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EFFECT OF PLYOMETRIC TRAINING ON REPEATED SPRINT PERFORMANCE IN AMATEUR SOCCER PLAYERS

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Abstract:
The aim of this study was to investigate the effect of plyometric training on repeated sprint ability in amateur soccer players. Twenty amateur soccer players participated in this study as the subject. The subjects were randomly assigned to plyometric training group (n=10, age: 19.7±2.26 years) and control group (n=10, age: 18.8±0.6 years). The training group is experienced a plyometric exercise 2 days a week for 12 weeks. Pre- and post-tests assessed 6x35 meters (Repeated Anaerobic Sprint Test) repeated sprint test, body composition, rest heart rate, and peak heart rate in control and plyometric group. For the comparison of groups, paired samples t-test and independent (IBM SSPS 21.0) was used. The results revealed that significant difference in six piece repeated first sprint after the 12 weeks plyometric training were in the plyometric group. The plyometric group also showed a significant difference in rest heart beat rate, peak heart beat rate, right leg fat (%), fat mass, fat free mass, left leg fat mass, and fat free mass. However there was no a significant difference in left leg fat (%), BMI, BMR and total body water. The major finding in the study was the significant improvements in repeated sprint performance and body composition. According to these results, it can be said that practicing of plyometric training develops repeated sprint performance and also increases mass fat loses, in addition to regular soccer training.

Keywords: plyometric training, repeated sprint, amateur soccer players

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1. Introduction

Tactical part of football is developing rapidly. With this development, practice and physical condition in football plays a significant role. Time reaction, power, strength, aerobic, anaerobic capacity and ability are among most important skills in sports (Dadic, Svilar, and Milanovic, 2014, Birinci et al., 2014, Yılmaz et al., 2017, Mayda et al., 2016). When we considered these factors, during the game, it is stated there 2 and 4 second sprints occur for each 90 second and these sprints correspond to 3% of the duration of the game and 1-11% of the distance. Approximately, 96% of the sprints is shorter than 30 m and 49% are shorter than 10 m. Thus, performance and initial speed above or below 10 m is the key indicator of the performance of the player. Additionally, many of the games have bursting movements and approximately 15 steals and 10 headers require hitting the ball and different speeds at different distances (Chelly et al., 2010). Repeated sprints (RS) are less considered subjects. Historically, since the movement of the player could not be estimated in field-based, team sports games, investigating repeated sprint skills is challenging. However, with technological developments, researches have the opportunity to document templates of team player movements (time-motion analysis). In field-based, team sports games, researches for time-motion analysis stated that average sprints occur between 10-20 meter and 2-3 seconds (Spencer, Bishop, Dawson, and Goodman, 2005).

Various researches (Oliver, Armstrong, and Williams, 2009; Krustrup et al., 2003; Mohr, Krustrup, and Bangsbo, 2003, Yılmaz, 2016) stated that high level football players during a football game, had higher running intensity compared to lower level players. Thus, in sports types that has multiple sprints, identifying repeated sprint skills of players was considered as an important performance indicator (Oliver, Armstrong, and Williams, 2009, Krustrup et al., 2003, Mohr, Krustrup, and Bangsbo, 2003; Yılmaz et al., 2017). Previous researches (Shalfawi et al., 2012, Iaia, Rampinini, and Bangsbo, 2009) suggested that successful team have the ability to produce high-speed repeated movements compared to less successful teams.

Plyometric practice is a common physical condition type. The objective of plyometric practice is to increase the power by using the natural, flexible components of the muscle, strain reflex of tendons and balance. In sports types such as football and rugby, plyometric practice could be selected. Plymetric practice increases neuromuscular functions (Behm, Faigenbaum, Falk, and Klentrou, 2008, Markovic, and Mikulic, 2010, Lloyd, Meyers, and Oliver, 2011, Mahmood et al., 2017) and bone mineral density (Witzke, and Snow, 2000), promote psychological health, reduce cardiovascular disorder ratios, develop weight control, and decrease injuries in sports. Researches

adopt plyometric practice in experiment groups and measure sportive capabilities of the participants (Bedoya, Miltenberger, and Lopez, 2015). The studies indicated that different practice methods such as plyometric practice could positively contribute to sports performance. Plyometric method is one of the method that could produce positive outcomes (Dadic et al., 2014).

In this study, the effect of plyometric practices of amateur football players on repeated sprint performance was investigated. In this study, it was assumed that plyometric practices would develop repeated sprint performance and body compositions of the amateur football players. Thus, it is expected that the results of experiment group would be better than control group.

2. Material and Method

2.1 Research Group

Research group consists of Telekomspor that competes in Super Amateur League in Samsun province during 2015-2016 season. This study was conducted on total of 20 healthy and volunteer participants where 10 participants were randomly selected as experiment group (19.7±2.26) and the remaining 10 were control group (18.8±0.6). Before the study, written permissions were taken from the participants. During the study, experiment and control group (CG) continued team practices, and practice group (PG) went under plyometric practice program for 12 weeks, 2 days a week for 30-35 minutes including warm up. Before plyometric practice program, pre-test and post-test measurements were done for both groups.

This study was approved by Ondokuz Mayıs University Clinical Research Ethical Board on 20/11/2015, issue B.30.2.ODM.0.20.08/2057.

2.2 Data Collection Tools

Body Analysis of Participant: Before test and practice, height of participants were measured. The measurement were taken in vertical position where the participants were bare foot and stand parallel the ground and their shoulder and gluteal section was in contact with the wall. During body composition analysis (Tanita BC418) measurements, participants only wore short and t-shirt. Weight, BMI, fat percentage (F%), fat mass (FM), weight without fat (WWF) were identified.

Identifying repeated Sprint Skills: Before the tests, to ensure that tests were effectively done and there were no injuries, slight jog and stretching exercises were done for 15 minutes. In RAST (repeated sprint skill test protocol) sprints consist of 6x35 metre with 10 seconds rest. To identify repeated sprint skills of players, Newtest 300

(Finland) test batteries were used. When participant started running behind the initial photocell, the photocell began the measurement, and sprint durations for 6 different repeated sprints were recorded in terms of seconds.

Measurement of Heart Beat Rate: Heart beat rates of the players were measured before the practice while they were seated, after 6x35 repeated sprint test using Riester 4240 Cardiophone stethoscope and Q&Q watch for 15 seconds and by multiplying this result with four.

2.3 Data Analysis

Compliance of the tested parameter with normal distribution was tested with Shapiro-Wilk test. As the data has normal distribution, doing parametric analysis ($p>0.05$) was decided. Dependent group comparison was made with Paired Samples - T test and intergroup comparison was made with independent t-test. Significance level of the results were evaluated as $p>0.005$.

3. Findings

Table 1: Comparison of Pre-Test and Post-Test of Practice and Control Group Physical Properties

Variables	Measurement	Practice group (n=10) X±SS	Control group (n=10) X±SS	P	
				PG	CG
Height	pre-test (1)	174.4±7.71	176.60±5.02		
	post-test (2)	174.4±7.71	176.60±5.02		
Weight	1	68.29±7.96	67.85±7.42		
	2	67.86±9.28	67.72±7.49		
BMİ	1	21.91±1.83	21.61±1.78	0.516	0.221
	2	21.90±1.88	21.74±1.81		
BMR (kcal)	1	1834.40±203.73	1851.1±159.48	0.34	0.31
	2	1831.30±210.74	1876.2±163.08		
F%	1	8.95±2.77	9.22±3.16	0.27	0.21
	2	8.82±2.81	7.81±3.54		
FM (kg)	1	5.93±1.71	6.56±2.46	0.694	0.144
	2	5.29±2.68	5.32±2.96		
WWF (kg)	1	62.37±7.15	61.30±5.68	0.694	0.239
	2	62.47±7.01	62.41±5.96		
FR (kg)	1	45.90± 6.18	44.88±4.37	0.123	0.194
	2	46.95±4.83	45.88±4.21		

There were no significant differences between Height, Weight, VKI, BMR, Fat (%), Fat Mass, WWF, and Fluid Ratio (FR) values of practice and control group for pre-test and post-test (p>0.05) (Table 1).

Table 2: Results of Comparison of Repeated Sprint Test and Heart Beat Rate Pre-Measurement of Practice and Control Group

Variables	Measurement	Practice group (n=10) X±SS	Control group (n=10) X±SS	P PG and CG
RHR	1	61.40±9.32	64.00±9.11	0,536
RS1(1. 35m)	1	4.72±0.19	4,73±0,13	0.934
RS2 (2. 35m)	1	4.87±0.09	4.88±0.10	0.853
RS3 (3. 35m)	1	4.98±0.12	5.10±0.19	0.110
RS4 (4. 35m)	1	5.17±0.16	5.28±0.17	0.175
RS5 (5. 35m)	1	5.37±0.23	5.57±0.39	0.189
RS6 (6. 35m)	1	5.57±0.24	5.58±0.22	0.954
PHR	1	199.5±18.79	201.80±13.44	0.757

When rest heart rate, peak heart rate, and repeated sprint skill pre-test were investigated, there were no significant relationship between practice and control group (p>0.05) (Table 2).

Table 3: Results of Comparison of Repeated Sprint Test and Heart Beat Speed Pre-Measurement and Post-Measurement of Practice and Control Group

Variables	Measurement	Practice group (n=10) X±SS	Control group (n=10) X±SS	P	
				PG	CG
RHR	1	61.40±9.32	64.00±9.11	0.0*	0.0*
	2	59.30±8.00	62.00±8.31		
RS1	1	4.72±0.19	4,73±0,13	0.00*	0.0*
	2	4.54±0.22	4.63±0.15		
RS2	1	4.87±0.09	4.88±0.10	0.0**	0.0**
	2	4.67±0.16	4.80±0.12		
RS3	1	4.98±0.12	5.10±0.19	0.0*	0.231
	2	4.82±0.23	5.02±0.10		
RS4	1	5.17±0.16	5.28±0.17	0.00*	0.0*
	2	5.05±0.19	5.20±0.13		
RS5	1	5.37±0.23	5.57±0.39	0.00*	0.139
	2	5,27±0.23	5.42±0.17		
RS6	1	5.57±0.24	5.58±0.22	0.00*	0.90
	2	5.49±0.25	5.58±0.19		

PHR	1	199.5±18.79	201.80±13.44	0.0*	0.0**
	2	193.8±18.58	199.60±12.57		

When RHR, PHR, and pre-test and post-test of 12-week plyometric practice of repeated sprint skills were investigated, there were significant differences in practice group ($p<0.05$). When RHR, PHR, RS 1, RS 2, RS 4 pre-test and post-test results of control group were investigated, there were significant differences ($p<0.05$). When RS 3, RS 5, RS 6 pre-test and post-test results were investigated, there were no significant differences ($p>0.05$) (Table 3).

Table 4: Comparison of Physical (Foot) Properties Pre-Test and Post-Test of Practice and Control Group Physical Properties

Variables	**Measurement**	**Practice group (n=10) X±SS**		**Control group (n=10) X±SS**		**P**			
		Right Foot	**Left Foot**	**Right Foot**	**Left Foot**	**Right Foot**		**Left Foot**	
						PG	**CG**	**PG**	**CG**
F %	1	7.62±2.56	7.42±2.68	6.74±3.86	6.22±3.95	0.0*	0.81	0.106	0.725
	2	7.02±2.46	7.11±2.54	6.68±3.70	6.14±3.73				
FM	1	1.03±0.39	1.02±0.40	0.92±0.42	0.85±0.40	0.0**	0,415	0.0*	0.363
	2	0.85±0.40	0.88±0.37	0.86±0.48	0.80±0.45				
WWF	1	11.00±1.37	10.99±1.30	10.61±0.64	0.66±0.66	0.0**	0.0**	0.0*	0.095
	2	11.69±1.12	11.55±1.27	11.00±0.83	11.05±0.94				

After 12-week plyometric practice of the practice group pre-test and post-test right leg fat (%), Fat Mass, WWF values were investigated and there were significant differences ($p<0.05$). When Fat (%) and Fat Mass of right foot of control group were investigated for pre-test and post-test, there were no significant differences ($p>0.05$). However, there were significant differences for WWF pre-test and post-test results ($p<0.05$) (Table 4). For left foot Fat (%) pre-test and post-test values of practice group, there were no significant differences ($p>0.05$) (Table 4). When Fat Mass and WWF values of pre-test and post-test were compared, there were significant differences in practice group ($p<0.05$). For left foot Fat (%), Fat Mass and WWF values of pre-test and post-test values of control group, there were no significant differences ($p>0.05$) (Table 4).

4. Discussion and Results

In this study, it was aimed to investigate the effect of 12-week plyometric practice of amateur football players on repeated sprint performance and certain physiological

properties. When the findings of this study were examined, after 12-week plyometric practice, there were significant differences between pre-test and post-test of repeated sprint performance of experiment group (Table 3). While RS 1 average was 4.72 seconds before plyometric training (PT) it was 4.54 sec. after PT; while RS 2 average was 4.87 sec. before PT, it was 4.67 sec. after PT, while RS 3 average was 4.98 before PT, it was 4.82 sec. after PT; while RS 4 average was 5.17 before PT, it was 5.05 sec. after PT; while RS 5 average was 5.37 sec. before PT, it was 5.27 sec. after PT; while RS 6 average was 5.57 sec. before PT, it was 5.49 sec. after PT (Table 3). When the literature is reviews, there are similar studies that investigated plyometric practice and repeated sprint skills (Haghighi et al., 2012). When separate plyometric practice and repeated sprint skill studies are examined: Haghighi et al., (2012) applied 8-week plyometric practice for sub-extremity to a different group to measure the effect of plyometric practice and durability practices on sprint and skill performances of young football players. Before and after the study, separate 30 sec. 6x15m repeated sprint tests were applied to plyometric group (n=10, age: 19.1 ± 1.7) and durability practice group (n=10, age: 18.0 ± 0.81). After the test, there was statistical significance between control group and plyometric practice group and there were statistically significant differences between durability practice group and control group (n=10, age: 18.8 ± 1.5). Michailidis et al., (2013) applied 12-week plyometric practice 2 times a week on pre-adolescence football players. As a result of the program, there were significant differences for 10m, 20m, and 30m sprint tests. Söhnlein, Müller, and Stöggl (2014) separately measured week 4, 8, 12, and 16 20m metre sprint tests conducted on adolescence football players for 16-weeks. The measurements after week 8 and 12 have similar development results. Moreover, pre-measurement and post-measurement of 30m sprint test after week 16 was significant. Kotzamanidis (2006), applied 10-week plyometric practice that contained total of 790 jumps. There were significant differences between control and practice group for 0-10m; between groups and inside practice group for 10-20m; between groups and inside practice group for 20-30m; and between groups and inside practice group for 0-30m. Dadic, Svilar, and Milanović (2014) applied 7-week plyometric practice on football players between 16-18 years old. After plyometric practice, there were significant differences between practice and control groups for 30m sprint test. Villarreal, Requena, and Cronin (2012) emphasised that if plyometric practice is intense during the general practice (each week the number of jumps increased), sprint performance would develop. Sohnlein et al., (2014); Michailidis et al., (2013); Meylan and Malatesta (2009), increased the number of jumps (practice intensity) for beginner level each week. In this study, practice intensities should be higher at week 5 and 8. This situation could be another reason for development in repeated sprint skill of

practice group. When the studies above that investigated the effect of plyometric practice on sprint performance and this study were considered, there are similarities between 30m sprint of the literature and first sprint of RAST (35m) (Table 3) of this study.

When 6-7 week plyometric and 12-week plyometric practices are considered, 6-7-week plyometric practice has effect on agility however; there was no significant effect on sprint performance. These comments could be made based on other studies in the literature (Nakamura et al., 2012; Chelly et al., 2010). These types of discrepancy could be caused by differences of plyometric practice methods or congruity of participants (football players) (Chelly et al., 2010). Additionally, Nakamura et al. (2012) applied 3-week plyometric practice for twice a week on player participants when the game season was completed. When control group that never had practice and practice group were compared, there were no significant differences for 20m sprint. Based on this study, it can be commented that plyometric practice could be effective for practice programs that are longer than 6-7 weeks. Additionally, it can be deducted from the study of Nakamura et al. that plyometric practices after the season does not benefit to sprint performances of players.

Similar literature review showed similar results with this study (Thomas et al., 2008; Haghighi et al., 2012; Michailidis et al., 2013; Kılıç, 2008). However, other literature that has shorter plyometric practice duration does not coincide with the findings of this study (Miller et al., 2006 and Gomez et al., 2008). It is believed that the differences in these studies depend on gender, practice status, test method, type and duration differences of devices, intensity, and practice types used during the practice program (Vaczi et al., 2013).

Based on the results of this study, it is believed that 12-week plyometric practice applied on amateur football players could lead up to develop repeated sprint performance, and certain physiological properties.

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