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COMPARISON OF PHYSIOLOGICAL RESPONSES BETWEEN INTERVAL METHOD, 8V8 AND 4V4 GAMES AND TECHNICAL-TACTICAL EXERCISE IN SOCCER TRAINING

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ABSTRACT. ***Purpose:*** Football is a sport that requires strong player demands. During the workout of improving the endurance are used exercises with or without the ball as well as racing games. In the present study we analyzed the burden of 4 different types of exercise(intermittent without the ball, 8v8 game, 4v4 game, and technical exercises) to determine which kind is best suited for improving the specific endurance. ***Material***: The sample was 5 professional players (mean ± SD) of age (26± 2.9 years), height (1.79 ± 0,03m) and body weight (75± 3 kg). Prior to the experiment, a Test to determine the anaerobic threshold was performed. Measurements of lactic acid were made by using the Dr Lange photometer, while heart rate measurements by using POLARFT60 portable heart ratemeters. ***Results:*** The assumption of normal distribution was verified using the Kolmogorov-Smirnov test and it was found that in all variables the data follows the normal distribution. For the statistical treatment of the data a Analysis of Variance for repeated measure was used and for the detection of statistically significant differences between the measurement conditions was used the LSD multiple comparison test. The level of significance was defined as $p<0.05$. The analysis of the results showed that there is a statistically significant difference between the different types of exercise: a) the concentration of lactic acid ($F3,12) = 11,053$, $p<0,05$), b) in the min of heart rate >4mmol lactic acid ($F(3,12)= 21,331$ $p<0,05$). c) in the min of the heart rate at 3-4 mmol lactic acid ($F(3,12)= 3,584$, $p<0,05$) d) in the min of heart rate at 2-3mmol lactic acid ($f(3,12= 4,310$,$p <0,05$) and e) averages of the heart rate relative to ANK ($F (3,12)= 25,404$, $p<0,05$). ***Conclusion***: It seems that the 4 different types of exercise cause different metabolic processes of lactic acid production as well as different heart rate responses.

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The intermittent and 4v4 game schedule is better suited to improving the endurance the 8v8 game is suitable for improving aerobic endurance, while technical-tactical exercises do not produce sufficient stimuli to improve endurance but involve speed stimuli.

Keywords: *soccer, lactic acid, heart rate, interval training, 4v4, 8v8, technical exercises.*

Introduction

Football is a sport that requires from the footballers high standards of stamina. This can be confirmed by the fact that the average intensity of a football game is about the 80-84% of VO2max and 171-174 hr/min, percentages that are placed into the anaerobic threshold of the soccer players (Weineck 1992, Helgerud et al., 2001). We should consider the fact that the demands of stamina in team sports are named as "uncircled stamina burdens" , unlike the "cyclic endurance" which is being encountered in medium or long distances in the track field and this is the reason why is it important in team sports and especially in football to use exercises which at first are at uncircled form and at second, cause effects appropriate for the improvement of the specific uncircled endurance (Harre, 1982; Groesser et al., 1986; Zintl, 1988; Wienecke, 1998; Martin, 1979; Schrey and Feil, 2012).

According to Arcelli and Ferretti (1993), sprints 3-5% up to anaerobic threshold which last for a couple of minutes, cause a high production of lactic acid, are the best burden for aerobic training results, while Pate et al. (1984) report that high intensity trainings which are a bit higher from anaerobic threshold, seem to be more effective for the improvement of it. In soccer, for the boost of special endurance or the high intensity endurance are applied drills with or without the ball, with small or big number of players but also technical-tactical drills (Bangsbo, 2006; Fucci and Esposito, 2006; Sassi, 2008; Weineck, 1992; Capanna, 2000). In this research we analyzed the outcome of different drills with or without the ball which are used in football endurance training in order to find which kind offers the most reliable results for the improvement of special endurance in footballers.

Method

Sample: Our sample were five (5) professional footballers (mean ± SD) aged (26 ± 2,9 years old), height (1,79 ± 0,03 m) and overall weight (75 ± 3 kg) who are playing in Super League.

Experimental process

Before the experiment, footballers had passed the Feldstufentest test to identify their anaerobic threshold as well as the heart rate which were corresponded to it (Weinecke, 2007). Subsequently, per three days the players were taking part in four (4) different schedules of drills. Firstly, an interval training drill 3x8min with intermittent run in 110%-120% and 80% of anaerobic threshold (8min: 30sec fast/ 30 sec slow, 8min: 20 sec fast/40 sec slow, 8min: 2min fast/2min slow). Secondly a real condition drill of football game 3x8min (8v8 + 2GK back to back) in all the soccer training ground (100x68m), divided in three equal zones where in middle zone players were made to compete with only two touches and in the other two zones without restrictions but with man to man (Bangsbo, 2006). Thirdly a drill 5x5 min (in 33x40m)(4v4+2GK) with man to man and a technical-tactical drill which aims to the cooperation of 2 players in order to score (3 sets of 10 repeats) , high intensity lasting for 10seconds and 50 seconds rest. For the calculation of heart rate the footballers were wearing portable heart rate transmitters (PolarFT60), with "Polar wear Link" and the lactic acid calculation was made by the use of LP20 photometer of Dr. Lange.

Table 1. Training methods, quantity and intensity in different types of training

Training method	Quantity	Intensity
Interval training	3x8min	110-120% anaerobic threshold
8v8+2GK back to back	3x8min	Man to man (100x68m)
4v4+2GK	5x5min	Man to man(33x40)
Technical-Tactical training	3sets x 10 repeats X 10sec/50sec	100%

Statistical analysis

The review of normal distribution was made by the Kolmogorov-Smirnov test and it was found that in all variables the data are following the normal distribution. For the statistical treatment of the data a Analysis of

Variance for repeated measure was used and for the detection of statistically significant differences between the measurement condition was used the LSD multiple comparison test. The level of significance was defined as $p<0.05$.

Results

The analysis of the results showed that there is a statistically significant difference between the different types of exercise: a) the concentration of lactic acid (F3,12) = 11,053, p<0,05), b) in the min of heart rate >4mmol lactic acid (F(3,12)= 21,331 p<0,05). c) in the min of the heart rate at 3-4 mmol lactic acid (F(3,12)= 3,584, p<0,05) d) in the min of heart rate at 2-3mmol lactic acid (f(3,12= 4,310,p <0,05) e) averages of the heart rate relative to ANK (F (3,12)= 25,404, p<0,05) but f) in the min of heart rate <2mmol/l we didn't found some differences between the different kinds of exercise (F(3,12)+0,562,p<0,05).

Table 2. Lactic acid rates and min of heart rate to : >4mmol/l, 3-4mmol/l, 2-3mmol/l and <2mmol/l. Also the average heart rate into the different ways of exercise and the result in anaerobic threshold test

	Interval[1]	8V8+2GK back to back[2]	4V4+2GK[3]	Tech-Tact[4]	Average anaerobic threshod[5]	*F – rate*
Lactic Acid	5.8 ± 2.26 [2,4]	2.94 ± 0.30 [1,3]	5.92 ± 1.61 [2,4]	3.79 ± 1.23 [1,3]		*11.053**
HR>4 mmol	9.20 ± 8.59 [2,3,4]	1.00 ± 1.73 [1,3]	17.80 ± 3.56 [1,2,4]	0 ± 0 [1,3]		21.331 *
HR:3-4 mmol	9.20 ± 6.91 [4]	4.40 ± 3.44	5.80 ± 2.49 [4]	1.00 ± 0.71 [1,3]		3.584 *
HR:2-3 mmol	9.80 ± 4.60 [2]	14.40 ± 5.73 [1,3]	5.80 ± 2.23 [2]	12.00 ± 8.60		4.310 *
HR<2 mmol	23.80 ± 8.87 [2]	22.80 ± 6.91 [1,3]	25.20 ± 3.11 [2]	25.20 ± 9.01		0.562
Aver HR	169.00 ± 6.29 [2,4]	152.40 ± 8.56 [1,3,4,5]	175.00 ± 2.92 [2,4]	143.20 ± 6.98 [1,2,3,5]	172.20± 5.22 [2,4]	25.404 *

(*numbers indicate were is a statistically significant difference between the different types of exercise)*

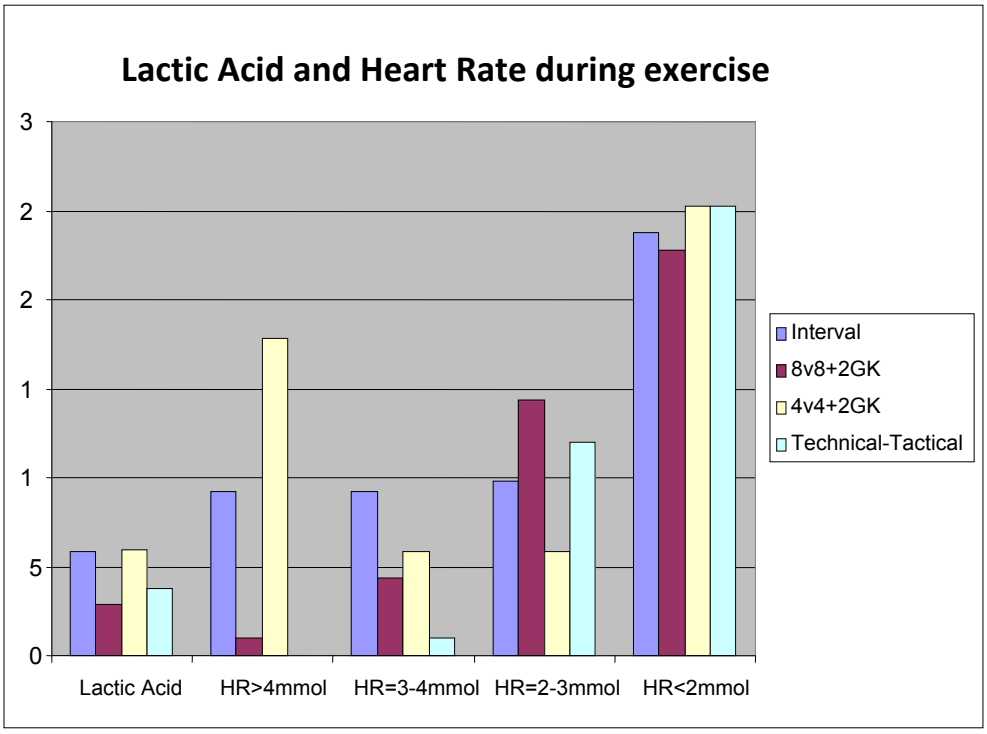

Fig. 2. Lactic acid mmol/l and min of heart rate to >4mmol, to 3-4 mmol/l, to 2-3 mmol/l and <2mmol/l

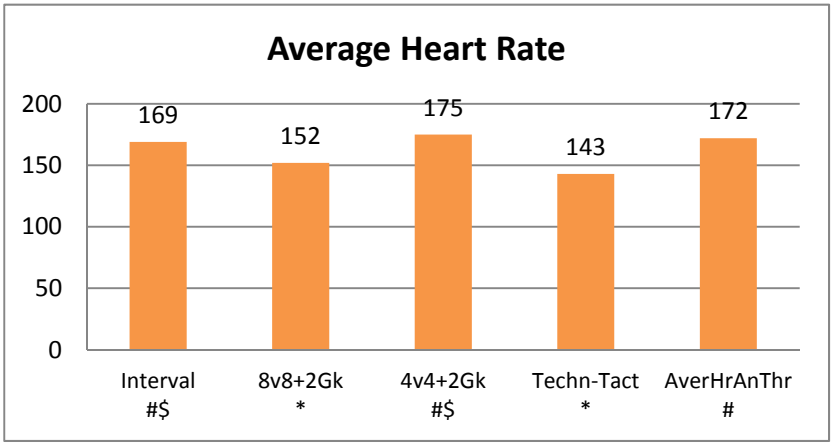

Fig. 3. Heart rate average of the exercises and anaerobic threshold

Note: *=statistically significant difference in contrast with: #, #S;
#$= not statistically significant difference, in contrast with #

Discussion and Conclusion

From the rates of lactic acid and the averages of heart rate in the different kinds of exercise, the higher rates resulted in Interval method (5,8± 2,6 mmol/l), (169±6,26 hr/min) and in 4v4+2GK (5,92±1,61mmol/l), (175±2,92 hr/min) in contrast with the 8v8+2Gk (2,94±0,30mmol/l), (152,4±8,56 hr/min) and technical-tactical training (3,79±1,23mmol/l), (143± 6,98 hr/min).

Similar results were found by Sassi and Tibaudi (2006) by studying similar training methods in football players: 1) Interval training 4X1000m with lactic acid and heart rate (7,9±3,4 mmol/l), (169±4hr/min) respectively, similar to our research, 2) game 4v4+2Gk with lactic acid and heart rate (6,2±1,4mmol/l),(174±7hr/min), similar to 4v4+2Gk of this study, 3) game 8v8+2Gk with lactic acid and heart rate(3,3±1,2mmol/l),(160±3hr/min), alike 8v8+2GK of our research and 4) a technical-tactical training with lactic acid and heart rate (2,9±0,8mmol/l), (140±5hr/min) respectively, same to our technical-tactical training of the study. Impellizeri et al. (2006) studying the effects of two kinds of exercise a) interval 4x4 min in 90-95% of Max HR and b) two real-condition games 3v3+2Gk, 4v4+2Gk (for a 12 week period /2 trainings per week the interference training) found differences only in the 95-100% of Max HR between the two kinds of exercise, when in the other rates of HR(Heart Rate) and in the averages of HR (90,7% and 91,3%) they didn't found any differences, results that partly agree with our research where no differences were found in averages of HR in the 4v4+2Gk game, the interval and in the rates that are corresponded to the anaerobic threshold. Rebello et al. (2016) observing the real-conditions games 4v4+2Gk and 8v8+2Gk found statistically significant differences in lactic acid rates (6,56±1,23and 4,59±1,48 respectively), fact that is confirmed by our research.

As far as that concern the average HR (170±2 and 169±3,5) weren't noted significant differences, facts that agree with Steven et al(2007) who report HR average (175±10hr/min and 168±6hr/min). These conclusions disagree with our research because they were found statistically significant differences of HR between our 4v4+2Gk and 8v8+2Gk games (175±2,92 and 152±8,56) due to the different game restrictions. Dellal et al. (2008) compared the burden which is caused by different kinds of interval training with different real-condition games (1V1, 2V2, 4V4+2GK, 8V8+2GK, 8V8, 10V10+2GK). From this research was concluded that interval training (30sec/30sec in 100%VO2max with active rest at 9Km/h) had a result in average HR(85,7% of MaxHR, statistically significant in relation with the 1v1 (77,6% of MaxHR), 4v4+2Gk (77,1% of MaxHR), 8v8(71,7 of MaxHR) and 10v10+2Gk(75,7 of MaxHR), facts that partly agree with our study where the HR average and the lactic acid in interval training and 4V4+2Gk game are statistically significant different in comparison with the

8v8+2Gk. This is happening due to the different game restrictions and the dimensions of the pitch where the training took place. Arcos et al. (2015) compared the effect of different kind 4v4 (with or without Gk, with Jolly e.t.c.) with an interval (3X4 in 90-95% of MaxHR with 3min constant run between them in 50-60% of MaxHR) according to some physical activity parameters like VAM and CMJ for a 6 week period.

As it emerged from the measurement of HR during the training, the time whose intensity was >90% of MaxHR was bigger than the time of the different kinds of 4v4 compared with the interval (12,7±6,4%, 7,2±3,8% respectively), in full agreement with our study. However, both of them didn't have an impact in VAM and CMJ. Hoff et al(2002) comparing the effect of one special interval training (parcours) and the 4v4+2Gk game in cardiopulmonary parameters found differences either in % MaxHR with rates 93,5% of MaxHR and 91,3 of MaxHR or the average rates of HR with rates of 185,5 and 181, rates that are higher than the corresponding rates of our research. Jastrebski et al. (2014) studying an interval training (7X3min with 15sec intensity/ 15sec jogging) and 3v3+2Gk (7X3 min) for a 8 week period with interfering application of the upper training 2 times per week found that the average HR in both types of exercise was about 85-90% of MaxHR (with only one little difference: 1,5% smaller than 3v3+2Gk game) while it caused different effects. The 3v3+2GK game caused big difference improving VO2Max, while the anaerobic threshold was improved by 12% in 3v3+2Gk game instead of interval which caused only 4% increase. According to Hoff et al. (2004) intensities around 90-95% of MaxHR in set 3-8min is an effective way to improve endurance and in-game performance. Also it is proved that 1 minute is demanded until heart rate (HR) reaches the required high zones (90-95%MaxHR) in order to have the required affects (Hoff et al. 2002). In different exercises with real-condition games (SSG) it was found that 4 minutes were enough to achieve high intensity exercise for at least 3min continuously (Fanchini et al., 2010).

In conclusion, according to the upper elements and from the kinds of exercise we examined, interval training and 4v4+2Gk compared with the 8v8+2Gk and technical-tactical training are the most suitable to improve high intensity endurance both from the metabolic side as well as for the activation of cardiopulmonary system. The 4v4+2Gk seem to cause higher quality results in the improvement of special endurance in contrast with interval. The 8v8 game seem to be more appropriate to improve basic endurance or low-intensity endurance compared with what is believed to improve (endurance of high –intensity) while technical-tactical drills contain agility stimulations and they don't burden the cardiopulmonary but the lactic acid operation-mechanism causing this training method suitable for the last days of competitive circle.

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