Med. J. Cairo Univ., Vol. 86, No. 7, December: 4243-4247, 2018
www.medicaljournalofcairouniversity.net

The Impact of A 10-Week Proposed Training Program on Some Physiological Variables and Physical Abilities of Football Referees

EMAN S.H. ABD ALLAH, Ph.D.*; IBRAHIM M. RAMADAN, M.Sc.**; YASSER H. FARGHALY, Ph.D.*** and MOHAMED I.M. SULTAN, Ph.D.***

The Department of Physiology, Medical Physiology, Faculty of Medicine, Assiut University, Assiut, Egyptian Football Association** and The Department of Sport Training and Science Movement, Faculty of Physical Education, Assiut University, Assiut***, Egypt*

Abstract

Background: Football referees' physiological and physical fitnesses have received a growing interest over the last decades.

Aim: The purpose of the present study was to evaluate the effect of a 10-week training program on some physiological variables that enable the referees to pass the physical fitness tests endorsed by the international Federation of Football Association (FIFA).

Material and Methods: Thirty Egyptian soccer referees from Assiut football branch volunteered to participate in a 10-week training study (pre-to-post measurements) as follows: Second class referees (2nd R, n=11); third class referees (3rd R, n=13) and new referees (NR, n=6). Pre-to-post training measurements of physiological variables (heart rate, blood pressure, Rate-Pressure Product (RPP) and VO_2 max) and FIFA-approved physical fitness tests (repeated sprint ability and interval test) were assessed.

Results: The decrement of heart rate, blood pressure, RPP and increment of VO_2 max were observed following the 10-week training program that enables the referee to pass the fitness test approved by the FIFA.

Conclusion: We concluded that the 10-week training program succeeded in improving the physical fitness of football referees in Assiut governorate.

Key Words: *Football referees – Repeated sprint abilities – Heart rate – Blood pressure.*

Introduction

FOOTBALL referees' physiological and physical fitnesses have received a growing interest over the last decades. A referee could cover an average of 11469±983 meters in a 95-minute match [1], thus referees need to possess a significant physical and physiological fitness. Passing physical fitness test is challenging and it is crucial for registration, renewal and match selection of the referees [2]; however many referees could not pass these tests, thus couldn't participate in the national and world cup competitions. There are two widely used FIFA-approved physical fitness tests. Firstly, repeated sprint ability (40m X 6 times) in which referees should run 40 meters (m) as fast as he can for 6 times interspersed with 90 sec recovery [3]; this test needs speed. The maximum time needed to complete each time/trial must be less than 6.2 seconds (sec) for national assistant referees and 6.4sec for national referees. If the referee fails in any trial, he should do another trial immediately. If he fails in two trials out of seven, this considered failure of the test. Secondly, the interval test (150m X 30sec X 20 times) which is a repeated 150m track runs in 30sec interspersed with 50m of walking in 40sec [4]. This test measures the referees' ability to sustain for repeated high intensity runs [5] and reflects the actual match intermittent exercise profile [4]. There is an increasing demand for training programs that enhance the referees' physical fitness. Thus, the aim of the present study was to examine the effects of a 10-week proposed training program on physiological variables of football referees in order to pass the fitness test approved by the international federation of football (FIFA).

Material and Methods

Participants:

Thirty Egyptian soccer referees (24.44±2.77yr, 63.60±6.07kg, 176.9±6.16cm and 23.5±0.76 $kg.m^{-2}$) that were registered at Assiut football branch during the 2014/2015 season volunteered to participate in this study. Second class referees (2nd R, n=11), third class referees (3rd R, n=13)

Correspondence to: Dr. Eman S.H. Abd Allah,
E-Mail: eman_sayyed2@yahoo.com

and new referees (NR, n=6) participated with an average refereeing experience 4.4±1.41yr. All the referees were informed by the aim and the protocol of the program.

The proposed training program:

The proposed training program and its duration were selected according to the outcomes of a questionnaire that was done to identify the most appropriate physical tests that measure cardiorespiratory endurance, speed, agility, speed endurance, flexibility and power endurance. The questionnaire was completed by ten experts in football and sports training from different universities in Egypt and experts in the international federation of football. The proposed training program aimed to improve the physiological and physical variables of football referees in 10 weeks in order to pass the fitness test approved by the FIFA.

The validity of the training program was confirmed by examining the significant difference in physiological variables and physical abilities between a distinct group (1 st class referee; n=10) and an indistinct group (new referee, n=10). Furthermore, the reliability of the training program was assessed by subjecting a group of referees (n=10) to the same test twice (test-retest) with 10-days interval. In both cases, calculated *t*-value was higher than the tabulated *t*-value which means that the training program is valid and reliable.

Starting in June 2015, all referees were subjected to a 10-week training program, including 30 training units (3 units/week; 90 minutes each). The general and special preparation periods were 4 and 6 weeks; respectively. The methods of training were continuous or repetitive ranging from low to high with a graded training load ranging from medium, high and maximum. The percentage of general and special physical preparations were 30 and 70%, respectively. The time spent in the general physical preparation was as follows: General endurance 25%, strength 20%, flexibility 15%, agility 15% and speed 25%. The time spent in the special physical preparation was as follows: Cardiorespiratory endurance 20%, speed 15%, strength endurance 20%, speed endurance 20%, agility 15% and flexibility 10%. Pre-and post-participation evaluations of heart rate, blood pressure, VO_2 max and physical abilities were done.

Resting and post-exercise blood pressure was evaluated using an electronic sphygmomanometer. Heart rate was measured by determination of radial pulsation for one minute. The mean of three successive readings was used. Rate-pressure product was calculated by multiplying heart rate (beats/min) and systolic blood pressure (mm Hg). Maximum oxygen consumption (VO_2 max) was calculated using Cooper's 12-minute run test (CRT) which is a widely used test for assessing cardiorespiratory fitness. The referees were instructed to complete as many laps as they could in 12 minutes. The total distance covered in 12 minutes was determined. It is an indirect estimate of maximum oxygen consumption (VO_2 max), which is the rate of oxygen usage under maximal aerobic metabolism and it is calculated by the following equation [6]: VO2 max (ml/Kg/min) = 22.351 X distance covered in kilometer-11.288.

Statistical analyses:

Data are expressed as means ± SD. Statistical differences between pre-and post-measurements were evaluated using the paired *t*-test. A value of $p \leq 0.05$ was considered statistically significant. SPSS Version 20 (SPSS Inc., Chicago, Ill., USA) was used for all analyses.

Results

Table (1) shows that resting heart rate was significantly lower after the 10-week training program (63.60±4.33) as compared to the pre-training level (74.20±3.27). The mean values for resting systolic and diastolic blood pressures were also found to be lower after the 10-week training program (127.04±4.66 and 72.52±1.82; respectively) as compared to the pre-training levels (113.0 ± 6.89 and 62.6±2.32; respectively).

Table (1): Heart rate, systolic and diastolic blood pressure, Rate Product Pressure (RPP) and VO_2 max during rest and after six 40m sprint and 150m track run X 30sec X 20 times. Mean ± SD shown.

Physiological variables	Pre-measurement	Post-measurement
Heart rate (beat/min):		
Resting	74.20±3.27	63.60±4.33*
After 40m X 6 times	174.08±3.32	164.92±3.09*
After 150m X 30sec X 20 times	183.72±3.9	172.52±4.19*
Systolic blood pressure (mmHg):		
Resting	127.04±4.66	113.00±6.89*
After 40m X 6 times	150.20±6.11	138.84±5.77*
After 150m X 30sec X 20 times	165.28±2.97	154.00±2.95*
Diastolic blood pressure (mmHg):		
Resting	72.52±1.82	62.60±2.32*
After 40m X 6 times	76.84±1.84	72.12±1.71*
After 150m X 30sec X 20 times	82.88±1.66	76.64±1.7*
RPP:		
Rest	9425.7±533.5	7187±664.6*
After 40m X 6 times	26142.4±1069.8	22893.8±952*
After 150m X 30sec X 20 times	30366.5±891.3	26567±791.8*
VO2 max (ml/Kg/min)	49.79±1.19	54.88±1.31*

*: Significant as compared to pre-training measurement $p<0.05$.

After 40m X 6 times and 150m X 30sec X 20 times, the heart rate was increased, but the post-training measurements (1 64.92±3 .09 and 172.52± 4.19; respectively) were significantly lower than the pre-training measurements (174.08 ±3.32 and 183.72±3.9; respectively). Similarly, systolic blood pressure and diastolic blood pressure were increased after exercise, but the post-training measurements were significantly lower than that of the pre-training measurements (Table 1). A significant reduction in resting and post-exercise RPP was observed after a 10-week training program as compared with pre-training measurements. In contrast, maximum oxygen consumption (VO_2 max) was significantly increased after 10-week training program (54.88± 1.31) as compared to the pre-training level (49.79± 1.19) (Table 1).

Table (2) shows that time needed to complete each of the six sprints was significantly lower after 10-week training as compared to the pre-training measurements; it was lower than the required time needed to pass this test.

Table (2): Time spent (sec) in each trial of repeated sprint ability test (40m X 6 times). Mean ± SD shown.

Trials	Pre-measurement	Post-measurement
1st trial	5.99±0.04	5.68±0.09*
2nd trial	5.98±0.03	5.69±0.08*
3rd trial	5.99±0.03	5.67±0.08*
4th trial	6.00±0.03	5.69±0.07*
5th trial	5.99±0.03	5.70±0.08*
6th trial	6.01±0.02	5.67±0.04*

*: Significant as compared to pre-training measurement $p<0.05$.

Table (3): Time spent (sec) in each time of interval test (150m X 30sec X 20 times). Mean ± SD shown.

Trials	Pre-measurement	Post-measurement
1st time	30.17±0.5	29.32±0.42*
2nd time	29.80±0.7	29.36±0.53 *
3rd time	30.07±0.89	29.13±0.66*
4th time	30.15±0.53	29.11±0.48*
5th time	30.17±0.67	28.90±0.31 *
6th time	30.18±0.62	28.87±0.42*
7th time	30.42±0.72	28.80±0.55*
8th time	30.28±0.64	29.06±0.38*
9th time	30.81±0.43	29.32±0.63 *
10th time	30.19±0.71	29.14±0.66*
11th time	29.66±0.58	29.04±0.31*
12th time	30.83±0.96	28.81±0.64*
13th time	30.80±0.75	29.06±0.67*
14th time	30.28±0.52	29.11±0.39*
15th time	30.51±0.56	28.88±0.41*
16th time	30.91±0.65	29.15±0.56*
17th time	30.69±0.72	28.98±0.46*
18th time	31.10±0.85	28.82±0.47*
19th time	3 1.06± 1.00	28.56±0.56*
20th time	30.96±0.88	28.18±0.51*

*: Significant as compared to pre-training measurement $p<0.05$.

Similarly, the time needed to complete high intensity runs in the interval test (150m X 30sec X 20 times) was significantly lower in the post-training measurements as compared to the pre-training measurements; it was lower than the required time needed to pass this test (Table 3).

Discussion

Our results show that the 10-week training program succeeded in improving the referees' physical fitness as evidenced by lowered resting heart rate, blood pressure, and rate-pressure product and increased VO_2 max that enables the referees to pass the FIFA-approved physical fitness tests. Previous studies reported that physical fit persons have lower heart rate and blood pressure and higher VO_2 max **[7,8]** . The training program consisted of aerobic and anaerobic maneuvers. Aerobic exercise augments the parasympathetic nervous system activity leading to a reduced resting heart rate **[7]** . Moreover, reduced resting systolic and diastolic blood pressure after the 10-week training program could be explained by a reduced sympathetic tone which reduced the peripheral resistance and thereby reduced the blood pressure **[9]** .

After exercise (40m X 6 times and 150m X 30sec X 20 times), heart rate, systolic and diastolic blood pressure were significantly increased both in the pre-and post-training measurements. These elevations are due to activation of the sympathetic nervous system and increased cardiac output and these are beneficial to maintain muscle homeostasis and ensure satisfactory blood supply to the muscles. A similar observation was reported by other researchers **[10,11]** who reported an increase in systolic blood pressure with a minor increase in diastolic blood pressure shortly after the beginning of the exercise.

Rate pressure product is an indicator of myocardial work, oxygen consumption, and coronary blood flow. It is the outcome of multiplication of heart rate and systolic blood pressure **[12]** . The present study shows that RPP is lower after the 10-week training program both during rest and after exercise as compared to the pre-measurement. This agrees with the reduction of heart rate and systolic blood pressure and it indicates that the myocardium exert less work with adequate oxygen supply **[12]** this means that training program is optimal to improve oxygen uptake by the myocardium. Similar results were reported by **[11,12]** who noted that athletes have lower RPP as compared to the control.

VO_2 max is a novel predictor of cardiopulmonary health **[13]**. It measures the ability of subjects for aerobic ATP resynthesis **[14]** An increased VO_2 max was reported in the present study after a 10-week training using a wide range of intensity. Previous studies show that endurance training (continuous training with moderate intensity) **[15,16]**, interval training (repeated training for a short duration with high intensity) **[17,18]** as well as training using a wide range of intensities **[13]** could improve VO_2max. An increased blood supply to muscles, increased the amount and the size of the mitochondria with an increased availability of the source of energy and increased cardiac output could explain the increase in VO_2 max **[14]**.

Conflict of interest:

The author (s) declared no potential conflicts of interest.

Funding:

The author (s) received no financial support.

References

1- D'OTTAVIO S. and CASTAGNA C.: Physiological load imposed on elite soccer referees during actual match play. J. Sports Med. Phys. Fitness., 41 (1): 27-32, 2001.

2- WESTON M., CASTAGNA C., IMPELLIZZERI F.M., BIZZINI M., WILLIAMS A.M. and GREGSON W.: Science and medicine applied to soccer refereeing: An update. Sports Med., 42 (7): 615-3 1, 2012.

3- WESTON M., CASTAGNA C., HELSEN W. and IMPELLIZZERI F.: Relationships among field-test measures and physical match performance in elite-standard soccer referees. J. Sports Sci., 27 (11): 1177-84, 2009.

4- MALLO J., NAVARRO E., ARANDA J.M. and HELSEN W.F.: Activity profile of top-class association football referees in relation to fitness-test performance and match standard. J. Sports Sci., 27 (1): 9-17, 2009.

5- FIFA: 2017 FIFA Refereeing International Lists, 2016.

6- COOPER K.H.: A means of assessing maximal oxygen intake. Correlation between field and treadmill testing. Jama, 203 (3): 201-4, 1968.

7- MONT L., ELOSUA R. and BRUGADA J.: Endurance sport practice as a risk factor for atrial fibrillation and atrial flutter. Europace, 11 (1): 11-7, 2009.

8- QUAN H.L., BLIZZARD C.L., SHARMAN J.E., MAGNUSSEN C.G., DWYER T., RAITAKARI O., CHEUNG M. and VENN A.J.: Resting heart rate and the association of physical fitness with carotid artery stiffness. Am. J. Hypertens, 27 (1): 65-71.

9- GUIMARAES G.V., CIOLAC E.G., CARVALHO V.O., D'AVILA V.M., BORTOLOTTO L.A. and BOCCHI E.A.: Effects of continuous vs. interval exercise training on blood pressure and arterial stiffness in treated hypertension. Hypertens Res., 33 (6): 627-32, 2010.

10- ESKILDSEN P., GOTZSCHE H. and HANSEN A.T.: Measuring of the intra-arterial blood pressure during exercise. Acta Med. Scand. Suppl., 239 245-250, 1950.

11- VANDAVASI M. and SUKUMAR C.D.: Effect of Exercise on Blood Pressure in Athletes and Untrained Individuals. J. Cont. Med. A Dent., 4 (2): 37-40, 2016.

12- BUTE S. and SHETE A.N.: Rate Pressure Product and VO2max in young female athletes. Indian Journal of Applied Research, 5 (8): 374-76, 2015.

13- SCRIBBANS T.D., VECSEY S., HANKINSON P.B., FOSTER W.S. and GURD B.J.: The Effect of Training Intensity on VO2max in Young Healthy Adults: A Meta-Regression and Meta-Analysis. Int. J. Exerc. Sci., 9 (2): 230-47, 2016.

14- MCARDLE W.D., KATCH F.I. and KATCH V.L.: Exercise Physiology: Nutrition, Energy, and Human performance, ed 8th, Wolters Kluwer Health, Lippincott Williams and Wilkins, 2015.

15- EDDY D.O., SPARKS K.L. and ADELIZI D.A.: The effects of continuous and interval training in women and men. Eur. J. Appl. Physiol. Occup. Physiol., 37 (2): 83-92, 1977.

16- GOLLNICK P.D., ARMSTRONG R.B., SALTIN B., SAUBERT C.W.T., SEMBROWICH W.L. and SHEPHERD R.E.: Effect of training on enzyme activity and fiber composition of human skeletal muscle. J. Appl. Physiol., 34 (1): 107-11, 1973.

17- BURGOMASTER K.A., HOWARTH K.R., PHILLIPS S.M., RAKOBOWCHUK M., MACDONALD M.J., MCGEE S.L. and GIBALA M.J.: Similar metabolic adaptations during exercise after low volume sprint interval and traditional endurance training in humans. J. Physiol., 586 (1): 151-60, 2008.

18- COCKS M., SHAW C.S., SHEPHERD S.O., FISHER J.P., RANASINGHE A.M., BARKER T.A., TIPTON K.D. and WAGENMAKERS A.J.: Sprint interval and endurance training are equally effective in increasing muscle microvascular density and eNOS content in sedentary males. J. Physiol., 591 (3): 641-56, 2013.

تأثير برنامج تدريبى مقترح لمدة عشر أسابيع على بعض المتغيرات الفسيولوجية والقدرات البدنية لحكام كرة القدم

مقدمة\البحث: فى ضوء التطورات السريعة فى مجال كرة القدم على جميع الجوانب الفنية والمهارية يتطلب تطوير المستوى البدنى والكفاءة الفسيولوجية للحكام ليواكب تلك التطورات فى مجال اللعبة.

هدف\البحث: يهدف البحث إلى تقييم تأثير برنامج مقترح لمدة عشر أسابيع على بعض المتغيرات الفسيولوجية التى تمكن الحكم من إجتياز اللياقة البدنية المعتمد من الإتحاد الدولى لحكام كرة القدم.

منهج\البحث: إستخدم الباحث المنهج التجريبى بأسلوب القياس (القبلى-البعدى) على عدد ثلاثون من حكام كرة القدم منطقة أسيوط كالتالى: إحدى عشر حكم من حكام الدرجة الثانية-ثلاثة عشر حكم من حكام الدرجة الثالثة-ستة حكام جدد بفرع أسيوط لكرة القدم. تم تقييم معدل ضربات القلب وضغط الدم ومنتج معدل الضغط والحد الأقصى لإستهلاك الأكسجين وإختبارات اللياقة البدنية المعتمدة من الإتحاد الدولى لكرة القدم (قدرة العدو المتكررة وإختبار الفاصل الزمنى) قبل وبعد البرنامج التدريبى.

النتائج\: تمت ملاحظة إنخفاض معدل ضربات القلب وضغط الدم وRPP منتج معدل الضغط وزيادة الحد الأقصى لإستهلاك الأكسجين بعد البرنامج التدريبى لمدة ١٠ أسابيع والذى مكن الحكم من إجتياز إختبار اللياقة البدنية المعتمد من قبل الإتحاد الدولى لكرة القدم.

الخلاصة\والإستنتاج: إستنتجنا أن البرنامج التدريبى الذى إستمر ١٠ أسابيع نجح فى تحسين اللياقة البدنية لحكام كرة القدم فى محافظة أسيوط.