

Relationship between Aerobic Capacity and Yo-Yo IR1 Performance in Brazilian Professional Futsal Players

Daniel A. Boullosa*^{1ABCDG}, PhD; Lais Tonello^{2CDG}, BPhEd; Isabela Ramos^{2BG}, MSc; Alessandro de Oliveira Silva^{2DG}, MSc; Herbert G. Simoes^{2CEFG}, PhD; Fabio Y. Nakamura^{2ACEG}, PhD

Authors' Affiliation:

1. Departamento de Educação Física, Universidade Estadual de Londrina, Londrina, Brazil
2. Pós-Graduação Stricto Sensu em Educação Física, Universidade Católica de Brasília, Brasília, Brazil

Authors' Contribution

- A** Concept / Design
- B** Acquisition of Data
- C** Data Analysis / Interpretation
- D** Manuscript Preparation
- E** Critical Revision of the Manuscript
- F** Funds Collection
- G** Approval of the Article

* Corresponding Author:

Pós-Graduação Stricto Sensu em Educação Física, Universidade Católica de Brasília – UCB, QS 07, LT1 S/N - Sala 111 - Bloco G, 71966-700 Águas Claras - DF - Brasil

E-mail: d_boullosa@yahoo.es

Received: Dec 08, 2012

Accepted: Apr 28, 2013

Available Online: May 25, 2013

Abstract

Purpose: To evaluate the relationship between aerobic and intermittent capacities in a team of professional futsal players.

Methods: Fifteen futsal players from Brazilian first division (age: 25.9±5.1 yrs; height: 1.77±0.04 m, body mass: 74.37±6.02 kg) performed in random order a ramp test and the Yo-Yo intermittent recovery test level 1 (Yo-Yo IR1) at the start of the season for determination of maximum oxygen consumption (VO₂max), peak running speed (S_{peak}), and intermittent running ability.

Results: Mean VO₂max was of 57.25±6.35 ml·kg⁻¹·min⁻¹ with a S_{peak} of 17.69±1.88 km·h⁻¹. Yo-Yo IR1 performance was of 1,226±282 m. There was no correlation between VO₂max and Yo-Yo performance while S_{peak} and Yo-Yo IR1 performance were correlated ($r=0.641$; $P=0.007$).

Conclusion: From the current results, it may be suggested that both continuous and intermittent physical evaluations are necessary for obtaining a complete fitness profile of futsal players. The low Yo-Yo IR1 performance of Brazilian futsal players when compared to other elite team sport athletes warrants further investigation.

Key Words: Performance; Team Sports; Monitoring; Anaerobic Capacity; High-Intensity Actions

Asian Journal of Sports Medicine, Volume 4 (Number 3), September 2013, Pages: 230-234

INTRODUCTION

Futsal is an intermittent high-intensity sport that taxes both aerobic and anaerobic pathways [1]. A previous study has highlighted the importance of a high aerobic power in futsal players for allowing a greater tolerance of daily training and match workloads [2]. Additionally, another recent study has reported that the speed associated to maximum aerobic consumption (VO₂max) could be more sensitive for detecting differences between players' competitive level than VO₂max [3]. Collectively, these studies reinforce the necessity of monitoring VO₂max and its associated speed over futsal players' season. However, while these parameters are important, only one study has

evaluated the specific intermittent capacity of futsal players with the futsal intermittent endurance test (FIET) [4]. Interestingly, this previous study [4] reported a relationship between FIET performance and the speed associated to VO₂max, but not with VO₂max. This is an interesting finding that reinforces the need of using valid and specific tests to monitor aerobic fitness of futsal players over the season as these relationships would be mediated by the requirement of high-intensity actions (HIA) during matches [3].

The Yo-Yo intermittent recovery test level 1 (Yo-Yo IR1) is the most utilized test for monitoring the ability to cope with intermittent exercise in team sports [5]. Its value as a fitness monitoring tool is very high as it is simple and easy to apply in the field, while

performance in this test has been reported to be related to HIA during matches, VO_2max , and selected physiological responses during high-intensity intermittent exercise [5,6]. Whereas most of these studies were performed with soccer players [5,6], there is only one study evaluating Yo-Yo IR1 performance in elite futsal along the season [7]. However, this study did not provide VO_2max values of players for further analyses. Therefore, the relationship between Yo-Yo IR1 performance and VO_2max is still unknown in futsal players. This information would be important for understanding the nature of physiological adaptations of futsal players as previously suggested for soccer players [6].

Therefore, the aim of this study is to identify the relationships between Yo-Yo IR1 performance, VO_2max and its associated speed in a group of professional futsal players. Our hypothesis was that Yo-Yo IR1 performance would be highly correlated with both VO_2max and its associated speed.

METHODS AND SUBJECTS

Fifteen outfield futsal players of a local team from Brazilian first division volunteered for participation in this study. Based on a previous study [6] with male soccer players, a minimum of 12 athletes were estimated to be necessary for our purposes. Athletes performed in random order a laboratory ramp test for VO_2max assessment [8] and an on court Yo-Yo IR1 test [5]. These tests were performed individually with a minimum of 48 hrs between evaluations over a 10 days period at the start of the in-season period. They were informed of all the risks and procedures and provided informed written consent.

The ramp test [8] started at $8 \text{ km}\cdot\text{h}^{-1}$ and zero incline for 4 min on a treadmill (Inbramed Millennium, Super ATL, Brazil). The speed was then increased by $0.5 \text{ km}\cdot\text{h}^{-1}$ every 30 s until volitional exhaustion. The highest velocity completed was considered as the peak treadmill speed associated to the last complete stage (S_{peak}). Expired gases were continuously measured (Cortex Biophysik, Germany) and the VO_2max

($\text{mL}\cdot\text{kg}^{-1}\cdot\text{min}^{-1}$) recorded was the mean of the values reached during the last 20 s before exhaustion. Heart rate (HR) was continuously recorded at 5 s intervals (RS800, Polar Electro Oy, Finland).

The Yo-Yo IR1 was performed on court with HR being continuously recorded (RS800, Polar Electro Oy, Finland). This incremental test consists of repeated 20 m running bouts with changes of direction, interspersed with 10-s rest periods [5]. Immediately after exhaustion, earlobe blood samples (25 μl) were obtained from each player. Each sample was transferred to Eppendorf tubes containing 50 μl of NaF [1%] and subsequently analyzed for determination of final blood lactate [LA] with an electroenzymatic analyzer (YSI 2700, Yellow Springs, USA). Total distance (m) and the maximum HR (HRmax) recorded during this test were retained for further analyses.

Sample size was calculated with appropriate software (Medcalc® v.9.2.1.0) based on a power of 0.80 and α of 0.05. Descriptive data are shown as mean \pm SD. A Kolmogorov-Smirnov test was performed to verify the normal distribution of variables. Comparisons between selected parameters were performed via paired t test. Pearson product moment correlation coefficients (r) were employed for detection of significant ($p<0.05$) relationships between selected parameters. Statistical analyses were performed with the Statistical Package for the Social Sciences (SPSS v.19.0, IBM, Chicago, IL, USA).

RESULTS

The mean age of participants was 25.9 (± 5.1). Anthropometric and physiological data are presented on Table 1. The result obtained showed that the HRmax values during both tests were not significantly different to each other. Mean VO_2max was of $57.25\pm 6.35 \text{ mL}\cdot\text{kg}^{-1}\cdot\text{min}^{-1}$ with a S_{peak} of $17.69\pm 1.88 \text{ km}\cdot\text{h}^{-1}$. Yo-Yo IR1 performance was of $1226\pm 282 \text{ m}$. There was no significant correlation between VO_2max and Yo-Yo IR1 performance (Fig. 1). In contrast, a significant correlation was found between S_{peak} and Yo-Yo IR1 performance ($r=0.641$; $P=0.007$) (Fig. 1).

Table 1: Players' characteristics and physiological responses (n=15)

Parameters	Mean (SD)
Age (yrs)	25.9 (5.1)
Body Mass (kg)	74.37 (6.02)
Height (m)	1.77 (0.04)
Yo-Yo Intermittent Recovery Test level 1 (m)	1,226 (282)
Maximum heart rate recorded during the Yo-Yo test (bpm)	184 (15)
Maximum lactate after the Yo-Yo test (mmol·L ⁻¹)	8.17 (1.63)
Maximum aerobic speed recorded during the ramp test (km·h ⁻¹)	17.69 (1.88)
Maximum heart rate recorded during the Ramp test (bpm)	184 (5)
VO ₂ max (ml·kg ⁻¹ ·min ⁻¹)	57.25 (6.35)
VO ₂ max (ml·kg ^{-0.75} ·min ⁻¹)	76.34 (8.46)

SD: Standard Deviation; VO₂max: Maximum oxygen consumption in normal and mass adjusted values

DISCUSSION

Surprisingly S_{peak} significantly correlated with Yo-Yo IR1 performance while VO₂max did not. This result is in accordance with a previous study [4] in which the authors reported a similar correlation between the speed associated to VO₂max and intermittent performance evaluated with the FIET, but not with VO₂max. This finding also reinforces the importance of S_{peak} for evaluation of futsal players as this parameter has been demonstrated to discriminate between players' competitive level [3].

The mean VO₂max observed in the current study is similar to that reported in previous studies with elite

Brazilian players [2,9], but lower than the values reported (i.e. ~67-71 ml·kg⁻¹·min⁻¹) in a more recent study [10] in which a graded treadmill test was employed. In this regard, it would be suggested that differences in running protocols among studies would be influencing results as both VO₂max and S_{peak} could be affected by protocol design [11,12]. This is an important aspect that should be considered in further studies when determining laboratory testing methods. Nevertheless, the characteristics of the protocol employed [8] in our study suggest its utilization in this population, as it is short and easy to apply, therefore allowing time-saving during evaluations.

Yo-Yo IR1 performance was substantially lower

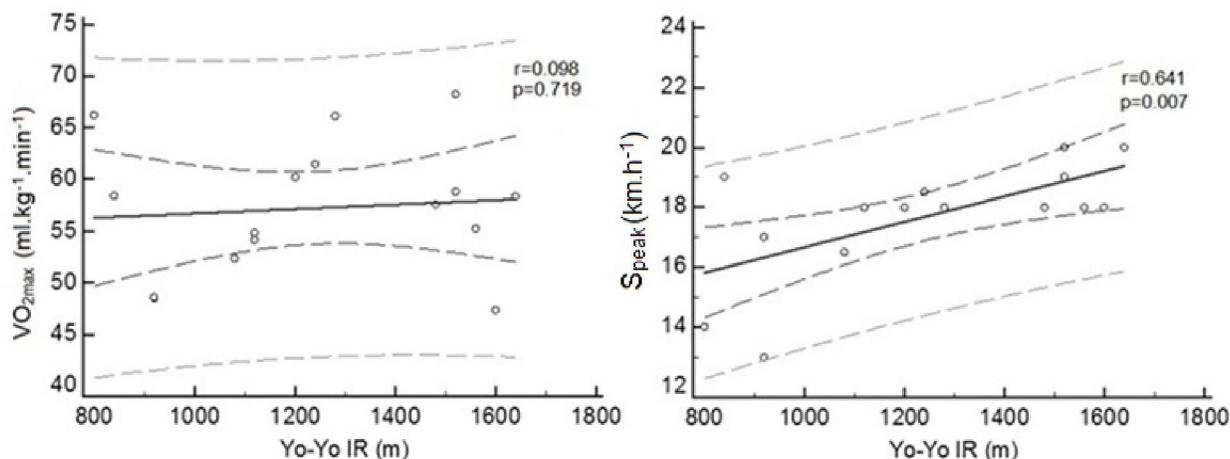


Fig. 1: Correlations between maximum oxygen consumption (VO₂max), peak treadmill speed (S_{peak}), and Yo-Yo intermittent recovery test level 1 (Yo-Yo IR1) performance

than the reported from other studies with elite team sport athletes [5,6] and similar to the observed results in semi- elite soccer referees; for example [13]. Moreover, we have systematically observed similar Yo-Yo IR1 performances (i.e. < 1500 m) in previous evaluations (unpublished observations), and as recently reported [7]. This is an interesting finding that may be related to the playing style and/or habitual physical preparation of professional Brazilian futsal players. As there are no reference values from other countries, further studies with players of different national championships are needed for adequately testing this hypothesis. Additionally, these observations raise some concerns on the validity of Yo-Yo IR1 for the evaluation of futsal athletes. Alternatively, the Yo-Yo Intermittent Recovery test level 2 (Yo-Yo IR2) would be more appropriate as futsal is characterized by a greater number of HIA than other team sports but with a half of the mean total distance covered during matches when compared to soccer [14]. Therefore, further studies are needed for testing this hypothesis by testing correlations between Yo-Yo IR tests and FIET performances with HIA recorded during matches.

Contrary to the current study, various previous studies have observed weak to medium correlations between $VO_2\text{max}$ and Yo-Yo IR1 performance in soccer [5,6]. Apart from the possible influence of protocol design on these relationships, we would speculate on the influence of other factors such as running economy, athletes' background, and current specific fitness [3]. While we do not know the exact reason for this result, from a practical point of view it would suggest the necessity of performing both continuous and intermittent evaluations for determining a complete physical profile of futsal athletes. Additionally, further longitudinal studies with players of different levels are warranted for exploring the relationship between intermittent and aerobic fitness components across the season.

This study presents some limitations that should be commented. Firstly, although we recruited a number of players that guaranteed a sufficient statistical power, the fact that they were of the same team could bias the results since players of the same team often exhibit a

wide range of competitive load depending on tactical decisions of coaches with players with more minutes of match participation often exhibiting a better specific fitness. In fact, the training background of players was very heterogeneous with most of them being novice in first division and therefore acting more as substitutes. This is an important aspect that should be considered in further studies. Secondly, while these tests were performed at the start of the season, it would be speculated that athletes would experience a delayed effect of preseason training with an improvement in specific fitness over the following weeks.

CONCLUSION

The main finding of the current study is that S_{peak} but not $VO_2\text{max}$ correlates with Yo-Yo IR1 performance in a Brazilian professional futsal team. From a practical point of view, it would be suggested that both continuous and intermittent tests are necessary for a complete description of fitness status of elite futsal players. Additionally, when there is limited time for testing, a ramp test could be utilized as it provides $VO_2\text{max}$ and S_{peak} , with the later being correlated with intermittent performance in the Yo-Yo IR1. More studies should be conducted for clarifying if these relationships between continuous and intermittent performances change over a whole season in teams of different competitions.

ACKNOWLEDGMENTS

We would like to recognize the help provided by Mr. Danilo Pinho Souza and Mr. Rafael Mato during data collection as well as to Paola Cárdenas for their comments on the manuscript. We also recognize the great predisposition of both players and their coaches for participation. This study was funded in part by Conselho Nacional de Desenvolvimento Científico e Tecnológico (305658/2010-7).

Conflict of interests: None

REFERENCES

- [1] Barbero-Alvarez JC, D'Ottavio S, Vera JG, et al. Aerobic fitness in futsal players of different competitive level. *J Strength Cond Res* 2009;23:2163-6.
- [2] Milanez VF, Pedro RE, Moreira A, et al. The Role of Aerobic Fitness on Session Rating of Perceived Exertion in Futsal Players. *Int J Sports Physiol Perform* 2011;6:358-66.
- [3] Pedro RE, Milanez VF, Boullosa DA, et al. Running speeds at ventilatory threshold and maximal oxygen consumption discriminate futsal competitive level. *J Strength Cond Res* 2013;27:514-8.
- [4] Castagna C, Barbero-Alvarez JC. Physiological demands of an intermittent futsal-oriented high intensity test. *J Strength Cond Res* 2010;24:2322-9.
- [5] Bangsbo J, Iaia M, Krstrup P. The Yo-Yo Intermittent Recovery Test. A Useful Tool for Evaluation of Physical Performance in Intermittent Sports. *Sports Med* 2008;38:37-51.
- [6] Rampinini E, Sassi A, Azzalin A, et al. Physiological determinants of Yo-Yo Intermittent recovery tests in male soccer players. *Eur J Appl Physiol* 2010;108:401-9.
- [7] Oliveira RS, Leicht AS, Bishop D, et al. Seasonal changes in Physical Performance and heart rate variability in high-level futsal players. *Int J Sports Med* 2013;34:424-30.
- [8] Di Prampero PE, Salvadego D, Fusi S, et al. A simple method for assessing the energy cost of running during incremental tests. *J Appl Physiol* 2010;107:1068-75.
- [9] Baroni BM, Leal Junior ECP. Aerobic capacity of male professional futsal players. *J Sports Med Phys Fitness* 2010;50:395-9.
- [10] Rodrigues VM, Ramos GP, Mendes TT, et al. Intensity of Official Futsal matches. *J Strength Cond Res* 2011;25:2482-7.
- [11] Hill DW, Rowell AL. Running velocity at VO_2 max. *Med Sci Sports Exerc* 1996;28:114-9.
- [12] Pokan R, Schwabergger G, Hofmann P, et al. Effects of treadmill exercise protocol with constant and ascending grade on levelling-off O_2 uptake and VO_2 max. *Int J Sports Med* 1995;16:238-42.
- [13] Boullosa DA, Nakamura FY, Perandini LA, et al. Autonomic correlates of Yo-Yo performance in soccer referees. *Motriz (Rio Claro)* 2012;18:291-7.
- [14] Barbero-Álvarez JC, Soto VM, Barbero-Álvarez V, et al. Match analysis and heart rate of futsal players during competition. *J Sports Sci* 2008;26:63-73.