort or a faster pace, To establish a profile of the aerobic capacity of soccer players, it is critical to consider many different independent factors which include chronological age, biological maturity, training age, morphology and anthropometry as well as preferred playing position. In order to establish normative data, profiles should be categorized against a range of levels of performance, as it appears that higher performance levels require higher physical and physiological demands (Rienzi et al., 2000).

However, (Reilly 1997) mentions that another important aspect is the upper limit at which an individual can maintain an exercise continuously. This limit is influenced by the anaerobic threshold and the frequent fractional utilization of $VO_{2\ max}$. Reilly also claims that oxygen consumption in football is equivalent to 75% of $VO_{2\ max}$, a value probably close to the anaerobic threshold in high level football players. The foregoing suggests the importance of conducting more research in order to determine Algerian soccer players' endurance to work close to or above their anaerobic threshold.

As detailed in Table **2** and after analyzing the results obtained, statistically significant differences were found between the competitive period (SS, start of season, MS, mid-season, ES, end-season). In comparison to ES, end of season, the work intensity corresponding to a $VO_{2\ max}$ (57.21±5.83) of was significantly higher in SS start of season (54.43±5.38) and MS, mid-season (51.49±4.77).The foregoing can be explained according to what has been indicated by (Heller et al, 1992) suggested optimal fitness may not be maintained over the season, although a Few studies have focused on change in fitness levels over a competitive season. Of these, the findings are equivocal with (Bangsbo, 1994) and (Reilly and Thomas, 1980) indicating fitness levels are maintained over season. Determining $VO_{2\ max}$ of soccer players is therefore useful when assessing talent, in selection of players, in the design of physical conditioning plans, predicting and monitoring physical match performance. (Castinheiras neto et al. 2009) state about the determinant factors of its magnitude and duration of oxygen consumption Resistance training influenced by factors related to the design methodology of the studies (resting metabolic rate RMR way of measuring the period of observation and the excess post-exercise oxygen consumption EPOC). Therefore, establishing reference parameters in high performance can assist in making important informed decisions, particularly for the strength & conditioning staff at soccer clubs and National teams to manipulate physical training to optimize the regimes.

Conclusions

In general, in this study results show that the Algerian third division football players tested have a normal $VO_{2\ max}$ in comparison with the findings of other studies of international soccer players. However, it is recommended that this type of analysis be extended beyond the competitive period in order to observe whether this indicator is improved during any competition according to the specific demands of each levels of competition.

Finally, the differences observed between three periods (SS, MS, and ES) at the competitive period necessitate the modification of training plans. It was obvious that team not could the emphasis on general aerobic capacity training with the soccer season. The modified Shuttle Run test is especially in evaluating the changes in aerobic capacity of soccer players.

Future studies should attempt to examine training loads simultaneously with monitoring in deference tests period, utilizing a larger sample size and comparison in difference soccer post. It is suggested that sport-specific tests may be better indicators of performance related measures. A modern battery of football specific tests should be developed to enable accurate evaluation of the players' abilities, in addition to overall performance evaluation.

References

Achten, J.; Jeukendrup, A. E. (2003) Heart rate monitoring: applications and limitations. Sports Medicine, v. 33, n. 7, p. 517-538.

Astrand, P.Ø., Rodahl, K. (1986). Textbook of work physiology. New York: McGraw- Hill.

Bangsbo, J. (1994).Energy demands in competitive soccer. J Sports Sci; 12(special no):S5–12.

Bangsbo, J.(1994a) The physiology of soccer, with special reference to intense intermittent exercise. Acta Physiologica Scandinavica, V. 619. P. 1-151.

Bangsbo, J., Mohr, M., Krustrup, P. (2006). Physical and metabolic demands of training and match play in the elite football player. Journal Sports Science; 24 (7), 665–674.

Bangsbo, J., Nørregaard, L., Thorsøe, F. (1991). Activity profile of competition soccer. Can J Sport Sci; 16:110–16.
Barros, R.M.L., Misuta, M.S., Menezes, R.P., Figueroa, P.J., Moura, F.A., Cunha, S.A., Anido, R., Leite, N.J. (2007). Analysis of the distances covered by First Division Brazilian soccer players obtained with an automatic tracking method. Journal of Sports Science and Medicine; 6, 233-242.
Bloomfield, J., Polman, R., O'Donoghue, P. (2007). Physical demands of different positions in FA Premier League soccer. Journal of Sports Science and Medicine 6, 63-70.
Casajús, J. A. (2001). Seasonal variation in fitness variables in professional soccer players. Journal of Sports Medicine and Physical Fitness; 41, 463-469.
Castinheiras Neto, A. G.; Farinatti, P. T. V. Oxygen consumption after resisted exercise: a critical approach about the determinant factors of its magnitude and duration. Brazilian Journal Biomotricity, v. 3, n. 2, p. 96-110, 2009.
Chamari, K., Hachana, Y., Ahmed, Y. B., et al. (2004). Field and laboratory testing in young elite soccer players. Br J Sports Med; 38: 191-196
Coelho, D. B.; Coelho, L. G.; Mortimer, L. A.; Condessa, L. A.; Ferreira-Junior, J. B.; Borba, D. A.; Oliveira, B. M.; Bouzas-Marins, J. C.; Soares, D. D.; Silami-Garcia, E. (2010) Energy expenditure estimation during official soccer matches. Brazilian Journal of Biomotricity, v. 4, n. 4, p. 246-255.
Coledam, D. H. C.; Santos, D.; Dos-Santos, J. W. (2010) Change on vertical jump after competitive period in professional's soccer players. Brazilian Journal of Biomotricity, v. 4, n. 2, p. 140-147.
Da Silva, C. D., Jonathan, B., João, C.B.M. (2008). A review of stature, body mass and maximal oxygen uptake profiles of U17, U20 and first division players in Brazilian soccer. Journal of Sports Science and Medicine; 7, 309-319
Dadi, A., Ababsa, N. (2011). Determination of maximal oxygen consumption of Algerian soccer players during preseason, Journal of Physical Education and Sport, 11(1), pp. 75-80.
Di Salvo, V., Baron, R., Tschan, H., Calderon Montero, F.J., Bachl, N., Pigozzi, F. (2007). Performance characteristics according to playing position in elite soccer. International Journal of Sports Medicine; 28, 222-227.
Ekblom, B. (1986). Applied physiology of soccer. Sports Med; 3:50–60.
Esposito, F.; Impellizzeri, F. M.; Margonato, V.; Vanni, R.; Pizzini, G.; Veicsteinas, A.(2004) Validity of heart rate as an indicator of aerobic demand during soccer activities in amateur soccer players. European Journal of Applied Physiology, v. 93, p.167-172.
Helgerud, J., Engen, LC., Wisløff, U., et al. (2001). Aerobic endurance training improves soccer performance. Med Sci Sports Exerc; 33:1925–31.
Heller,J., Prochazka, L., Bunc, V.,Dlouha, R and Novontny, J. (1992) Functional capacity in top league Football players during the Competitive period , Journal of Sports Sciences, 10, 150.
Hoff, J., Helgerud, J. (2004). Endurance and strength training for soccer players. Physiological considerations. Sports Med; 34:165–80.
Hoff, J., Wisløff, U., Engen, L C., et al. (2002). Soccer specific aerobic endurance training. Br J Sports Med; 36: 218-221
Kawakami, Y., Nozaki, D., Matsuo, A. and Fukunaga, T. (1992). Reliability of measurement of oxygen uptake by a portable telemetric system. European Journal of Applied Physiology; 65 (5), 409-414.
Kemi, O.J., Hoff, J., Engen, L.C., Helgerud, J. and Wisløff, U. (2003). Soccer specific testing of maximal oxygen uptake. Journal of Sports Medicine and Physical Fitness; 43, 139-144.
Kirkendall, DT. (1985).The applied sport science of soccer. Phys Sports med; 13:53–9.
Leger, L. A., & Gadoury, C. (1989). Validity of the 20 m shuttle run test with 1 minute stages to predict VO_2 max in adults. Canadian Journal of Sports Sciences; 14 (1), 21-6.
Leger, L. A., Mercier, D., Gadoury, C., & Lambert, J. (1988). The multi stage 20 m shuttle run test for aerobic fitness. Journal of Sports Sciences; 6 (2), 93-101.
McMillan, K., Helgerud, J., Macdonald, R., et al. (2005). Physiological adaptations to soccer specific endurance training in professional youth soccer players. Br J Sports Med; 39: 273-277
Moreira, S. B. (2008). The evolution of the individual factors performance in the elite of the world soccer, between 1970 and 1998. Fitness and Performance Journal; 7(2), 107-111.
Reilly, T. (1997). Energetic of high-intensity exercise (soccer) with particular reference to fatigue. Journal of Sports Sciences; 15, 257-263.
Reilly, T. and .Tomas, V. (1980). The stability of fitness Factors over a season of professional soccer as indicated by serial Factor analysis, in Kinanthopometry 11 (eds M, Ostyn, G.Beunen and J.Simons). University Park Press, Baltmore, pp. 247-257.
Reilly, T., Ball, D. (1984). The net physiological cost of dribbling a soccer ball. Res Q Exerc Sport; 55:267–71.
Reilly, T., Bangsbo, J. and Franks, A. (2000). Anthropometric and physiological predispositions for elite soccer. Journal of Sports Sciences; 18 (9), 669-683.

Reilly, T., Thomas, V. (1976). A motion analysis of work-rate in different positional roles in professional football match- play. J Human Mov Stud; 2:87–97.
Rienzi, E., Drust, B., Reilly, T., Carter, J.E.L. and Martin, A. (2000). Investigation of anthropometric and work-rate profiles of elite South American international soccer players. Journal of Sports Medicine and Physical Fitness 40(2), 162-169.
Santiago, C., González- Freire, M., Serratosa, L., et al. (2008). ACTN3 genotype in professional soccer players.Br J Sports Med; 42: 71-73 originally published online June 5, 2007
Shephard, R. J. (1992) The energy needs of the soccer player. Clinical Journal of Sport Medicine, v. 2, n. 1, p. 62-70.
Shephard, RJ. (1999). Biology and medicine of soccer: an update. J Sports Sci; 17:757–86.
Silva, A. I.; Fenandes, L. C.; Fernandez, R. (2008) Energy expenditure and intensity of physical activity in soccer referees during match-play. Journal of Sports Science and Medicine, v. 7, p. 327-334.
Silvestre, R., West, C., Maresh, C., Kraemer, W. (2006). Body composition and physical performance in men's soccer: a study of a national collegiate athletic association division I team. Journal of Strength and Conditioning Research. 20 (1), 177-183.
Stolen, T., Chamari, K., Castagna, C., Wisløff, U. (2005). Physiology of soccer: An update. Sports Medicine; 35(6), 501-536.
Tumilty, D. (1993). Physiological characteristics of elite soccer players. Sports Med; 16:80–96.
Vänttinen, T., Minna, B., Keijo H. (2010). Development of body composition, hormone profile, physical fitness, general perceptual motor skills, soccer skills and on-the-ball performance in soccer specific laboratory test among adolescent soccer players Journal of Sports Science and Medicine; 9, 547-556
Williams, C., Reid, R.M., Couttes, R., (1973). Observation on the aerobic power of university rugby players and professional soccer players. Br J Sports Med; 7:390–1.
Wisløff U, Helgerud J, Hoff J. (1998). Strength and endurance of elite soccer players. Med Sci Sports Exerc; 30:462–467.
Withers, RT., Maricic, Z., Wasilewski, S., et al. (1982). Match analyses of Australian professional soccer players. J Human Mov Stud; 8:159–76.