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Review Article

Determination of maximal oxygen consumption of algerian soccer players during preseason

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Abstract:
The aim of this study was to assess the cardio-respiratory profile (VO_2 max) of Algerian soccer players during preseason and compare VO_2 max by competition level. **Materials and Methods**.- A total of 45 Algerian soccer players participated in the study, of which 22 were second division, 23 third division forwards with an average age of 23.13 ± 2.46 years; height 180, 67 ± 3, 54 cm; weight 80,35 ± 3,25 kg; body mass index 24,61± 0,38 kg/m^2. In order 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=45) with a general average of 57,38 ± 1,83 ml/kg/min, in which Second division sample (n=22) with a average of 58,28 ± 1,35 ml/kg/min had the highest VO_2 max and third division sample (n=23) with a average of 56,53 ± 1,84 ml/kg/min. a statistically significant differences were found (P<0.05) between competition level. **Conclusion**: Results 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.

Key Words: Soccer, Competitions' Level, Aerobic Endurance, Sports Performance.

Introduction

Algerian football is currently preparing for the transition to professionalism that requires more materials and human resources for the training of top level players on a scientific basis of preparation, Top performance in athlete's results from a complex combination of diverse factors. It is very likely that the most important aspect when determining an athlete's potential is the genetic constitute. Another aspect that also has a strong effect on performance is the quantity and appropriateness of training prior to competition (MacDougall, Wenger, and Green, 1995). Physiological, technical, and strategic skills are all important to soccer performance. Factors such as acceleration (Hoff et 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 involves physical efforts of intermittent nature. An average professional player covers about 8000–12 000 m during a 90-min match. (Bangsbo etet al.., 1991; Withers et al., 1982) A large amount of this distance corresponds to walking or ''easy'' running, (Bangsbo etet al.., 1991; Tumilty et al., 1993) and up to 20% corresponds to maximal or near maximal running velocity hat is, during the decisive phases of games. (Bangsbo et al., 1991; Reilly et al., 1976; Tumilty et al., 1993; Kirkendall, 1985) In addition, jumping, tackling 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, identification of genetic factors related to the performance of soccer, show the possible role of such factors and influence on the ability of the muscles.(Santiago et al,2008).
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 variable that influences a soccer 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). Taking into consideration aerobic endurance performance is dependent on three important elements: maximal oxygen uptake (VO_2 max), anaerobic threshold, and work economy. VO_2 max is defined by Wilmore and Costill (2007) as the highest oxygen intake attained while doing maximal and exhausting exercises, this limit (VO_2 max) determines

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the intensity of the effort or the pace the exercise can have. These authors clarify that the individual can continue exercising only for a short amount of time after attaining VO_2 max, using up the anaerobic reserves, which, however, also have a limited capacity. (Hoff et al., 2002).
Previous studies (Bangsbo et al.. 1991; Withers et al., 1982; Wisløff et al., 1998) have shown a significant relation between VO_2 max and distance covered during a match, and a rank order correlation between VO_2 max and placement in the league of the best teams in Hungary has been shown. These findings are supported by Wisløff et al, who have shown a substantial difference in VO_2 max in members of the top team compared with those in the lowest placed team in the Norwegian elite league. McMillan et al. (2005) mentions 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 et al., 1973; Wisløff et al., 1998). 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 et al., 2004) Individual values higher than 70 ml kg21min21 for modern soccer players have been recently reported. (Helgerud et al., 2001; Hoff et al., 2004; Wisløff et al., 1998). It is evident that physical aspects are not the only key factor in modern sports training, evidence reviewed shows the importance that the determination of VO_2 max has in the physical preparation of football players. However, in spite of the importance, studies conducted with football players are not as frequent and even less so in North Africa. Therefore, based on the findings mentioned above, the purpose of this study was to determine the oxygen consumption of Algerian second and third division football players during preseason and compare VO_2 max by players' divisions.

Methods

Subjects

Forty five male Algerian soccer players volunteered to participate in the study, of which 22 were second division, 23 third divisions 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 23.13 ± 2.46 years; height 180, 67 ± 3, 54 cm; weight 80, 35 ± 3, 25 kg; body mass index 24, 61± 0, 38 kg/m^2. Subjects were invited to participate. Of the 12 local second and third division teams invited 9 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. Characteristics of the Algerian soccer players by competitions' level. Data are means (±SD).

Competition Level	N	Age (years)	Height (cm)	Weight (kg)	Bmi (kg· $m^{2)}$
Second division	22	23,40 ± 2,36	180,50 ± 3,47	80,50 ± 3,40	24.69 ± 0,.34
Third divisions	23	22.86 ± 2,.58	180.82 ± 3,68	80.2 ± 3,17	24.52 ± 0,40
Total	45	23,13 ± 2,46	180,67 ± 3,54	80,35 ± 3,25	24,61 ± 0,38

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.) and 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)

Statistical analysis

Data are expressed as means, standard deviation (M ± SD). A probability level less than 0.05 was accepted as statistically significant. To analyze differences in VO_2 max (Second division; Third divisions) t-Student test was

performed. The data were analyzed using the statistical package SPSS, PC program, version 15.0 (SPSS Inc., USA).

Results

Table 2. Averages and standard deviations (SD) by division for the variable maximal oxygen consumption

	N	Minimum	Maximum	Average (ml/kg/min)	t	p
(SD VO_2 max)	22	55,60	60,10	58,28 ± 1,35	4,014	0,001
(TD VO_2 max)	23	54,10	60,10	56,53 ± 1,84		
Total	45	54,10	60,10	57,38 ± 1,83		

(SD VO_2 max) the predicted VO_2 max by 20-m MST (Second division)
(TD VO_2 max) the predicted VO_2 max by 20-m MST (Third division)

The table above shows the results of the total sample (n=45) with a general average of 57,38 ± 1,83 ml/kg/min (range 54.10~60.10 ml/kg/min), in which Second division sample (n=22) with a average of 58,28 ± 1,35 ml/kg/min (range 55.00~60.10 ml/kg/min) had the highest VO_2 max and third division sample (n=23) with a average of 56,53 ± 1,84 ml/kg/min (range 54.10~60.10 ml/kg/min). These two values show significant variation (P<0.05). The mean difference between VO_2 max (Second division) and VO_2 max (third division) was 1.75 ml/kg/min with 95% confidence interval 0.001.

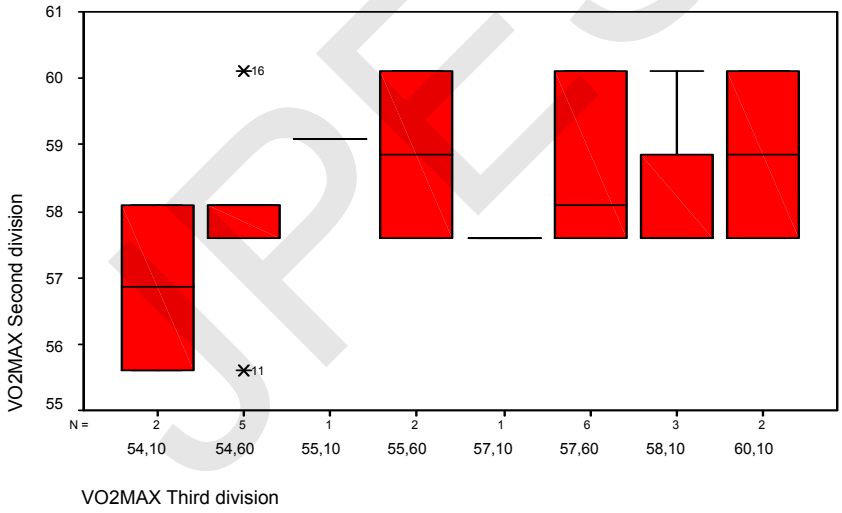

Figure 1. Plotting of difference between VO_2 max values against their means (The 20-m Multi Stage Shuttle Run Test method).MST method

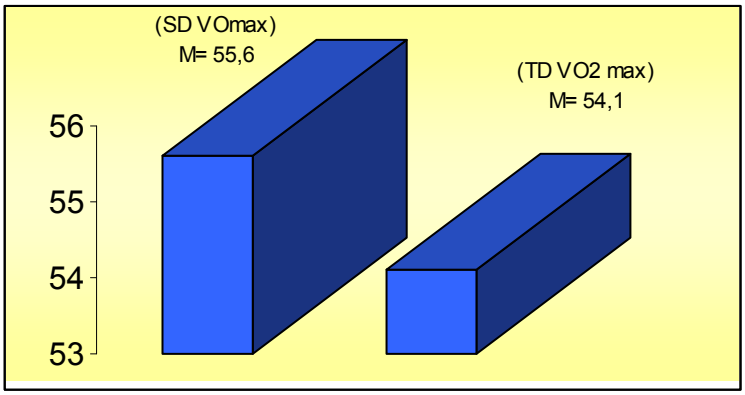

Figure 2. Difference between (SD VO_2 max) and (TD VO_2 max)

Discussion

As observed above, average VO_2 max of Algerian players during preseason in general agrees with the figures expected for high level football players according to what has been proposed by (Abrantes et al. 2004), (Moreira 2008) and (Vänttinen et al. 2010). Regarding the average VO_2 max for each division, it behaves very similarly to what has been reported by (Silvestre et al. 2006). During the training in soccer have used dynamic exercise and various forms of games (Bloomfield et al., 2008) to a measurement that allows improved the physical factor of the players. This model involves a multitude of physiological processes necessary throughout the game-play especially at specific times of the game. (Bloomfield et al., 2008). 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). At the top- level of soccer, research shows that the average distance covered by players from about 10 Km to 13.5Km, with deference between the positions of the play. (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 divisions. The foregoing can be explained according to what has been indicated by Da Silva et al. (2008), for high level soccer players 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 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); although it is important to note that this is not a limiting factor to successful performance (Da Silva et al, 2008).. Determining VO_2 max of soccer players is therefore useful when assessing talent, in selection of players, in the design of physical conditioning programmes, predicting and monitoring physical match performance. Therefore, the results of research and reference values archived in high level can help make important decisions, particularly for staff in the football clubs to manipulate physical training. (Da Silva et al, 2008).

Conclusions

Finally, results 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. However, it is recommended that this type of analysis be extended beyond the preseason in order to observe whether this indicator is improved during the competitive period according to the specific demands of each division.

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