

DETERMINATION OF MAXIMAL OXYGEN CONSUMPTION OF COSTA RICAN FIRST DIVISION FOOTBALL PLAYERS DURING 2008 PRESEASON

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ABSTRACT

The objective of this study was to assess the cardiorespiratory profile (VO₂max) of Costa Rican first division football players during preseason and compare VO₂max by players' positions. Methodology: A total of 9 Costa Rican first division football teams were evaluated in this study for a total sample of 219 professional players ages 20-36 with an average age of 24.64 ± 4.35 years, average body weight of 73.34 kg ± 7.34, and a fat percentage of 9.78 % ± 3.64. In order to evaluate the VO₂max of players, the treadmill protocol was used as recommended by Wilmore and Costill (2007). This was a maximal test. Results: an average VO₂max of 57.71 ml/kg/min ± 8.8 was found; however, no statistically significant differences were found (p = .752) between positions. Conclusion: there were no differences in VO₂max by positions.

KEY WORDS: Football, cardiorespiratory endurance, sports performance.

INTRODUCTION

Top performance in athletes 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 makeup. 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).

Alba (2005) mentions that sports scientists cannot modify hereditary factors, but they are able to control performance progress and prescription using lab and field tests. According to MagDougall et al. (1995), VO₂max is the best indicator of the examinee's aerobic endurance potential because it integrates multiple organ functions (ventilatory, cardiovascular, blood, muscular); consequently, VO₂max is closely related to the person's level of fitness and state of health.

Taking into consideration that VO₂max is defined by Wilmore and Costill (2007) and MacDougall et al. (1995) as the highest oxygen intake attained while doing maximal and

exhausting exercises, this limit (VO₂max) determines 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 VO₂max, using up the anaerobic reserves, which, however, also have a limited capacity.

According to MacDougall et al. (1995) and Wilmore and Costill (2007), it has been proven that with training a young healthy relatively untrained adult can improve his/her VO₂max between 15% and 20% or even more depending on the person's previous training.

Wilmore and Costill (2007) mention that this improvement permits the performance of endurance activities with a higher level of effort or a faster pace, thus enhancing the potential for performance.

According to Alba (2005), it is important to add that VO₂max is ideal for football players when training for competition and that their VO₂max should be 58 ml/kg/min, which is within the range defined by MacDougall et al. (1995), who reported it to be between 50-70 ml/kg/min.

According to MacDougall et al. (1995), assessing the different components and characteristics of aerobic power may be useful when determining the following: 1) The athlete's current preparation or his/her capability to do a given activity. 2) The emphasis to be given to aerobic training and other types of training. 3) The type of aerobic training that must prevail. 4) The time the individual should take in that particular type. 5) The extent and pace of the change generated by the training program. 6) The pace and pattern or strategy to be used in the competition. It is also important to take into consideration medical and nutritional problems or those related to growth or excess of training since they may limit performance particularly during competition and the athlete's aerobic performance in general.

Vargas (2007) believes that VO₂max value can be attained indirectly or directly. The former may be attained applying an indirect test, which must be valid, objective and reliable, such as the 12 minute run test while the latter is determined by measuring gasses using a telemetric analyzer.

Vargas (2007) also mentions that VO₂max does not always determine the sports performance of a football player because other factors also affect performance such as technical, tactic, psychological and social contents of the football action.

However, authors like Garrido and González (2006) and Arecheta, Gómez, and Lucía (2006) consider that VO₂max is extremely important to increase sports performance and to plan training better during preseason and regular season. Following this line of thought, authors like Silvestre, West, Maresh and Kraemer (2006) have reported VO₂max according to the position of U 20 players since planning must comply with this specification. Goalkeepers presented a VO₂max equivalent to 55.94 ± 5.78 ml/kg/min, defenders 57.20 ± 9.86 ml/kg/min, midfielders 58.38 ± 9.85 , and forwards 57.87 ± 5.94 ml/kg/min. In general, the VO₂max reported was 57.71 ± 8.80 ml/kg/min.

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 VO₂max 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 Latin America. Therefore, based on the findings mentioned above, the purpose of this study was to determine the oxygen consumption of Costa Rican football players during preseason and compare VO₂max by players' positions.

METHODOLOGY

Subjects: A total of 219 Costa Rican first division football players participated in the study, of which 23 were goalkeepers, 57 defenders, 94 midfielders, and 45 forwards with an average age of 24.64 ±4.35 years. Subjects were invited to participate. Of the 12 local first 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.

Instruments and Materials: A Medgraphics VO2000 gas analyzer (with a .98 reliability and a 95% confidence interval) and a Hill-Med treadmill were used in the study.

Procedure: Subjects were evaluated using the following protocol recommended by MacDougall et al. (1995) on a treadmill as a maximal test. Speed was increased by 1 mile (1.609 km) each stage. Stages lasted 2 minutes each and there was no treadmill incline percentage in any of them.

Stage	Time	Speed (km/h)
Warm up	3 min	7.0
1	2 min	8.2
2	2 min	9.4
3	2 min	10.6

Note: example of how speed is increased by stage. The number of stages is endless.

All participants were subject to the protocol at their maximum effort until attaining VO₂max, which was determined by the changes in the VO₂ /VCO₂ values shown by RQ that had to be equal to or higher than 1.

Statistical Analysis: descriptive statistics were applied (averages and standard deviations) and, as part of inferential statistics, a one-way ANOVA was used for independent samples followed by a Scheffe's Post Hoc test to compare VO₂max according to each player's position. Data was analyzed with the statistical package SPSS 8.0 for Windows.

RESULTS

Table 1. Averages and standard deviations (SD) by position for the variable maximal oxygen consumption

<i>Position</i>	<i>Average (ml/kg/min)</i>	<i>n</i>
Goalkeepers	55.94 ± 5.78	23
Defenders	57.20 ± 9.86	57
Midfielders	58.38 ± 9.85	94
Forwards	57.87 ± 5.94	45
Total	57.71 ± 8.80	219

The table above shows the results of the total sample (n=219) with a general average of 57.71 ± 8.8 ml/kg/min, in which midfielders had the highest VO₂max and goalkeepers the lowest; however, no statistically significant differences were observed between the different positions (p = .752, F = .477).

DISCUSSION

As observed above, average VO₂max of Costa Rican players during preseason in general agrees with the figures expected for high level football players according to what has been proposed by Alba (2005), Moreira (2008) and MacDougall et al. (1995). Regarding the average VO₂max for each position, it behaves very similarly to what has been reported by Silvestre et al. (2006).

Wilmore and Costill (2007) state that an adequate level of oxygen consumption permits the performance of endurance activities with a higher level of effort or a faster pace, thus enhancing the potential for performance. However, Reilly (1996) 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 VO₂max. Reilly also claims that oxygen consumption in football is equivalent to 75% of VO₂max, 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 Costa Rican football players' endurance to work close to or above their anaerobic threshold.

In addition to what has been found in this study, maximal oxygen consumption should be determined not only during preseason but also at the end of each competitive season as established in the literature (MacDougall et al., 1995).

As detailed in Table 1 and after analyzing the results obtained, no statistically significant differences were found between positions. The foregoing can be explained because the aerobic capacity has not been sufficiently stimulated at the beginning of the preseason, resulting in homogeneity of players in this parameter. However, knowing the nature of each position these results will vary with training as the requirements for each position are met, according to what has been indicated by Reilly (1996), who says that during a game a goalkeeper runs an average of 4 km, defenders 8.5 km, midfielders 10.2 km, and forwards 8.8 km. Consequently, it is clear that the aerobic capacity varies according to the position during the competitive period.

In conclusion, results show that the Costa Rican first division football players tested have a normal VO₂max at the beginning of the preseason in comparison with the findings of other studies of international football 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 position.

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