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Examination of Physiological and Performance Responses of Repeated Sprint Tests in Football Players

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ABSTRACT

Purpose: This research was conducted to examine the physiological and performance responses of repeated sprint tests in football players.

Method: 14 amateur male football players participated in the research. Measurements were made at Bingöl University Sports Hall. Height, body weight, age, sports year, body mass index (BMI) and body fat percentage (BFP) measurements were taken for defining characteristics of the participants. For repeated sprint measurements, participants participated in straight repeated sprint (6x25m; StRST), 180° shuttle repeated sprint (6x(2x12,5m); ShRST) and 100° repeated change of direction sprint (6x25m; RCODST) tests with 25 second passive rest in random order on three separate days. The best sprint time (BST), total sprint time (TST) and performance decreasing percentage (PDP) values of the participants were determined as performance responses after three different RST. In addition, resting heart rates (HRrest) and the warm-up heart rates (HRwarm) were taken with the help of polar clock.

Findings: The mean age of the participants in the study was 20.42±1.39 years, sport year 4.71±3.83 years, height 1.74±0.05 m, body weight 64.77±7.24 kg, BMI 21.22±1.97 kg/height2 and BFP 11.20±3.42 (%). There were no significant differences in the values of HRrest before warm-up and HRwarm before exercise ($p>0.05$) as a result of the comparison of the different sprint tests. BST and TST values were significantly different at $p<0.001$ as a result of different sprint tests. The results of the Bonferroni multiple analysis to determine which group the difference is from show in Table 2 that StRST-BST values are better than ShRST-BST and RCODST-BST. Similarly, StRST-TST values are better than ShRST-TST and RCODST-TST values. There was no significant difference in RPEmax values as a result of comparison of different sprint tests.

Results: There was no significant difference in the physiological variables and RPEmax values of the participants. However, StRST has been found to give more positive performance responses than ShRST and RCODST.

1. Introduction

Football is one of the most popular team sports in the world, with millions of athletes regularly working as members of football clubs. Among the physical parameters, sprint ability, especially with short recovery times, is one of the most important as it can distinguish football players at different levels. Sprint has been suggested as the most frequent action before a goal (Nikolaidis et al., 2016). In football, various psychological, mental, physiological, coordinated technical-tactical features as well as conditioning features are needed to be improved. In the context of the conditioning characteristics of football players, players with high sprint ability can be said to have an important and influential role in the football match (Barnes et al., 2014).

In many team sports, such as football, athletes run a different number of repeated sprints, ranging from low to high. Studies have shown that during football matches, sprint runs occur repeatedly before adequate recovery time has expired, and thus there is a deterioration in successive sprint performance (Spencer et al., 2004; Spencer et al., 2006). Thus, one of the most important characteristics of a team sport athlete is that he / she has the ability to apply sprints with short-term and short recovery intervals and this ability is called repeated sprint ability (Mujika et al, 2009). Many studies show that repeated sprint ability is a fairly important performance determinant for football (Meckel et al., 2009; Mujika et al., 2009).

In team sports, players performing during the competition is performing high intensity movements and full relaxation a large number of high-intensity activity, this also affects the sustainability of both the players and the success of the team (possession of the ball, interference with the ball, etc.) . In team sports, repeated sprint ability (RSA) training, which includes short time sprints with short recovery intervals (in accordance with the game structure of the sport), is also used for this purpose (Faiss et al., 2013; Brocherie et al., 2015a).

Due to the rapid flow of play, players in football must have high endurance to perform repeated sprints, jumping, dribbling, kicking the ball and changing direction quickly (Silva and Pereira, 2017).

Although repeated sprinting, defined as an ability to produce maximum sprint effort, supported by short rest periods, represents a small fraction of the activity during a match in team sports such as football, basketball or rugby today, it can affect the score of a match. (Oliver et al., 2007).

Repeated sprint ability is an ability supported by short rest periods that allows maximum repeat production of sprint effort and is considered an important conditioning component for many team sports (Hill-hass et al., 2017).

2. Method

2.1.The Model of the Research and Study Group

This research was conducted with an experimental model. 14 amateur male football players from Bingol province who had an average age of 20.42±1.39 years, sports year 4.71±3.83 years, height 1.74±0.05 m, body weight 64.77±7.24 kg, BMI 21.22±1.97 kg/height2 and BFP 11.20±3.42 (%) participated in this study. The research was conducted in Bingol University Sports Hall. Participants participated in their different RST in random order on 3 different days at least 24 hours apart. All tests were conducted between 12:00 and 14:00 noon. Participants were asked not to do any training on the day before the tests, not to consume caffeinated drinks and to eat at least 2 hours before the tests (Göveli, 2019).

2.2.Materials

Height, Body Weight, BMI and BFP: The height of the participants was measured by a wall-mounted stadiometer (Holtain, England) with a sensitivity rating of ±1mm. The body weight and BFP measurements of the participants were measured using electronic scale and biolectric impedance method (InBody 270) with a degree of sensitivity of ±100 g. The body mass index was evaluated using the formula kg/height2.

HR: Participants' Resting Heart Rate (HRrest) and Warm-up Heart Rate (HRwarm) were recorded at one sec intervals with telemetric heart rate monitors (Polar M400, USA).

Rating of Perceived Exertion (RPE): The RPE values of the participants were determined by the Rating of Perceived Exertion Scale of the Borg, whose scores ranged from 6 to 20. 6 on the scale represents the lowest difficulty rating, while 20 represents the highest difficulty rating (Borg, 1982).

Repeated Sprint Test (RST): Repeated sprint performance determined by applying three different RST was measured using the two-door photocell system (Fusion Sport, Australia). As RST, straight repeated sprint test (StRST) 6*25 m., shuttle repeated sprint test (ShRST) 6*(2*12,5 m), and 1000 repeated change of direction sprint test (RCODST) 6*25 methods were used.

2.3.Procedure

Prior to the RST, each participant ran 2 maximal 25 m sprints with a rest interval of 2 minutes for each RST. These runs were made to determine the duration of the maximal sprint run to enable participants to participate in repeated sprint tests with maximal effort. For each repeated sprint test after the maximal sprint run, participants were expected to run the first sprint run in a time equivalent to at least 95% of the maximal sprint run value (Buchheit et al. 2010; Gantois et al, 2017; Chaouachi et al., 2010; Göveli, 2019). No participant ran lower than 95% of the maximal sprint in the first sprint runs for all tests. After the maximal sprint run, participants performed 5 minutes of passive rest and then participated in their StRST, ShRST and RCODST with a 25 sec rest interval in random order on different days. Prior to repeated sprint tests, participants were allowed to take the ready position 5 seconds before the end of the rest period and to start the test by counting backwards in a voice manner for the last 3 seconds before the start of the test. During the RST, the RPE scale was shown at the end of each 25 m and participants were asked what they felt and RPE values were recorded for each sprint repeat (Göveli, 2019).

2.4.Determination of Performance Variables for Repeated Sprint Tests

For each repeated sprint test (StRST, ShRST, and RCODST), the following performance variables were determined.

Best Sprint Time (sec): Fastest sprint time achieved during 6 sprint repetitions (Wadley and Le Rossignol, 1998).

Total Sprint Time (sec): Total of all sprint times run during the test (Wadley and Le Rossignol, 1998)

Performance Decreasing Percentage (%): The decreasing in sprint time during testing was calculated by the formula developed by Wadley and Le Rossignol (1998) (Göveli, 2019).

PDP (%): [(Total Sprint Time x 100)/Optimal Sprint Time]-100

2.5.Data Analysis

Statistical analysis of the data obtained from SPSS 23 program and the significance level was accepted as 0.05. Descriptive statistics of variables (Mean ± Standard Deviation) were calculated. The compatibility of variables with

normal distribution was controlled by Kolmogorov-Smirnov test. Deviation from normal distribution was found to be insignificant for all variables (p>0.05). The effect of different RST on physiological and performance variables was determined using Anova in repeated measurements. The Bonferroni Post-Hoc Test was used to determine which RST the difference was due to when the Anova statistic was significant

3. Findings

Table 1. Characteristics of the Participants

Variables	M	SD
Age (yrs)	20,42	1,39
Sports year (yrs)	4,71	3,83
Height (m)	1,74	,05
Weight (kg)	64,77	7,24
BMI (kg/height^2)	21,22	1,97
BFP (%)	11,20	3,42

BMI: Body Mass Index, BFP: Body Fat Percentage, M: Mean, SD: Standard Deviation

According to Table 1, the mean age of the participants was 20.42±1.39 years, sport year was 4.71±3.83 years, height was 1.74±0.05 m, body weight was 64.77±7.24 kg, BMI was 21.22±1.97 kg/height2 and BFP was 11.20±3.42 (%).

Table 2. Comparison of performance and physiological responses to different repeated sprint tests

Variables	StRST x̄±SS	ShRST x̄±SS	RCODST x̄±SS	F	p
$HRPM_{rest}$ (heart rate.$^{min-1}$)	73,21±5,14	72,64±6,72	74,92±4,26	0,661	0,522
$HRPM_{warm.}$ (heart rate.$^{min-1}$)	145,42±26,69	131,64±19,19	141,42±12,63	1,702	0,196
BST (sec)	3,666±0,159*	5,123±0,179*	6,719±0,342*	560,458	0,000***
TST (sec)	22,952±0,618*	31,795±1,224*	41,541±2,377*	481,864	0,000***
PDP (%)	4,447±3,392	3,419±1,419	3,010±1,225	1,533	0,229
RPE_{max}	13,214±1,050	13,714±1,540	14,142±0,949	2,072	0,140

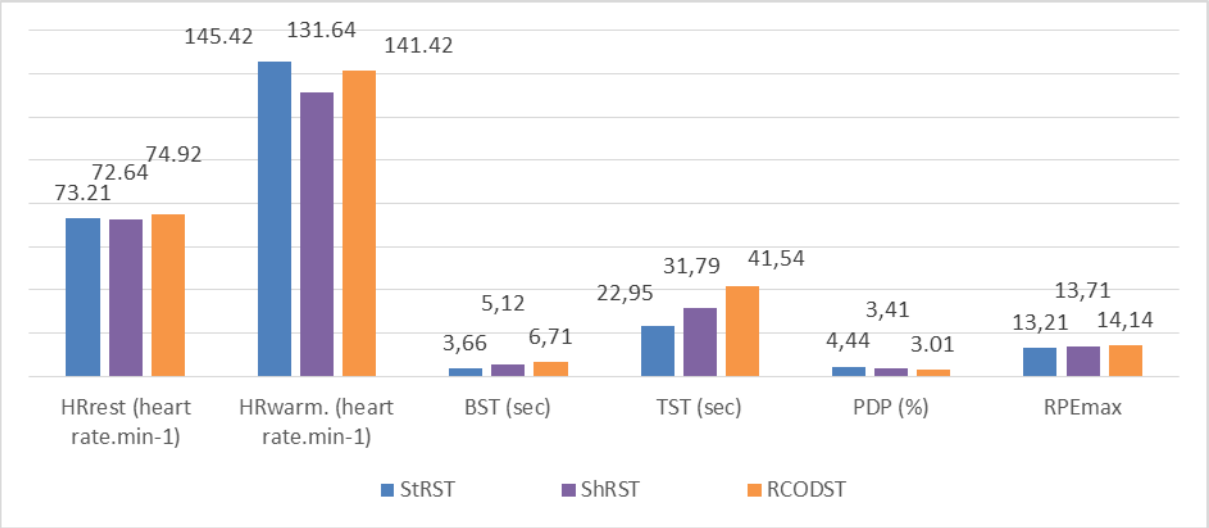
StRST: Straight Repeated Sprint Test, ShRST: Shuttle Repeated Sprint Test, RCODST: Repeated Change of Direction Sprint Test, BST: Best Sprint Time, TST: Total Sprint Time, PDP: Performance Decreasing Percentage, RPEmax: Rating of Perceived Maximal Exertion, RHRPMrest: Resting Heart Rate Per Minute, WHRPMwarm: Warm-up Heart Rate Per Minute

In Table 2, HRPMrest averages were 72.21±5.14 heart rate.min-1 at StRST, 72.64±6.72 heart rate.min-1 at ShRST and 74.92±4.26 heart rate.min-1 at RCODST before 3 different repeated sprint tests. HRPMwarm averages were 145.42±26.69 heart rate.min-1 at StRST, 131.64±19.19 heart rate.min-1 at ShRST and 141.42±12,63 heart

rate.min.-1 at RCODST. In 3 different sprint tests, BST averages were found to be 3,666±0.159 sec at Dtst, 5,123±0.179 sec at MTST and 6,719±0.342 sec at RCODST. TST values were determined as 22,952±0.618 sec at StRST, 31,795±1,224 sec at ShRST and 41,541±2,377 sec at RCODST. PDP averages were determined as 4,447±3,392% at StRST, 3,419±1,419% at ShRST and 3,010±1,225% at RCODST. RPEmax averages were 13,214±1,050 at StRST, 13,714±1,540 at ShRST and 14,142±0.949 at RCODST.

There were no significant differences in the values of HRPMrest before warm-up and HRPMwarm before exercise ($p>0.05$) as a result of the comparison of the different sprint tests. BST and TST values were significantly different at $p<0.001$ as a result of different sprint tests. The results of the Bonferroni multiple analysis to determine which group the difference is from show in Table 2 that StRST-BST values are better than ShRST-BST and RCODST-BST. Similarly, StRST-TST values are better than ShRST-TST and RCODST-TST values. There was no significant difference in RPEmax values as a result of comparison of different sprint tests.

Graphic 1. Average of participants' physiological and performance responses



The graphic shows that participants had similar physiological characteristics according to HRrest variable averages prior to 3 different sprint tests. Also, RPEmax results do not change even if TST increases in different sprint tests.

4. Discussion and Results

The research was conducted to examine the physiological and performance responses of repeated sprint tests in football players.

More importantly, the participants' repeated sprint measurements; straight repeated sprint test (6x25m; StRST) with 25 sec passive rest, 180° shuttle repeated sprint test (6x(2x12,5m); ShRST) and 100° repeated change of direction sprint test (6x25m; RCODST) were aimed to determine which tests were more effective on physiologic and performance.

14 amateur male football players with an average age of 20.42±1.39 years, sports year 4.71±3.83 years, height 1.74±0.05 m, body weight 64.77±7.24 kg, participated in the study.

There were no significant differences in the values of HRrest before warm-up and HRwarm before exercise ($p>0.05$) as a result of the comparison of the different sprint tests.

BST and TST values were significantly different at $p<0.001$ as a result of different sprint tests.

In their study, Aslan et al (2017) examined the relationship between football players' speed and dribbling skills. 22 amateur football players with an average age of 21.56 years, height average of 179.17 cm, body weight average of 73.98 kg and training history average of 6 years participated in the study. Measurements were made at the end of the preparation season. Age, height and body weight characteristics of amateur male footballers who underwent two different dripling tests with 10 m and 30 m sprint tests in similar studies (Aslan and Koç, 2015; Cerrah et al., 2011; Kumartaşlı et al., 2011; Alemdaroğlu, 2008) has been stated to have parallels with many results obtained.

Young et al. (1996) in their study of Australian football players they found a low correlation between speed and agility tests. Again, Buttifant et al. (2002) found a low correlation between 4-Way speed change tests and 20 m sprint test performances in football players. ($r = 0.33$).

In our study, mean age was 20.42±1.39 years, sport year was 4.71±3.83 years, height was 1.74±0.05 m, body weight was 64.77±7.24 kg, BMI was 21.22±1.97 kg/height2 and BFP was 11.20±3.42 (%). There were no significant differences in the values of HRrest before warm-up and HRwarm before exercise ($p>0.05$) as a result of the comparison of the different sprint tests. BST and TST values were significantly different at $p<0.001$ as a result of different sprint tests.

In their study Imamoğlu et al. (2018), 21 male football players competing in Samsun province U 15 age category were taken as subjects. Ten repeated sprints with a distance of 20 meters were photocell with 15 sec active rest. It is the study of vertical jump, standing forward jump, leg strenght relationships and fatigue time were determined with 10 repeated 20 metre sprint runs.

Running times 1. and 2. sprint average (best running average) 3.61 sec, 9. and 10. the average of sprints (best final average) was 4.24 sec. There is a statistically significant difference between these two averages ($p<.01$).

In our study, we found significant difference in BST and TST values at $p<0.001$ as a result of different sprint tests.

In the study of Özdemir et al. (2014), a total of 46 voluntary young football players from the U14, U15 and U16 age category were involved in the study, which is the youth system team in the Spor Toto Super League. The repeated sprint performance of young players was determined by 12x20 metres (short) and 6x40 metres (long) repeated sprint test. The best sprint time, total sprint time and performance decreasing percentages of the athletes were determined as a result of the 12x20 meter and 6x40 meter repeat sprint tests. Performed one-way ANOVA results U14, U15 and 16 age category 20 meter sprint test, young players are the best obtained as a result of repeated sprint time ($F(2, 45)= 10010$ am; $p<0.01$) and total sprint time ($F(2, 45)= 9.822$; $p<0.01$) show that there is a statistically significant difference between values, while the decline in the percentage of performance did not identify a significant difference ($p>0.05$). Similarly, the best sprint time ($F(2, 45)= 16.114$ achieved by young footballers in the U14, U15 and U16 age category as a result of the repeated 40 metre sprint test; a statistically significant difference was determined between $p<0.01$) and total sprint time ($F(2, 45)= 74.968$; $p<0.01$), while a significant difference was determined between performance decreasing percentage values in repeated sprint performances in young players ($p>0.05$).

In our study, BST averages were found to be 3,666±0,159 sec at StRST, 5,123±0,179 sec at ShRST and 6,719±0,342 sec at RCODST in 3 different sprint tests. TST values were determined as 22,952±0.618 sec at StRST,

31,795±1,224 SEC at ShRST and 41,541±2,377 sec at RCODST. PDP averages were determined as 4,447±3,392% at StRST, 3,419±1,419% at ShRST and 3,010±1,225% at RCODST. RPEmax averages were 13,214±1,050 at StRST, 13,714±1,540 at ShRST and 14,142±0.949 at RCODST.

There were no significant differences in the values of HRrest before warm-up and HRwarm before exercise ($p>0.05$) as a result of the comparison of the different sprint tests. BST and TST values were significantly different at $p<0.001$ as a result of different sprint tests.

Yılmaz et al. (2012) in their study, the relationship of aerobic and anaerobic performance characteristics with repeated sprint ability was examined; the relationship of aerobic and anaerobic performance characteristics with repeated sprint ability of team athletes who exercise regularly was examined. 25 male athletes (mean age; 23.52 ± 2.45 years) participated voluntarily. 12x20m repeated sprint test with 30s rest intervals was used to evaluate the repeat sprint capabilities of the subjects. Wingate Anaerobic Strength and Capacity Test (WanT) was used to determine anaerobic performance. Yo-Yo Interval Recovery Test Level 1 (YYIRT1) was applied to determine aerobic performance. Test results to determine the relationship between non-parametric correlation analysis "Spearman's Rank Order Correlation Analysis" has been carried out and the results of the analysis according to the subjects in 0-10m the Best Sprint Time, with Peak Power (PP) ($r=-0.771$; $p=0.000$), Relative Peak Power (RPP) ($r=-0.608$; $p=0.01$) and Exertion Index (EI) ($r=-0.462$; $p=0.020$) a significant negative relationship was found between. A negative directional relationship between 0-10m Performance Decreasing Percentage (PDP) and 0-20m PDP and VO2max was found (respectively: $r=-0.664$; $p=0.00$; $R= 0.712$; $p=0.00$).

In this respect, it was determined that aerobic and anaerobic performance characteristics and repeated sprint ability were statistically significant and it was concluded that team athletes with high aerobic and anaerobic performance had high repeated sprint abilities.

In our study, there were no significant differences in HRrest values prior to warm-up and HRwarm values prior to exercise ($p>0.05$) as a result of comparison of different sprint tests. BST and TST values were significantly different at $p<0.001$ as a result of different sprint tests. The Bonferroni multiple analysis results to determine which group the difference is from show in Table 2 that StRST-BST values are better than ShRST-BST and RCODST-BST. Similarly, StRST-TST values are better than ShRST-TST and RCODST-TST values. There was no significant difference in RPEmax values as a result of comparison of different sprint tests.

As a result, there was no difference in the physiological variables and RPE values of the participants. However, StRST has been found to give more positive performance responses than ShRST and RCODST.

Conflict of interest

The authors declare that they have no conflict of interest.

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