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PJBS

ISSN 1028-8880

Pakistan Journal of Biological Sciences

ANSInet
Asian Network for Scientific Information
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan

OPEN ACCESS Pakistan Journal of Biological Sciences

ISSN 1028-8880
DOI: 10.3923/pjbs.2018.24.28

Research Article
Aerobic Profile During High-intensity Performance in Professional Saudi Athletes

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Abstract

Background and Objective: The aerobic power, expressed relative to body mass, of different Saudi elite players is one of the most important area of interest and with great values because of its restrictively that reported in the previously literatures, the present study was conducted to investigate the aerobic characteristics of Saudi elite, Saudi triathlon and soccer players and to compare between measures of aerobic power between both players using graded treadmill protocol to assess maximal cardiorespiratory fitness (VO_{2max}), within a groups of high trained youth Saudi elite players. **Materials and Methods:** Twenty two professional Saudi athletes, 11 Saudi triathlon athletes, 11 Saudi soccer players were selected. Their Mean±SD for age, height, weight, body mass index (BMI), body fat mass (%), body fat free mass percentage, cardiovascular parameter, including, absolute and relative peak oxygen consumption "VO_{2max}" and maximal heart rate "HR max". Data were analyzed using independent sample t-test and SPSS software. **Results:** Descriptive statistics for anthropometric characteristics were performed to compare between the means, independent sample. T-test showed mean value of absolute "VO_{2max}" (3605.18±515.74), for triathlon athletes, while football players absolute VO_{2max}, (3645.63±897.60) with non-significant different between the groups. Overall mean of peak training values was (3625.40 mL min^{-1}), relative VO_{2max} was appears to be (53.46±7.242) mL^{-1} min^{-1} kg^{-1}, for triathlon athletes, while football athletes relative VO_{2max} has a mean value and ±SD of (52.35±6.342) mL^{-1} min^{-1} kg^{-1} with non-significant different between the groups. HR max was (157.90±8.167) beats min^{-1} for triathlon athletes, while football players HR max, was (139.18±6.646) beats min^{-1} with non-significant difference between the groups. **Conclusion:** This clinical approaches that use Cardio Pulmonary Exercise Testing (CPET) in performance testing revealed that aerobic power, expressed relative to body mass, of Saudi soccer players was in the near range of values normally reported in the literatures for soccer players and triathletes during exercise training as well. Degrees of aerobic achievements during both exercise testing seems to be with non-significant different between Saudi soccer player and Saudi triathlon.

Key words: Aerobic profile, absolute "VO_{2max}", relative "VO_{2max}", maximum heart rate, triathlon, soccer players

Citation: Manar M. Badawy and Qassim I. Muaidi, 2018. Aerobic profile during high-intensity performance in professional Saudi athletes. Pak. J. Biol. Sci., 21: 24-28.

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Competing Interest: The authors have declared that no competing interest exists.

Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

Soccer is the world's most popular sport, being played in every nation without exception, soccer players and soccer coaches are more open to contemporary scientific approaches to assess their performance in order to be prepared for competitions[1,2]. Assessments of physical fitness allow for a more accurate evaluation of the effects of the conditioning program and are also more likely to identify the areas of weakness and strength of the soccer players. Overall physical fitness is important for functioning of the soccer players at a professional level, the most frequently used fitness test for soccer players was performed (VO_{2max} test) and morphologic characteristics were tested (body height, weight and percentage of body fat)[3-5].

Triathlon is a multiple-stage competition involving the completion of three continuous and sequential endurance disciplines. While many variations of the sport exist, triathlon, in its most popular form, involves swimming, cycling and running in immediate succession over various distances. Triathletes compete for fastest overall course completion time, including timed "transitions" between the individual swim, cycle and run components[6].

Triathlon becomes a popular and rapidly increasing sport, in particular the shorter events, such as the Olympic distance (1500 m, 10 and 40 km) or the sprint triathlon (500 m, 5 and 20 km). Triathlon competition time ranges from 50-70 min for the sprint events to several h for the Olympic and long distance races. Accordingly, top-level triathletes are characterized by a very high aerobic power (maximal rate of oxygen consumption)[6].

High aerobic demand in soccer is necessary to provide power in an endurance event as well as to provide quick recovery after a high-intensity activity[7,1]. Furthermore, the development of soccer players' aerobic fitness can elevate technical performance and promote greater contact with the ball during the game, in addition the total distance covered (about 10-12 km) is performed at a relative intensity of 75% of the VO_{2max}[1], resulting in an aerobic contribution of about 90% of the total energy cost of the game.

VO_{2max} is the maximal amount of oxygen that delivered and utilized during intense exercise. The standard method of assessing VO_{2max} is through use of specialized metabolic measuring equipment and a widely used treadmill-based Bruce protocol, which has been routinely used with both athletic and clinical populations[1,8-12]. To investigate the aerobic characteristics of Saudi elite, Saudi triathlon and Saudi soccer players and to compare between measures of aerobic power between both players using graded treadmill protocol. To assess maximal cardiorespiratory fitness (VO_{2max}), within a group of high trained youth Saudi elite players.

MATERIALS AND METHODS

Twenty two Saudi athletes, their age Mean±SD were (22.0±3.17), height (173.09±4.01), weight (69.477±4.04 and BMI (21.9±2.6), body fat mass (8.9±2.3%), body fat free mass (62.4±4.1%). This study was conducted between January and June, 2016, at Exercise Physiology Laboratory, Center of Excellency, Physical Therapy Department, Faculty of Applied Medical Science, Imam Abdulrahman Bin Faisal University, KSA.

To ensure validity of the test, the participants had been instructed to abstain from food, coffee for at least 3 h before the study, training and testing should be 2 h after moderate aerobic-anaerobic exercise,14 h after vigorous resistance exercise.

Experimental protocol: After approval by the institutional review board for human study protocols reference number IRB-2015-03-162, subjects undergoing treadmill stress testing and cardio respiratory performance, the subjects assigned in to two groups, the first group include Saudi triathlon player, second group includes Saudi soccer players. The purpose and the procedures of the study has been explained to each subject by the examiner, all participants anthropometric data [name, age (years), height (cm), weight (kg)] were entered to allow the COSMED apparatus flow screen to calculate the predicted values. Quark 'CPET' Cardio Pulmonary Exercise Testing Unit, using face mask with its gas and flow sensor "Turbine flow meter' was used during the running test, procedures equipment and performance. Calibration of the COSMED apparatus was done daily before the procedure, gas calibration were performed before the procedure for each subject and flow calibration was performed weekly.

Weight and height were measured using weight, height scale. Measurements were performed while the subject standing erect, back and knees extended and both upper limb beside the body. Insertion of personal data into body composition analyzer (BCA) machine including patient age, sex, weight and height, for each patient and measuring of fat mass and fat free mass, body water composition was monitored.

Statistical analysis: Data were analyzed using the SPSS computer program, version 19.0. Continuous data were analyzed to compare mean differences and ±SD between the anthropometric characteristics. Independent sample t-test were conducted to determine the significant different

Table 1: Comparing means of anthropometric characteristics between triathlon athletes and football athletes

				Levene's test significance		
Variables	Game types	Mean values	±SD	F	Significant	p-value
Age (years)	Triathlon athletes	22.63	2.730	7.295	0.014	NS
	Football athletes	23.36	1.2060			
Height (cm)	Triathlon athletes	174.00	6.8560	1.368	0.256	NS
	Football athletes	173.00	4.4000			
Weight (kg)	Triathlon athletes	67.50	3.6270	7.020	0.015	NS
	Football athletes	71.30	4.1310			
Fat mass (kg)	Triathlon athletes	9.62	1.8488	2.243	0.150	NS
	Football athletes	8.25	2.6485			
Fat free mass (kg)	Triathlon athletes	63.44	5.2443	1.826	0.192	NS
	Football athletes	61.54	2.7431			
BMI	Triathlon athletes	21. 69	1.1280	.0660	0.799	NS
	Football athletes	21. 83	1.4440			

Table 2: Test protocol durations and response VO_{2max}, HR Max between triathlon athletes and football athletes

				Levene's test significance		
Variables	Game types	Mean values	±SD	F	Significant	p-value
Test durations (min)	Triathlon athletes	24.30	3.020	0.192	0.666	NS
	Football athletes	27.00	3.190			
VO_{2max} (mL^{-1} min^{-1})	Triathlon athletes	3605.18	515.740	0.397	0.535	NS
	Football athletes	3645.63	897.600			
VO_{2max} (mL^{-1} min^{-1} kg^{-1})	Triathlon athletes	53.46	7.242	0. 287	0.866	NS
	Football athletes	52.35	6.342			
HR max (beats min^{-1})	Triathlon athletes	157.90	8.160	2.909	0.104	NS
	Football athletes	139.18	6.640			
Rating of perceived exertion	Triathlon athletes	6.10	0.934	0.007	0.934	NS
	Football athletes	5.35	0.924			

*Significant at $p<0.05$

between both groups from baseline, in physical characteristics as well as dependents variables responses to exercise protocol (both absolute and relative VO_{2max} and HR max), using Levene's test was determined ($p<0.05$), at a confidence interval of 0.095.

RESULTS

Compare mean tests have been performed using independent sample t-test Levene's test for equality of variance at 95% confident interval of the difference for anthropometric characteristics: Age, height, weight, fat free mass, fat mass and BMI as shown in Table 1.

Descriptive statistics using SPSS for anthropometric characteristics were performed mean and slandered deviations (SD) were presented to compare between the means, independent sample t-test were conducted to determine the significant difference between both groups.

Compare mean tests have been performed using independent sample t-test Levene's test for equality of variance at 95% confident interval of the difference for protocol parameters, test durations and responses, both absolute and relative VO_{2max}, HR max and rating of perceived exertion (Borg scale 0-10). Test duration ($f = 0.192$, $p = 0.666$), relative VO_{2max} ($f = 0.287$, $p = 0.866$), absolute VO_{2max} ($f = 0.397$, $p = 0.535$), HR max ($f = 2.909$, $p = 0.104$) and rating of perceived exertion ($f = 0.007$, $p = 0.934$), as shown in Table 2.

VO_{2max} achievements, the mean and SD, for the absolute, relative VO_{2max} (mL min^{-1}) as well as HR max, mean value is (3605.18±515.74), for triathlon players while football players absolute VO_{2max}, (3645.63±897.60) with non-significant different of the absolute VO_{2max}, between the groups.

Relative VO_{2max} is (53.46±7.242) mL^{-1} min^{-1} kg^{-1}, for triathlon players, while for football players relative VO_{2max}, has a mean value and SD (52.35±6.342) mL^{-1} min^{-1} kg^{-1}. With non-significant difference of the relative VO_{2max} between the groups. Comparing the actual peak achieved VO_{2max} to the predicted values, illustrate high aerobic performance records.

DISCUSSION

High achievements of VO_{2max} level both absolute and relative showed high aerobic profile for both types of athletes. VO_{2max} achievement was reliable, as the portable system's measurement error is about 1%, (using confidence interval of the different equal to 99%). The mean and SD for the absolute, relative VO_{2max} (mL min^{-1}) as well as HR max.

Mean value is (3605.18±515.74) for triathlon athletes while football athletes absolute VO_{2max} (3645.63±897.60) with non-significant different of the absolute VO_{2max}, between the groups, overall mean of peak training values was (3625.40 mL min^{-1}), that presents (115.3%) of the predicted values.

Relative VO_{2max} was appears to be (53.46±7.242) mL^{-1} min^{-1} kg^{-1}, for triathlon athletes, while football athletes relative VO_{2max}, has a mean value and SD of (52.35±6.342) mL^{-1} min^{-1} kg^{-1} with non-significant different of the relative VO_{2max} between the groups, overall mean of peak training values was (53mL^{-1} min^{-1} kg^{-1}), that presents (115.008%) of the predicted values of relative VO_{2max} HR max records appeared to be (157.90±8.16) beats min^{-1}, for triathlon athletes, while football athletes HR max, has a mean value and SD of (139.18±6.64) beats min^{-1}. Overall mean of peak training values was (153 beats min^{-1}), that presents (88.60%) of the maximal predicted HR max values. Comparing the actual peak achieved VO_{2max} to the predicted values, illustrate high aerobic performance records.

Detected aerobic capacities level was in consistency to Al-Hazzaa *et al.*[13], who have examined the aerobic characteristics of Saudi soccer players with VO_{2max} of overall average equal to 56.8 mL^{-1} min^{-1} kg^{-1}, with maximal heart rate (HR max) records of 188 beats min^{-1} that represents 96% of their maximal predicted HR max. In current study protocol, the overall mean of peak training values was (153 beats min^{-1}), that presents (88.60%), of the maximal predicted HR max values. This could be correlated to the high duration protocol used in this study. These two regressions may illustrate the increased VO_{2max} with test protocol duration, with non-significant high HR level, that may put the cardiovascular system in stress and may reduce the cardiovascular risk during both exercises training and testing in CPET procedure[13].

On the other hand, many studies that investigate the mean rating of perceived exertion, from the revised Borg scale (0-10), recorded the value of 8±1, 15, 16, which can considered to be higher than the mean rating of perceived exertion records the subjective response of the subjects to the test, which has an average rating of perceived exertion with a value of, 6±1 for triathlon athletes and 5±1 for football players.

Many studies that compared testing protocols stated that duration of exercise with many subjects reaching volitional fatigue outside of the 8-12 min of test duration for the ramp than the bruce protocol, 8:25±3:00 min was recorded for the Bruce and 10:01±2:32 min for the ramp ($p<0.0001$). The subjective rating of each test was 2.5±0.9 for the Bruce and 4.1±0.9 for the ramp ($p<0.0001$) indicating that the athletes found the ramp more tolerable and hence easier. Seventeen participants achieved target heart rate in both protocols and in this group, subjects exercised for a longer duration on the ramp before reaching that rate. Time was 6:22±2:52 min for the Bruce and 7:19±2:22 min for the ramp ($p<0.03$)[14,15].

Correlation between estimated oxygen uptake and measured uptake has been shown to be poorer with the Bruce protocol than with a ramp protocol[10]. Having clearly defined stages also may affect participants perception of their exercise ability, being seen as sequential hurdles that define imaginary boundaries that may limit true performance[14-16]. Participants exercised longer with the ramp than with the Bruce protocol and achieved an optimal duration for the exercise test of approximately 10 min. A mean duration of 10:01±2:32 min was reached on the ramp without individualization and individual data showed that each participant exercised longer with the ramp than with the Bruce protocol. METs achieved with the ramp protocol were significantly higher than with the Bruce protocol[16,17].

CONCLUSION AND FUTURE RECOMMENDATION

Both Saudi soccer and Saudi triathlon have obtained high achievements of physical performance and cardio respiratory and vascular response through high technology equipment and obviously high achievements of both absolute and relative VO_{2max} level.

Recommendation of further research estimating and comparing different Saudi games players in order to establishing a normative data of Saudi athletes, which considered one of the limitation of sport field, expecting future implications of this research in normative records of acerbic performance of Saudi players.

SIGNIFICANT STATEMENT

This study was conducted to assess the characteristics of Saudi elite players and to examine the interrelationship between different game plays using new technology of clinical approaches that use Cardio Pulmonary Exercise Testing (CPET) in performance testing revealed the aerobic power. Saudi elite players were in the higher range of values that previously reported in the literatures for elite players. This study will help the researchers to uncover the critical area of aerobic profile of Saudi players helping researchers to re-evaluate their performance during high-intensity training protocols.

ACKNOWLEDGMENTS

The authors wish to thank all participants in the study for their cooperative participation. Also the authors express their sincere thanks to referees for careful reading and helpful suggestions. The authors gratefully acknowledge the Saudi Federation of Sport medicine, the Center of Excellency at Physical Therapy Department, Dammam University.

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