EFFECTS OF HIGH INTENSITY AEROBIC INTERVAL TRAINING AND REPEATED SPRINT TRAINING ON AEROBIC AND ANAEROBIC PERFORMANCE IN FOOTBALL PLAYERS

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ABSTRACT

The aim of this study is to examine the effects of the high-intensity aerobic interval and the repeated sprint training model on YYIRT1, RAST and agility. 20 young players (mean age: 17.4, ± age: 0.64 years, mean body weight: 64.7 kg± body weight: 6.04 kg, mean height: 172.6 cm, ± height: 4.57cm) participated. After the players completed YYIRT1, RAST and agility pretests, they were separated into 2 groups. Players in the first group completed 3x (6x40m) repeated sprint training twice a week for six weeks while players in the second group completed 4x4 minute running at 90% maximum heart rate for high-intensity aerobic interval training twice a week for six weeks. Although repeated sprint and high-intensity aerobic interval training had positive effects on YYIRT1, no statistically significant difference was found between the groups (p>0.05). However, significant differences were found in RAST test total time (TT) and the fatigue index (FI) of the players in the repeated sprint group (p<0.05). Repeated sprint or high-intensity aerobic interval training practiced twice a week were observed to affect YYIRT1 levels positively. In the literature, although significant differences in YYIRT1 results were indicated applying the repeated sprint training model, a significant difference was not seen in the current study. However, within the group using the repeated sprint training model, repeated sprint total time decreased and fatigue index improved, showing an improvement in their performance.

Keywords: *YYIRT1, High Intensity Aerobic Interval, Repeated Sprint, Agility*

INTRODUCTION

Football is considered one of the most common and complex sports type where players require technical, tactical, and physical skills. Researches on developing football performance mainly have focused on technical and tactical properties as well as physical properties such as strength, speed, and endurance. In today's world, football has become a fast-paced coordinated race which is played under space and time constraints (1,2).

Characterised by the intermittent structure of the game, active changes occur at 1,200 acyclic structure in each 3-5 second period. In addition, the game includes the 30-40 sprint, more than 700 turns, 30-40 jumps, 2-3 km sprints faster than 15 km, and 600m sprint faster than 20 km. During a match, low intensity, long aerobic exercises corresponds to 78.5% of the total distance where anaerobic exercises correspond to 18.8% (3). Adequate aerobic capacity, and repeated, high-intensity activities, and recovery skills are considered the necessary physiological requirements to be successful in football. During a football game, since 30-40 sprints are run, and there are high-intensity activities, it is clear that anaerobic metabolism has significant effect (3, 4).

Football is an aerobic-based sport where repeated sprints are present and an anaerobic energy path is adopted. Especially, in international football games, the number of short, and long sprints are considerably high (4). When the match analysis studier is considered, football game covers short-time, repeated activities that include maximal or minimal activity and recovery periods (5, 6, 7). Therefore, football practices should be based on increasing both aerobic fitness level and repeated sprint skills. High-intensity, aerobic interval practices are considered as effective practice models to develop overall aerobic fitness levels of the players without any negative impacts on strength, power, and sprint performances (1, 5). The repeated sprint practice model is based on consecutive sprints followed by recovery models (6, 8, 9).

In this study, the effect of Yo-Yo intermittent recovery one which is a football-specific endurance indicator of high-intensity aerobic interval proactive model and repeated sprint practice model on repeated sprint skills and agility was investigated and compared.

METHODOLOGY

Study Group

In this study, the participants were 20 young football players (age17.4 ± 0.64 years old, height 172.6 ± 4.57 cm, weight 64.7 ± 6.04 kg, BMI 20.9 ± 1.90, and BFR 12.6 ± 3.33) who practice four days a week and play one game on the weekend in a regional amateur league. All the participants approved and signed a written document that lists the purpose of the study and the potential risks of the study.

Data Collection/Tests and Measurement

Height, Weight, and Body Fat Ratio: Height of all the football players participated in the study were recorded in a position where the heels are touching each other, the body is vertical to the ground, and without shoes. The measurements were recorded in cm. The measurements were made bare foot and tested with Tanita BC-418 device using bio-impedance method with 0.01 sensitivity.

Agilitt Test: To determine agility levels of the participants, the Illinois agility test was applied.

Repeated Sprint Test: The RAST test was adopted as the repeated sprint test. The RAST test was run as 6x35m and 10 seconds breaks were taken at each

35m. The duration of six 35 m runs were summed and the total running time was calculated.

Fatigue Index: The index was calculated with Maximal Power-Minimal Power / Total Time formula according to RAST test results.

Football-Specific Endurance Test: For the football-specific endurance test,the Yo-Yo intermittent recovery test 1 (YYIRT1) was adopted. During the test, 3 cones were positioned. Running distance was set as 20 metres while recovery distance was set as 5 metres. Before the football players started 20 metre round trip, they had 10 seconds of active recovery time. During the test, round trip speeds were increased at certain periods. As the test continued with these increases, a warning was given if the round trip was not completed, and the test was completed when there was a second warning. Additionally, maximal heart beat number during YYIRT1 test was also identified.

Design of Study

20 football players, who practice during the season, were divided into two groups after pre-tests. The first group attended a repeated sprint practice program for 6 weeks and 2 days a week in addition to the regular practice program. The volume and the intensity of the program were kept constant. The repeated sprint practice model was applied as 3 sets and a 6x40 sprint run. The 40m shuttle sprint was run as a 20m going forward, and 20m coming back and one run was counted as one sprint repetition. Between sprints, 20 seconds passive resting, and between sets 4 minutes passive resting were given.

The second group were included in the high-intensity aerobic interval practice for 6 weeks and 2 days per week in addition to the normal practice. In this practice model, 4x4 minutes run was made according to 90% of maximal heart beat rate obtained during YYIRT1 test. Between sets, 3 minute active resting was conducted at 60% of maximal heart beat rate. Tests were conducted after 6 weeks and the results were compared intergroup pre-test results.

The results were indicated as mean, and standard deviation. For intergroup statistical comparison of sprint and endurance practices, the Man Whitney U test was adopted. For intragroup statistical comparison Wilcoxon test was adopted. Data were analysed using SPSS 10.0 statistical program and $p<0.05$ significance level was used. The Kolmogorov-Smirnov test was applied to test normality.

FINDINGS

Table 1*. Descriptive statistics of the participant players*

	N	Mean	Std. Dev.
Age (years-old)	20	17.4	.64
Height (cm)	20	172.6	4.57
Weight (kg)	20	64.7	6.04
Body mass index (BMI)	20	20.9	1.90
Body fat ratio (BFR)	20	12.6	3.33

As shown in Table 1, 20 volunteer football players participated in the study. Descriptive information showed that the age average was 17.4 ± 0.64 years old, and height average was 172.6 ± 4.57 cm. The weight average of the football players was 64.7 ± 6.04 kg, BMI was 20.9 ± 1.90, and BFR was 12.6 ± 3.33.

Table 2. *Effects of sprint and endurance trainings on performance parameters*

	Group	N	Average Value	Sequence Average	u	z	p
Illinois Right 1	Sprint	10	8.80	88.00	33.000	-1,286	0,199
	Endurance	10	12.20	122.00			
Illinois Right 2	Sprint	10	7.80	78.00	23.000	-2.041	**0.041**
	Endurance	10	13.20	132.00			
Illinois Left 1	Sprint	10	9.10	91.00	36.000	-1,058	0,290
	Endurance	10	11.90	119.00			
Illinois Left 2	Sprint	10	7.70	77.00	22.000	-2.117	**0.034**
	Endurance	10	13.30	133.00			
RAST Total Time (TT) 1	Sprint	10	9.40	94.00	39.000	-0,832	0,406
	Endurance	10	11.60	116.00			
RAST Total Time (TT) 2	Sprint	10	6.50	65.00	10.000	-3.024	**0.002**
	Endurance	10	14.50	145.00			
RAST Fatigue Index (FI) 1	Sprint	10	10.20	102.00	47.000	-0,227	0,821
	Endurance	10	10.80	108.00			
RAST Fatigue Index (FI) 2	Sprint	10	6.10	61.00	6.000	-3.326	**0.001**
	Endurance	10	14.90	149.00			
Yo-Yo 1	Sprint	10	10.60	106.00	49.000	-0,076	0,940
	Endurance	10	10.40	104.00			
Yo-Yo 2	Sprint	10	10.15	101.50	46.500	-0,265	0,791
	Endurance	10	10.85	108.50			

**1 means Pre Test, 2 means Post Test*

Table 2 showed the comparison of parameters of repeated sprint and high-intensity aerobic interval practices of groups. When the pre-test and post-test results of two different practice groups were investigated, there was a statistically significant difference on the right-turn and left-turn of the agility test. Both repeated the sprint practice model and the high-intensity aerobic interval practice model had significant effects on agility values of the football players.

When the RAST test results, which were applied to test the anaerobic endurance levels, were examined, there were significant differences in test complementation times (total test time) and fatigue indexes found.

When the effect of repeated sprint and high-intensity aerobic interval training on aerobic endurance were investigated, there were no significant difference in intergroup development levels.

Table 3. *Intragroup comparison for repeated sprint training group (Wilcoxon)*

	Illinois Right 2-1	Illinois Left 2-1	RAST TT.2-1	RAST FI. 2-1	Yo-Yo 2-1
z	-2.395(a)	-1.784(a)	-2.803(a)	-2.803(a)	-2.712(b)
p	0.017	0.074	0.005	0.005	0.007

**1 means Pre Test, 2 means Post Test*

As Table 3 indicated, while there were no significant differences of only left turn test results of parameters in repeated sprint practices, there was highly significant differences between RAST total time, fatigue index, and Yo-Yo results.

Table 4. *Intragroup comparison for high-intensity aerobic interval training group*

	Illinois Right 2-1	Illinois Left 2-1	RAST TT.2-1	RAST FI. 2-1	Yoyo 2-1
z	-2.191(a)	-.764(a)	-.663(b)	-.561(b)	-2.807(b)
p	0.028	0.445	0.508	0.575	0.005

**1 means Pre Test, 2 means Post Test*

Table 4 indicates the parameters of the football players who applied the high-intensity aerobic interval practice model. While there were significant differences for the yo-yo test, which is an indicator of right-turn agility and aerobic endurance, there was no significant difference between other parameters.

DISCUSSION

The aim of this study was to investigate the effect of repeated sprint and high-intensity aerobic interval practice models applied on young football players on aerobic and anaerobic performance. After the pre-tests were applied to 20 football players who participated in the study, the participants were divided into 2 groups as repeated sprint practice model and high-intensity interval aerobic practice and were included in these practices for 6 weeks and 2 days per week.

In this study, the repeated sprint practice model was applied for 6 weeks and 2 days per week as 3x (6x40m) sprint run. The 40m shuttle sprint was run as 20m going forward, and 20m coming back and one run was counted as a one sprint repetition. Between sprints, 20 seconds passive resting, and between sets 4 minutes passive resting were given. As high-intensity aerobic interval practice model, 4x4 minute high-intensity running at 90% maximal heart rate ratio was applied for 6 weeks and 2 days per week. Between sets, 3 minute active resting was applied at 60% of maximal heart beat rate as low-intensity running. When 2 different practice models adopted in this study were compared, there were similarities between the yo-yo intermittent recovery test 1 (YYIRT1) results which was used for measuring football-specific endurance. These results indicated a positive effect. In this study, although there was a significant statistical increase (p=0.005) in high-intensity aerobic interval practice group on YYIRT1, and a

statistical increase (p=0.007) on the repeated sprint practice, when the practice models were compared there were no significant differences between models. The literature review indicated that groups that applied repeated sprint practice model had development in football-specific endurance levels (5).

It is well-known that YYIRT1 performance and VO_2 max correlate (10, 11, 12). Differences in YYIRT1 test results of the players who had similar VO_2max levels could be caused by the physiological requirements in tests. While during VO_2max test aerobic power is often measured, YYIRT test contributed to both aerobic and anaerobic energy systems (1, 10). The repeated sprint practice model provides aerobic and anaerobic metabolism development (13-16). Impellizzeri et al. (2008) stated that when there were 20 seconds breaks between runs and 3 minute breaks between sets during 8-week seasonal practices applied for 2 days per week, increased YYIRT1 results 28.15% and repeated sprint skills by 2.1% after 3x(6x40m) repeated sprint running protocol. In the same study, 4x4 minute high-intensity aerobic interval practice model with 3 minute breaks were given between sets was applied. YYIRTR1 performance increased 12.5% while there was no significant difference in repeated sprint skills (17). In line with this study, Hill-Haas et al. (2009) applied 18-20x30-60 second repeated sprint runs for 7 weeks during the season for 1 day per week where 60-90 second rests were given for 7x34 m sprints with 35 second rest between runs. The study obtained a 22% increase in YYIRTR1, however there was no significant increase in repeated sprint skills. Hill-Hass et al.(2009) applied the 3-6x6-13 minute high-intensity aerobic practice model for 7 weeks, 2 days per week at >80% maximal heart rate. The authors observed a 17% increase in YYIRT1 performance while there were no significant differences at repeated sprint skills (19). Jensen et al. (2007) applied high-intensity aerobic interval practice model during 12 weeks of the season for 30 minutes (2-4 minutes). The results indicated that when 1-2 minute rests were given between sets, repeated sprint skills increased 20.8%(19).

There are significant differences in favour of repeated sprint practice model when the RAST test total time (RAST Top.) which was used for measuring repeated sprint test and fatigue index (RAST YI) were compared. Although repeated sprint skill have no significant effect on aerobic power (21, 22), average repeated sprint time was reflected to anaerobic metabolism increase and this was an important indicator of repeated sprint skills (22). In this study, the average time of repeated sprints was excluded. However, the total repeated sprint time was investigated as another indicator. The fatigue index that was calculated for repeated sprint total time and 6 sprint runs showed significant differences in the group that applied repeated sprint practice model. The reason for this could be that anaerobic metabolism developed with repeated sprint practices. Another factor that affects fatigue in repeated sprint practices could be that the dominance of parasympathetic activity which is a neuromuscular parameter (23).

Castagna et al. (2007) applied the 7x30m repeated sprint with 20 second rest between sets. The study observed no significant difference for total repeated sprint time. However, there was significant difference for fatigue indexes (24). It is well-known that there is a relationship between repeated sprint performance and VO_2max (20, 21). In this study, significant difference in fatigue index among

repeated sprint practice model could be caused by significant development of aerobic capacities of football players. Impellizzeri et al. (2006) observed similar results when they investigated the effect of tight space games and high-intensive running practices applied for 12 weeks before the season (7.1% increase) (25). In another study, which lasted for 8 weeks during the season, no significant difference was found for VO_2max levels (1, 5). This situation could be linked with pre-practice levels of the football players. When the literature is reviewed for repeated sprint practice model, there were differences between total sprint numbers, weekly practice day numbers, and sprint resting periods. At the same time, the literature showed higher volume sprints compared to this study (26-29). Similar to this study, Impellizzeri (2008) identified that 18 shuttle sprint run with lower maximal intensity for 2 days a week significantly increased aerobic endurance levels of the players (17). The low-volume repeated sprint practice model is considered more advantageous in terms of time to high-intensity aerobic interval practice model (30).

When agility results of repeated sprint and high-intensity aerobic interval practice groups were investigated, there was a significant difference among both groups in terms of right-turn. Since players in repeated sprint group use their right foot for the last turn in 20m shuttle turns and they turn with push force from the ground, this significant difference was visible. It is believed that significant differences in right-turns of high-aerobic interval practice groups could be caused by constantly turning from the same side in the field.

Consequently, high-intensity aerobic interval practice or repeated sprint practice 2 days per week in addition to seasonal practice plans positively affected YYIRT1 levels. Based on the literature review, there were significant differences in the YYIRT1 results of the groups that were applied repeated sprint practice. However, in our study, there were no significant differences between groups. Yet, when the groups were compared in the same way, repeated sprint total time of the group that had repeated sprint practice model were decreased, fatigue index after each 6x35 repeated sprint run improved. Therefore, the performance of the football players was positively affected (31). In our study, it was determined that both high-intensity aerobic intervals and repeated sprint practice model had significant effects on the agility of the group.

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